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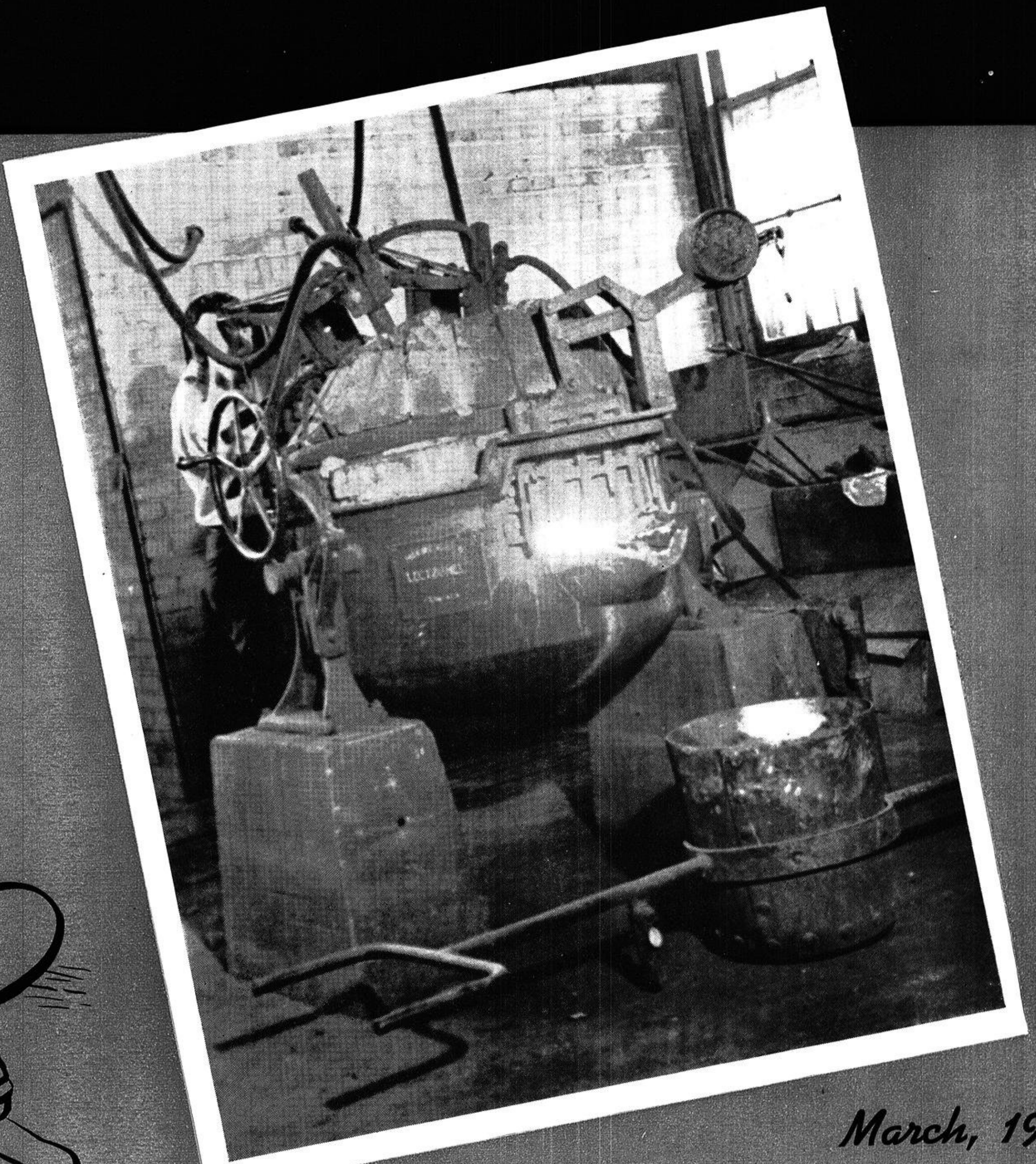
The WISCONSIN ENGINEER



Presenting

The Mining and Metallurgical Engineers

March, 1942

South America ★ St. Pat Candidates

Street Cars ★ X-Rays ★ Turbines

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

The heat treatment that contradicted itself

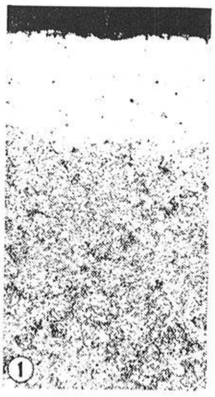
How Westinghouse Engineers straightened out a paradox in steel

METALLURGISTS have been heat-treating steel for 2,500 years. They've taken steel parts, subjected them to heat, cooled them quickly by quenching them in water, oil, or gas, and so hardened them.

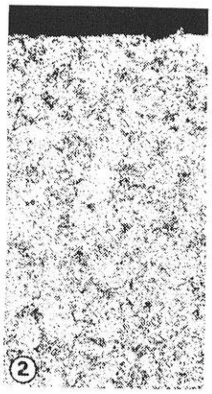
But the heat treatment contradicted itself.

For while they were heat-treating the steel to harden it . . . they also softened it. As the steel was being heat-treated, oxygen combined with the surface carbon, decarburized and softened the surface.

Naturally, metallurgists had to remove this softened surface. They had to pickle, grind, or machine the surface—processes



This photomicrograph of SAE-6150 Spring Steel shows .005" decarburization with ordinary scale-free atmosphere.



This photomicrograph of SAE-6150 Spring Steel shows no decarburization with Endogas atmosphere.

which not only wasted time and cost money but also accounted for a whole lot of inefficiency.

The dimensions of many steel parts, especially dies, have to be accurate to a few thousandths of an inch. So, metallurgists had to make the steel parts larger to start with, just enough larger so that they'd be the right size after the softened surface had been removed. And that left room for plenty of mistakes.

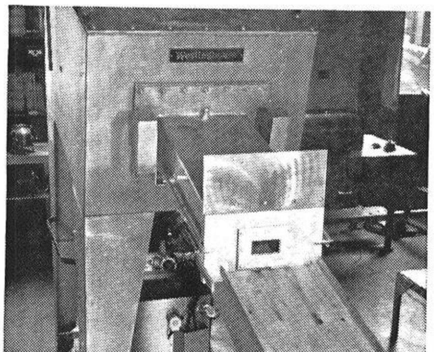
▸ Something, Westinghouse engineers decided, should be done to get rid of all this heat-treating trouble.

They figured the thing to do was to find a way to keep carbon-hungry oxygen from getting at the steel surface. And that was the thing they did.

First, they settled on using an electric furnace since it would give them accurate temperature control and entirely eliminate gas fumes. Then, they created a special atmosphere for the furnace. They heated ammonia (NH_3) in the presence of a catalyst and separated it into its component parts, nitrogen and hydrogen. The nitrogen is inert and won't combine with anything. The hydrogen, in the absence of oxygen and water vapor, also refuses to have anything to do with the carbon.

In this special atmosphere, which Westinghouse engineers called Ammogas, steel parts could be treated with electric heat and . . . no softening of the outer surface took place, no time-wasting, inefficient finishing had to be done. The dies and other steel parts came out of their heat treatment bright, shiny, all ready to use.

▸ The Ammogas furnace that Westinghouse engineers created took care of the heat-treating of costly parts like dies, which can be gas-hardened and are not produced in great quantities. But Ammogas is expensive—too expensive for



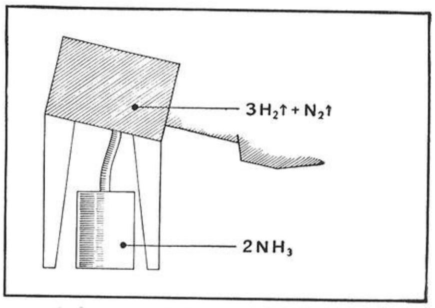
Here is an Ammogas Furnace.

the ordinary heat-treating of thousands of machine parts. And it is not suitable for heat-treatments requiring high temperatures.

So Westinghouse engineers developed Endogas—a special atmosphere which would do large-quantity, high-temperature heat-treating jobs, and do them at low cost. They heated ordinary gas (natural or manufactured city gas is all right) and, by a special but inexpensive process, changed it into a gas rich in hydrogen and carbon monoxide and containing a little water vapor and carbon dioxide.

Endogas doesn't do its work by *avoiding* all decarburizing agents, carbon dioxide and water vapor; it *overpowers* them by the inclusion of agents like carbon monoxide and methane that work in the opposite direction.

In effect, Endogas maintains a balance between carburizing and decarburizing forces. This balance can be so closely controlled that it is even possible to *add*



A diagram of the Ammogas furnace.

carbon to the steel that's being heat-treated.

Today, the Ammogas and Endogas furnaces are hard at work heat-treating dies, castings, airplane parts, steel parts of all kinds, helping to turn them out faster and better—saving industry time, money, and mistakes—speeding crucial war production.

★ ★ ★

There is one reason why Westinghouse was able to create controlled atmosphere furnaces and lick decarburization. It is because Westinghouse is an engineer's company.

There are 3,500 engineers in Westinghouse . . . in service, in sales, in design, in research, in management, in every branch of the business. Engineers hold key positions in each of the 17 Divisions of the Westinghouse Company.

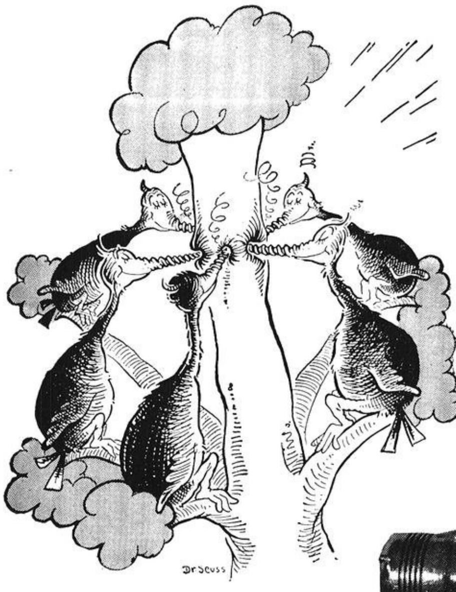
Engineers determine our ability to find better ways to get jobs done. Engineers direct the creation and manufacture of our products. Upon engineers our success depends.

Behind our training and our encouragement of individual effort, there is a definite purpose. Behind our organization set-up of many divisions, which are like small companies within a company, there is a definite purpose. That purpose is to develop young engineers like you into the kind of engineers who will take good care of our future.

Westinghouse

"An Engineer's Company," Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.

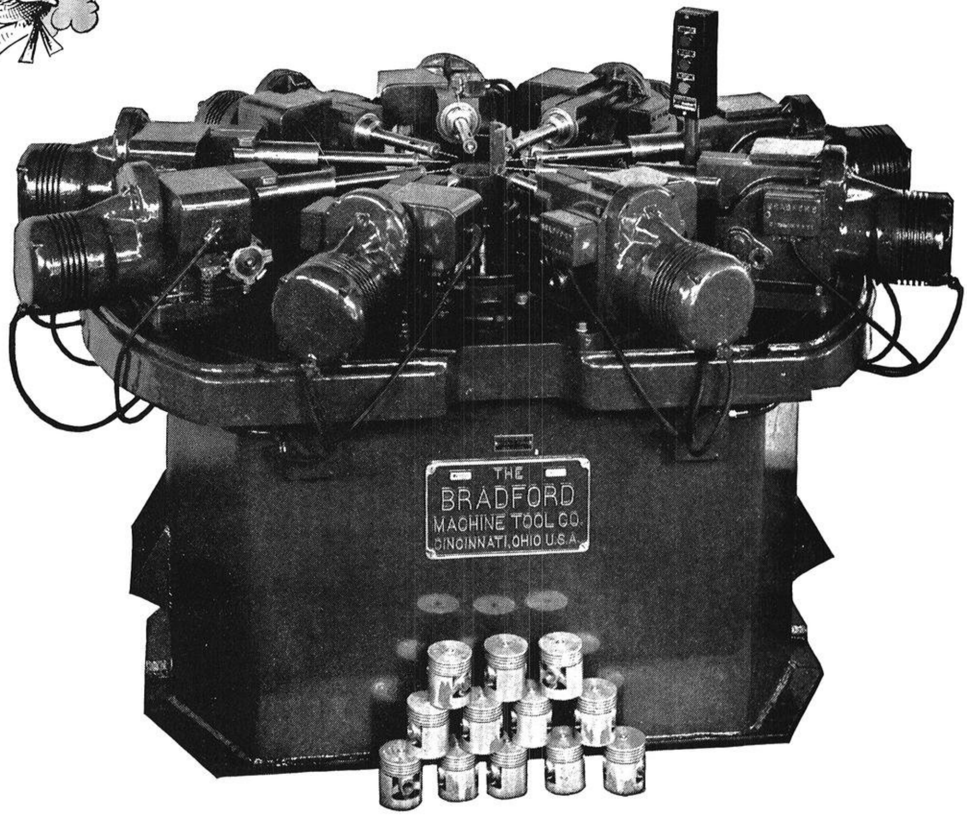
Copr. 1942, Westinghouse Electric & Manufacturing Co.



The Sapjap Calls It Heaven

He sits all day, drilling the beautiful wood. He has lots of time. Holes won't be spaced right, but he doesn't care. He thinks it's champagne—the sap.

How different his neighbor below. It has work to do—fast, accurate, continuous work. 10,800 holes per hour, 14,400 pistons per day. No time to adjust or fuss with bearings.



America Demands Speed . . .

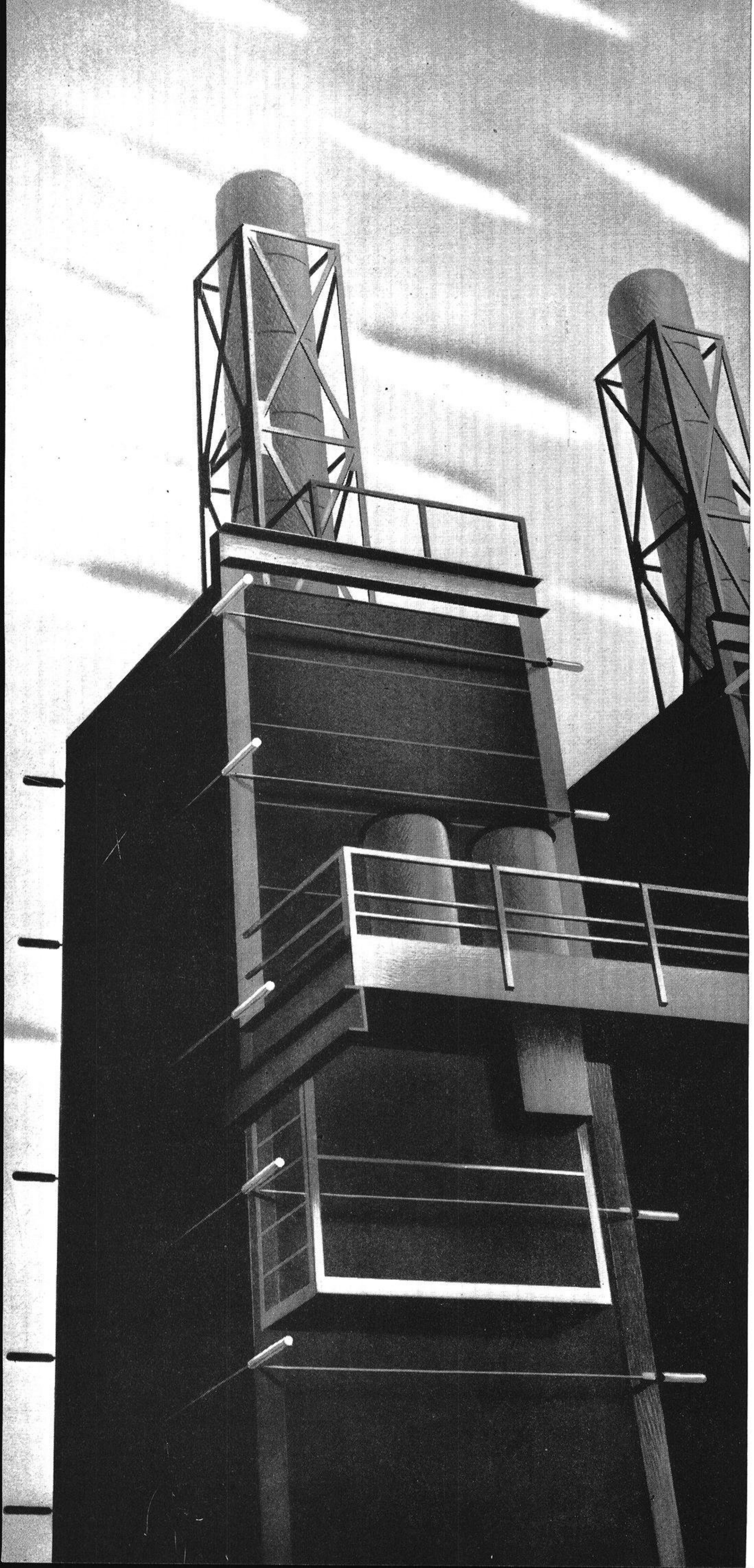
and gets it in this 9-spindle Bradford Drilling Machine. 92 New Departure ball bearings support its rapid fire spindles and other vital parts. 92 positions where accuracy and rigidity are permanently assured. It's no Sapjap.

. . . **Engineers Only:** A special bearing requires extra tooling and different machine set-ups—delays the delivery of many standard bearings. To speed war production, consult a New Departure engineer as to availability of bearing types and sizes. Do this when your design is still "on the board." New Departure, Division of General Motors, Bristol, Conn. Detroit, Chicago, San Francisco.

New Departure

THE FORGED STEEL BEARING

3078



Return of the Carbon Age

CARBON . . . one of Nature's oldest and most plentiful materials . . . is making possible some of industry's newest achievements.

In the *chemical* industry, massive black towers of carbon . . . erected in incredibly short periods of time . . . speed the delivery of vital acids. The all-carbon electrostatic precipitator . . . built of carbon from the bottom to the top of the stack . . . is now an actuality. Such towers can be erected in as little as a *week's time!* Staunchly immune to corrosion and thermal shock, they should last *indefinitely*.

Today . . . due to basic and applied research into the properties of carbon and graphite . . . it is possible to obtain these black, wonder-working materials in such a variety of forms—blocks, bricks, beams, tubes, pipes, and fittings . . . even valves and pumps . . . that almost any size or shape of structure can be built from them. For making tight joints, which give the structure uniform properties throughout, special carbon- and graphite-base cements have been developed.

Undisturbed by the torture of heat, carbon is also a "must" in the *metallurgical* industry. Carbon *cannot be melted* . . . will not soften . . . and has remarkable dimensional stability even at incandescent heat. In addition, it will not flake off and hot metal will not stick to it. That is why it is ideal for such uses as molds, cores, and plugs . . . for the lining of furnaces . . . and for sampling-dippers.

Because electric-furnace graphite conducts heat even *better than most metals,* it is becoming increasingly important in the manufacture of heat exchangers for the processing of corrosive liquids and gases.

These new uses for carbon and graphite . . . added to the almost interminable list of uses that existed before . . . make this era truly a carbon age. Your inquiries are cordially invited.

The strides made in the development of structural carbon, and in the uses of other carbon and graphite products, are greatly facilitated by the technical assistance of other Units of Union Carbide and Carbon Corporation including The Linde Air Products Company, Carbide and Carbon Chemicals Corporation, Electro Metallurgical Company, Haynes Stellite Company, and Union Carbide and Carbon Research Laboratories, Inc.—all of which collaborate with National Carbon Company in research into the properties and applications of carbon and graphite.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York, N. Y.

This all-carbon electrostatic precipitator stands 55 feet, 2 inches high.

The WISCONSIN ENGINEER

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In This Issue . . .

The miners and metallurgists come to the light in this issue, and the resume of their history is given by **Professor J. F. Oesterle.** The youngest of the engineering colleges at Madison has become an indispensable aid to Wisconsin industry.

To those of you who long to work in the South Americas, we have an article by **Fred Krenzky** describing his life as a mining engineer in Peru. It seems that mining jobs aren't all that they're cracked up to be!

Charles Phillips tells us about x-ray analysis on pages 8 and 9. The application of x-rays to practical problems confronting technologists in all fields is advancing rapidly.

Street car tracks have been torn up in most towns, but for those who still have them, a greatly rejuvenated trolley is in store. **Ray Benckenstein** describes **Streamlined Street Cars** on pages 10 and 11.

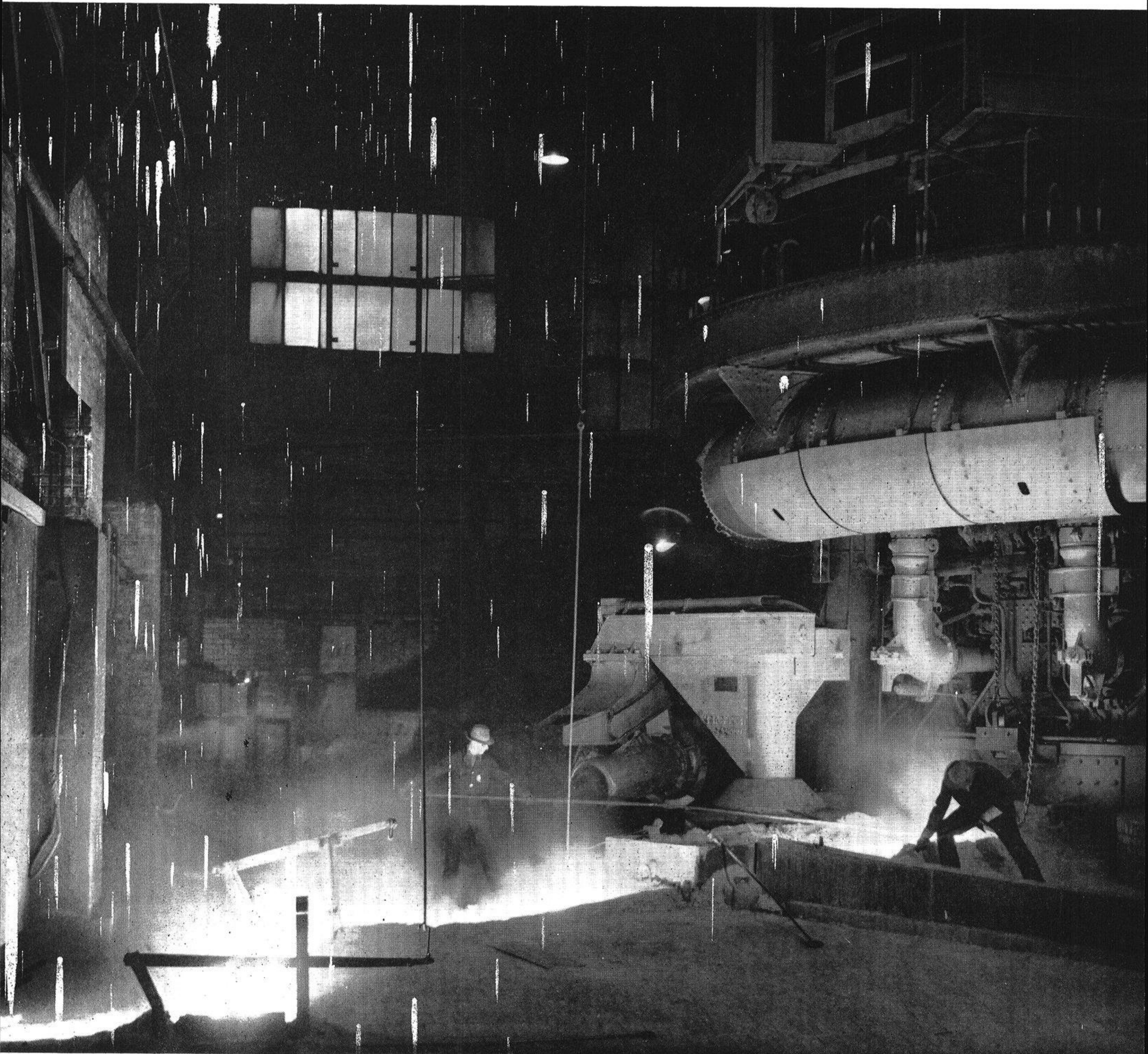
A turbine is merely a series of windmills on a shaft, arranged so that steam produced in a steam boiler can be directed against the vanes of the windmills so as to turn the wheels, and hence the shaft. **G. B. Warren** takes this description further, and gives us a comprehensive discussion of present day power plants. Pages 12 and 13.

Proteges of our patron saint are pictured on page 14. The pictures are of the pre-beard era, but the comments are true to life. Publicity concerning Polygon's contest, the engineers' dance, and other St. Pat's day activities is on the opposite page.

New laboratories and the Foundry conference are items of interest on the **Campus Notes** page, and of course there is a **Static** page or two. The jokes, though they are corny, are typical of the stuff one hears in the Mining building.

The frontispiece, courtesy of Metals and Alloys, is entitled **tapping a blast furnace.**

Roy McIntosh took our cover picture. It shows the metallurgists' electric arc furnaces in operation.



The Department of the Month

MINING AND METALLURGY

by Professor J. F. Oesterle

Chairman, Mining and Metallurgy

THE Department of Mining & Metallurgical Engineering is the youngest department in continuous service in the College of Engineering. The teaching of courses in mining and metallurgy, however, carry us back to the early days of the university. Roland D. Irving, an Engineer of Mines from Columbia University, was the first professor of geology, mining, and metallurgy, having been appointed in 1870. A department was started but students were few. Two degrees were awarded in 1876. President Charles R. Van Hise received his B.S. degree in mining and metallurgy in 1879. He instructed in metallurgy, and later (1886) took over the work of Prof. Irving. In 1889, mining and metallurgical instruction was assigned to the College of Engineering. It was set up as a group of electives in the General Engineering Course.

The year 1907 marked a period of increased mining interest in Wisconsin. The university catalogue carried a statement that a department of mining and metallurgical engineering was authorized. The following year Edwin C. Holden was brought in and seven courses in mining were offered. He carried on alone for one year, when, Francis T. Havard joined the faculty and initiated courses in metallurgy. Two years later, Frank A. Kennedy, filled a growing need for instruction and assisted in both groups of courses. Two years of this arrangement were interrupted by the sad demise of Prof. Havard. The following year R. S. McCaffery came to Wisconsin from Idaho to fill the gap, and this arrangement continued for four years.

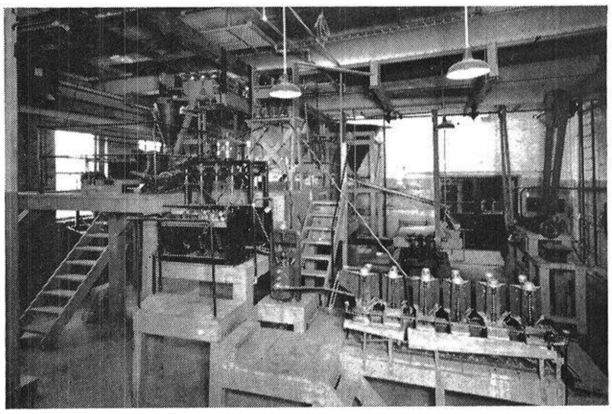
The World War wrought many changes in men and machines. Mining and metallurgical industry contributed no small share to the added impetus in development. Prof. Holden and Mr. Kennedy were attracted to industrial contacts. Prof. McCaffery and a Mr. Barnard carried on alone during the years 1917-19. Edwin R. Shorey succeeded Holden. Courses in mining have been brought to their present state of excellence by his untiring efforts. In February 1921, George Barker returned to his Alma Mater to instruct in reduction metallurgy, and J. F. Oesterle was brought in from the U. S. Bureau of Standards as Research Assistant. Separate curricula had already been set up in mining engineering, metallurgical engineering, and engineering geology.

The years 1925-27 saw the engineering college expanding in general to meet the post war technological demands. Much interest was shown in cooperative effort between engineering education and industry. Three state industrial associations were organized, one in gray iron, one in cast steel, and one in malleable iron. Monthly meetings were held for the discussion of metallurgical practice. One faculty member was expected to be in attendance. Because of the added work, Scott Mackay was brought from industry to assist. He had had previous experience in the production of malleable iron. Unfortunately, the interest in these groups could not be maintained, and the contact lasted but a few years. As a result of it, however, annual foundry conferences were organized for the round table discussion of foundry problems. These were enthusiastically received. One was held each year from 1927 to 1932. In 1936 Mackay was succeeded by Philip McCaffery, and he in turn, the following year, by Donald Phelps. Philip C. Rosenthal was appointed instructor in 1938. His particular interest was foundry metallurgy. Wisconsin is one of the leading foundry states and many opportunities await our graduates whose interests lie in this field. Dr. Daniel J. Girardi succeeded Rosenthal when he returned to Battelle Memorial Institute last summer.

The Wisconsin Chapter of the American Foundrymen's Association proposed in 1937 that we resume the annual foundry conferences, and do this as a joint effort with them. They also proposed that we hold it in Milwaukee because of its importance as a foundry center. The success of these has been excellent in both program and attendance, and they do represent an important contribution of the College to State Industry.

Valuable research projects have brought distinction to the department in many fields of endeavor. The economic concentration of Wisconsin zinc ores is afforded by our flotation studies. Studies in the electrolytic recovery of zinc have been outstanding. Data on the viscosity and sulphur solubility of iron blast furnace slags has given material aid to the blast furnace operator. Nation-wide attention has recently been attracted toward our work on the improvement of clays through pH control. A number of minor research papers acrue from the efforts of our off-campus graduate students.

The demands of defense industry are depleting the market of many metallic alloys. The substitution of alloy for alloy where service conditions can be met, is the rule rather than the exception. The men of the department are ever conscious of the demands made on its graduates by industry, and are always alert to keep courses in line with this demand.



Flotation Equipment in Mining Laboratory.

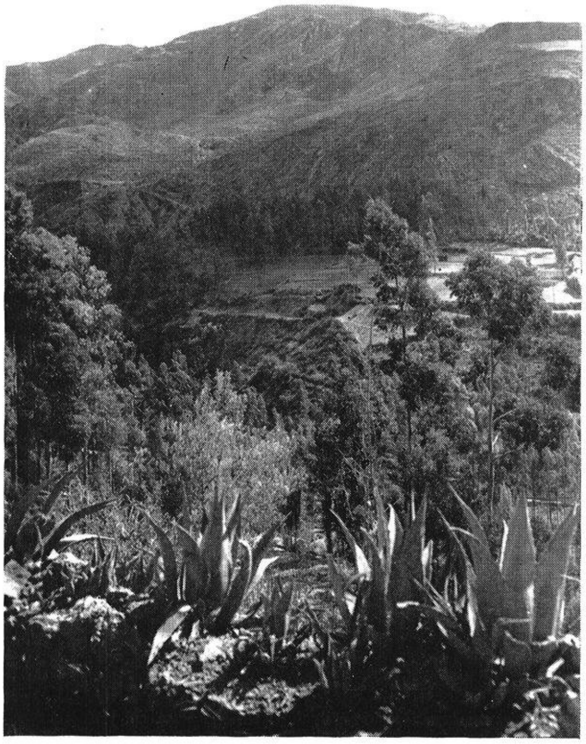
SOUTH AMERICA

by Fred Krenzky, min'40

LET'S think about West Coast South America as a place to live and work. Volumes have been written on the impressive ruins at Cuzco, the colorful splendor of Lima and the Alpine beauty of parts of Chile, but the young engineer who considers taking a job in a South American mining camp often has difficulty obtaining accurate information on living and working conditions. The material I'm passing on to you is based on either direct observation during the six months I spent in Peru or on first hand accounts of people who had lived in Bolivian or Chilean camps.

Mining camps are mining camps wherever one finds them. They are never exactly centers of culture or art and have a diminishing number of the niceties of civilization in direct proportion to their distance from large population centers. In South America vertical as well as horizontal distance becomes a factor.

Since most South American camps are located at altitudes between 8,000 and 15,000 feet, a question which troubles most men about to head south is, "How will the altitude affect me?" To say that it depends on the individual probably doesn't help a whole lot, but that's the case. Almost no one has any trouble living below 10,000 feet and nine out of ten normally healthy people suffer no appreciable effects, except for the first few days, even at 15,000 feet. I should add that they suffer no ill effects provided they don't try playing tennis after only a month on the "hill" as I did. As a result, however, I am able to give you a first hand account of how it feels to have saroche or mountain sickness.



Tropical valleys where one may enjoy summery warmth after the chilled, rarified air of higher altitudes.

You were feeling in tip-top shape and as a result used up too much energy. Suddenly you feel a tension spreading over your whole body; you feel jittery; you're apt to be cross and irritable for no good reason; you are tired. Supper time rolls around and those flip-flops going on in your stomach preclude any serious thought of eating. You go to your room to try to sleep it off, but sleep is impossible; you just toss and toss and toss and toss. For some strange reason you feel you are about to break down and cry. You're not sure what's wrong with you until one of the old-timers comes in and informs you that you have a case of saroche. He goes to his room and fetches a couple of sleeping pills for you. Next morning, still a bit shaky but in much better shape, you manage to put in your day's work. One good case of saroche is enough to make one rather careful about over-exertion for quite a while.

Air pressure at 14,000 feet is about eight and a half pounds per square inch. Unless one has a long line of ancestors bred in the high altitudes, he never becomes completely accustomed to the rarified air. After a period of several weeks to several months the blood builds up an excess of red corpuscles to help supply the body with sufficient oxygen, but never enough to cover the demands of more than very moderate exertion. Upon descent to sea level for only a few days the body again goes back to normal. Each ascent to the altitude is as unpleasant as the first.

The effect on the heart of living at high altitudes is an open question. No one claims any beneficial effects and some are quite positive about the harmful ones. Usually a few years don't seem to hurt anyone, but the effect on those who stay for ten or fifteen years seems to range from none at all to very serious. This is merely a personal opinion based on my own observations. Whether the effects I observed were due to the altitude or to excessive use of liquor is a question very much open to argument.

Food—Quien sabe? Just as it is in the States, the cook far too often ruins the makings of a good meal. In the Peruvian and Chilean camps fresh fruit, vegetables, and milk are available more often than in Bolivia. Meat is usually not of the excellent quality we enjoy in this country and llama chops often masquerade as beef. I was fortunate to be living in a camp which reputedly had the best food in central Peru, though even there I ate chicken so tough as to defy a sharp steak knife. Fine for the teeth though.

Entertainment facilities depend very much on the size and age of the camp. All of the larger and older camps have sound movie projectors, the pictures being American made, and usually not over a year old. There are always pool and billiard tables and often bowling alleys and a golf course. The golf course at our camp wasn't bad considering the country, although the fairways would be respectable roughs on most courses here in the States. The greens were sand, for grass does not grow at 14,000 feet. I've heard of courses in Bolivia where the fairways are dried creek beds and golf club casualties are relatively high.

Each Sunday natives come to town to offer their goods for sale at the market place. Here one may purchase fruit, blankets, rugs, silver work, anything which the natives produce.

Recreation

Most camps have some organization for sponsoring social events such as dances, stag parties, and holiday celebrations. A lot of time is spent at cards. It is a social necessity to know the rudiments of bridge; it is economic wisdom to have a nodding acquaintance with the fundamentals of poker and the whims of the galloping ivories.

However, all these modes of entertainment are secondary to that principal pastime of discussing what you're going to tell the boss when you turn in your time. Maybe it's the altitude, or the isolation, but at any rate little grievances seem quite significant after being mulled over and over by the same group. Sometimes rather elaborate organizations are built up for these discussions. At our camp we had a group known as the "community of little furry animals" composed of the "gente" of fellows in the less responsible jobs. We classified the bosses variously as monsters, beasts, or small beasts, depending on their jobs. We were the little furry animals who scurried about when these marauders approached. An account of some of the elaborate schemes we cooked up for trapping the beasts would make fine reading.

The llama, which is unique to the Andes, is a beast of burden that carries a load of sixty pounds.

I mention these things because in looking back they seem humorous enough, but at the time much of the discussion had more than an element of viciousness in it. It's an example of mental distortion caused by isolation and constant association with people having identical problems and grievances. Put yourself in the boss' shoes in the same isolation, but without the comfort of others in the same position, and you have the answer to much of the tremendous turnover in technical staffs in South America.

Most fellows who go to South America have itchy feet. The more country they can see, the better. Companies usually give two weeks vacation every six months to give the men a chance to get out of the altitude. Not unreasonably, these vacations are not cumulative so that one rarely has more than two weeks at a time in which to travel. Considering the transportation facilities and long distances between major points of interest, it is obvious one cannot see too much in so short a time. For instance, a man working near Lima would have to fly at least one way to make a round trip to Cuzco in two weeks. For most people vacation means two weeks in Lima or Santiago at the country clubs, beaches, or bars, depending on their individual bents. A man who has completed his contract (3 years) usually has enough money to do a little travelling. Common procedure is to cross over to Buenos Aires and take a ship up the east coast with stops at Rio de Janiero and Havana before reaching home.

(continued on page 22)

X - RAYS

by Charles Phillips, met'42

SINCE the discovery of x-rays by Roentgen in 1895 their use and importance has skyrocketed to undreamed of proportions.

What are x-rays? What are their properties that make them so useful? How are they produced and applied to problems that confront the engineer? An attempt to answer these and other questions will be made in this article.

X-rays—so named because their true nature was not understood upon their discovery—are merely light rays that have ultrashort wave lengths. The following list of properties demonstrates this fact. They are:

(1) propagated in straight lines and travel with the speed of light.

(2) undeflected by magnetic and electrostatic fields.

(3) capable of blackening a photographic plate, and producing phosphorescence and fluorescence in certain materials.

(4) capable of being reflected, refracted, diffracted, and polarized.

(5) able to pass through space without transferrence of matter.

(6) differentially absorbed by matter.

(7) capable of damaging and killing living cells.

The relative wave lengths of x-rays compared with those of other kinds of radiation may be seen from the following table:

Type of Wave	Wave Length, Å.U.*	Source
Gamma Rays	0.01 —1.4	Radioactive elements
X-rays	0.6 —1020	X-ray apparatus
Ultraviolet Rays	140 —3900	Incandescent bodies
Visible Light	3900—7700	and ionized gases
Infra-red Rays	7700—4×10^6	Hot bodies—heat waves.

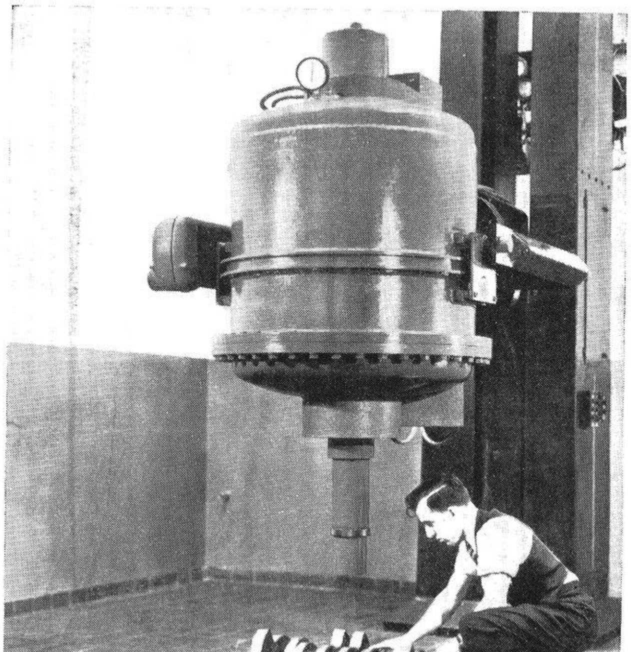
*Ångstrom Unit: 1/100,000,000 cm.

There are just two fundamental conditions necessary for the production of x-rays. The first is a stream of rapidly moving electrons (or positive ions, although they are never used in practice), and the second is a suitable target, usually of some high density metal, to suddenly stop this stream of electrons. The impact of the electrons on the individual atoms of the target raises these atoms to a higher energy level; upon falling back to their original energy levels the atoms yield part of this excess energy in the form of x-rays. Of the total energy expended to produce x-rays only about 2% of it is obtained as x-radiation, the rest being dissipated as heat.

There are a number of factors to be taken into consideration, however, before these two fundamental conditions are realized. The stream of electrons may be produced by one of two principal methods. If a glass tube containing an anode and cathode is evacuated to a pressure between 0.01 and 0.001 mm. of mercury and a high voltage (1,000-100,000 volts) applied to the electrodes the gas remaining in the tube will be ionized, the positive ions travelling to the cathode (—) where upon impact they release electrons. Under the influence of the high voltage the electrons travel to the anode (+) at a high speed and produce x-rays.

In the so-called Coolidge type tube the source of electrons is a filament heated to incandescence by a battery or low voltage transformer. A high voltage (1,000-4,000,000 v.) is applied to the tube, just as on the gas tube, to accelerate the electrons. The pressure in the tube must be of the order of 10^{-6} mm. of mercury, however, because any appreciable amount of positive ions present would strike and burn out the filament in short order.

The filament type tube is used almost exclusively in radiographic deep therapy (cancer, etc.), and special high voltage work. The gas type tube is very satisfactory for diffraction work, studies concerning crystal structure and the constitution of matter, and superficial therapy—purposes that do not require voltages in excess of 100 kv.



The 1,000,000 Volt Portable X-ray Machine
—Courtesy General Electric

The method used for producing the high voltage necessary for electron acceleration is almost universally the step-up transformer, properly designed to withstand the voltage. The new 1,000 kv. x-ray apparatus developed by General Electric (above), however, has a specially designed resonance transformer without an iron core. This saves a great deal of space and weight. Also, the tube itself is different—the electrons are accelerated in 12 steps of 84,000 volts each as they pass down the tube, so when they reach the anode they have a million volts behind them and a speed approaching that of light.

One more matter of some importance must be taken care of. The high voltage obtained is alternating, and the x-rays are produced only when electrons are accelerated away from the filament, since the target is cold and cannot emit them. This means that x-rays are produced only during half the high voltage cycle unless some rectifying unit (or units) are inserted in the circuit. Usually the unit consists of vacuum tubes designed for that purpose.

Now that we have an x-ray unit that is operating correctly, how is it controlled to get the necessary radiation from it? If we want to look into the interior of a thick piece of steel we would use a higher voltage than if the piece were thin, since the shorter wave-length rays are much more penetrating. This is the reason for such tremendously high voltages on industrial radiographic equipment used on very heavy metal sections. Million volt x-rays will penetrate 4½ inches of steel in two minutes to give a satisfactory radiograph, while 400,000 volt x-rays require about 90 hours.

To take a suitable radiograph of a sample of material, assuming we have the proper wave length, requires an exposure of a certain intensity for a certain time. The intensity is determined by the number of electrons striking the target per unit time, so to increase the intensity we would increase the tube current by raising the temperature of the filament, allowing it to give off more electrons. However, there is a limit to the tube current (usually the range lies somewhere between 5 and 100 milliamperes), so that a thicker amount of material requires more time of exposure.

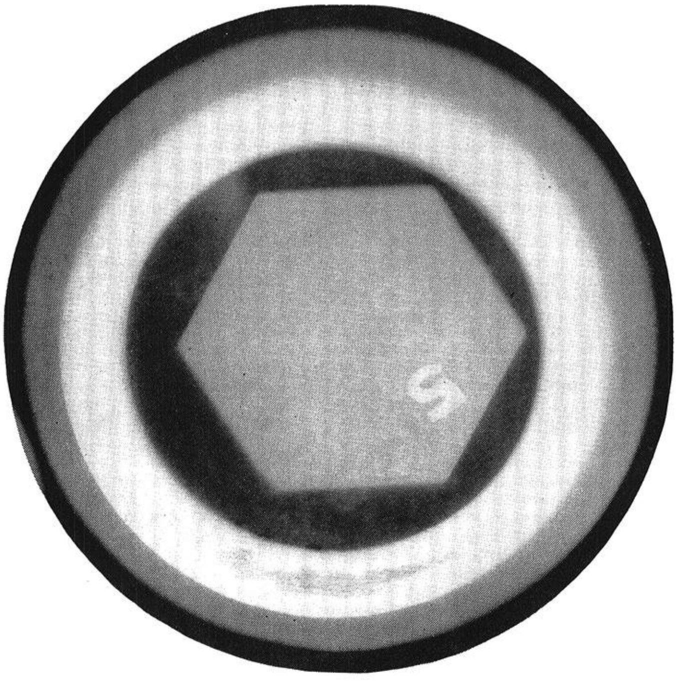
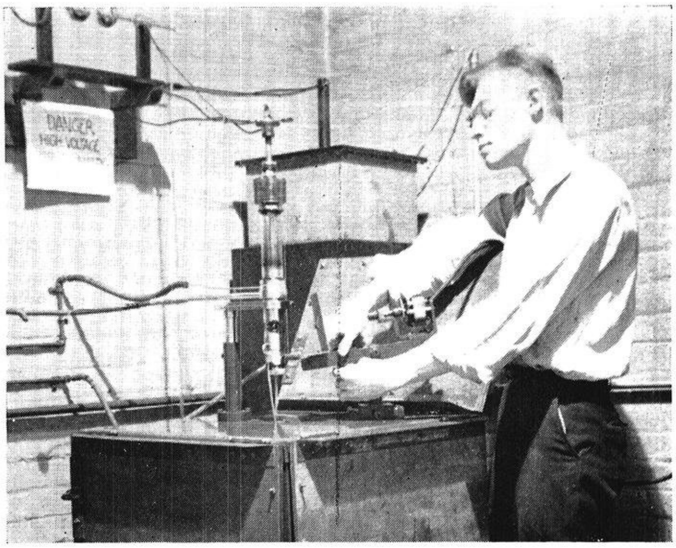


Figure 2 — Radiograph of a casting. The dark areas are the thicker sections. Note the shrink cavity directly above in the thin circular section.



The author adjusting the x-ray apparatus in the Mining and Metallurgy Building.

X-rays of Castings

Assuming that all the factors, voltage, tube current, and time of exposure for our sample are known, the piece is set from two to four feet from the target, a plate or film is placed directly behind it and the exposure is made. The result would be very similar to Figure 2. Obviously if there is some defect in the piece the x-rays are going to pass through it either less or more easily, showing a lighter or darker area on the film. In the example shown the defect is a shrinkage spot in a steel casting. The shape and distribution of the defect indicates what kind of defect it is—pipes, blows, shrinks, tears, slag and sand grain inclusions, gas bubbles, and porosity are those most commonly encountered in castings.

Industrial radiography may be divided into two main categories. In the development of articles for mass production x-rays are used to determine the optimum conditions of manufacture. Thus, if the article were a casting, the gating, risers, mold, and pouring conditions would be varied until the defects observed in the radiographs were a minimum. The other phase involves investigating the fabricated articles for perfection without damaging them in any way. Many parts used in airplane construction, and the welds in all high pressure boiler units are 100% examined. Many other articles require that only a small fraction of them be examined, say 5 to 25% of the total. If the proportion of defectives rises too high, steps are taken to correct the condition by an examination of the operations used in the fabrication of the piece. Very often both of these phases are used together.

Other Applications

Other uses of radiography are almost too numerous to mention. Their use by dentists and physicians for diagnosis is well known; radiographing of painting and other art work to establish authenticity and determine the presence of other work beneath the observable painting is increasing; the application of x-rays to the examination of

(continued on page 28)

Streamlined Street Cars

by Ray Benckenstein, e'42

Illustrations Courtesy Westinghouse

UP TO a few years ago it was generally assumed that the "trolley car" was on its way to the graveyard. Now, in some of our more progressive cities, one can hear people saying that there aren't enough cars. They aren't thinking of the old type of car—the car that slowed traffic up to a snail's pace, the car that woke them up at night when it passed their house, the car that jerked when it started and jerked when it stopped—but they are thinking of a new type of street car that has come into being within the last two or three years. This car is similar to the older models only in the fact that it runs on rails set in the street and that it draws its power from overhead trolley wires. Here, however, the similarity ends. Gone is the noise. Gone are the traffic tieups. And gone are the

Figure 1 — The Trolley Is Back Again.

annoying jerks. As can be seen from the photograph (Fig. 1) its appearance is strikingly different. It possesses a sleekness and a smoothness not usually attributed to street cars. The advent of this car has made many people change their minds about the street car. The official name of this car is the "P.C.C." car. The initials stand for the "Electric Railway Presidents' Conference Committee."

The drive of these cars is very similar to the older types. There are four 55 horse power series D.C. motors providing the motive power. It has the usual narrow and long characteristics of all traction motors. The two motors on each truck are connected in series so that the windings are made for 300 volt operation and operate from a trolley potential of 600 volts. In past years it was the practice to change the connections to the motors while the car was under the acceleration period. This is not done on the P.C.C. car, however, the series-parallel connections being maintained throughout the whole period. After the motor

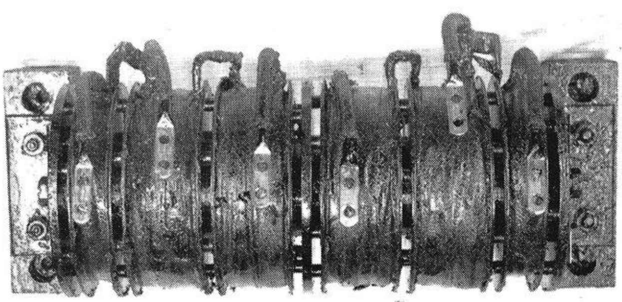


Figure 2 — Field-Weakening Shunt.

has been fully accelerated, a shunt is placed across the field which weakens the field and causes the motor to run a little faster. Fig. 2 is a photograph of this shunt. There are a number of taps on the shunt which enable the mechanics to have some control over the top speed of the car. To reduce the current during the starting period and to provide a controllable mechanism for starting a rheostat is placed in the line. This is circular in shape (Fig. 3) and is driven by a small 32 volt motor which is controlled by the operator's foot pedal. There are a large number of taps and therefore the change is smooth and even, preventing jerking when starting. This starting mechanism produces a much greater acceleration and the car is able to "stay with" passenger automobiles when starting from a dead stop.

The interior of the car is as striking as the exterior. The doors are wide and open with a spreading motion. That is, each door is made up of two sections and each section revolves and moves about its vertical centerline. This gives the maximum opening and at the same time the door will not strike a person either in or outside the car while it is opening or closing. Hand rails are provided at the doors for aid in boarding the car. The specifications are quite flexible on the matter of interior appointments as to seating arrangement, method of fare collection, and crew. The cars with which this writer is most familiar are one-man cars with the fare collection box in a prominent place at the operator's right so that passengers can easily deposit their fares as they board the car. The seating capacity varies between 50 and 65 depending on the seating arrangement chosen and there is plenty of standing room if traffic is heavy. There are numerous upright stanchions for the aid of standing passengers, as well as the usual handles on the seat backs. Because of the smoothly controlled acceleration and deceleration there is no inconvenience to standing passengers. The heating ducts are placed in such a manner as not to obstruct leg room and so that the majority of the heat is directed to the doorways. There are no drafts on the legs of passengers.

Every car produced must be given a complete test at the manufacturer's expense before delivery. This test not only includes actual running tests on representative tracks, but also tests of the materials and electrical tests before and after final assembly. All circuits are tested for grounding at a potential of more than 1000 volts both A-C and D-C. The materials, such as axles, wheels, rubber, etc. must come up to certain standards before they are accepted for delivery and installation. To insure similarity the wheels are shipped and handled in matched pairs.

One of the best features of the car is its braking mechanisms. There are, in all, four separate systems of brakes on the car—dynamic, magnetic, air, and hand. The dynamic is the main service brake. This brings the car down to a speed of about 3 or 5 miles per hour when it begins to fade. From here, the air brings the car to a stop and holds it there. One of the main advantages of dynamic braking is that it will not permit the wheels to slide. Eveveryone knows that a car will stop faster if its wheels do not slide. If the tracks are icy and the wheel starts to slide, the motors will of course stop and therefore the dynamic action stops and there is no more braking power. The brakes will fade, of course, before the wheel actually stops so there can be no sliding until after the air brakes take over. The magnetic brake consists of four electromagnets slung between the wheels (two on each truck) about one-quarter inch above the rails. They are held there by sensitive springs. If the operator so desires, he can throw a switch and energize these magnets which will then clamp down onto the rails and slide along until the car stops. This method, however, is ordinarily too severe for use as it stops the car too quickly. If the brake pedal is pressed down far enough, the magnets will be energized also. The hand brake, of course, is for emergency use only in case all other methods fail.

Every car is equipped with a safety interlock which serves the purpose of the dead man's throttle. The operator must keep his foot on the pedal at all times while the car is in motion. If due to some accident or other cause, he should remove his foot while the car is moving, the automatic controls will open the circuit to the propulsion motors, produce full application of the magnetic track brake, energize the buzzer circuit, and balance all doors. That is, the full braking rate of 6 to 7 miles per hour per second will be applied, the buzzer will sound, and all the doors balanced so that they may be pushed open by hand. The service braking rate is 4.75 miles per hour per second. The interlock also serves another function. When the car is stopped, the operator depresses the braking pedal all the way and then removes his foot from the interlock which locks the brake pedal in a position corresponding to full air brake application.

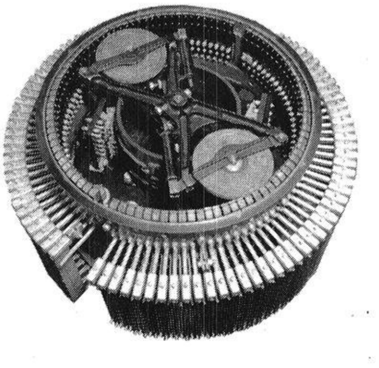


Figure 3—Motor-Controlled Rheostat

All of the controls are operated from a 32 volt source which is provided from either a storage battery or a motor-generator set. The generator, which is driven by a 600 volt motor, charges the battery and operates the controls while the battery is on charge. The motor performs three functions: drives the generator, drives the air compressor, and drives the fan of the ventilating system. The car is heated by blowing fresh air over the main starting resistance coils and, through a system of dampers into the car. The car temperature is controlled by a thermostat.

The car is built for a safe speed of 50 miles per hour. The maximum motor speed therefore, with a wheel diameter of 24 inches and a gear ratio of 7.166 is 5150 revolutions per minute. The Transit Research Specifications of January, 1941, gives the starting data:

"The starting performance of the car on level tangent track with a total weight of 38,000 lbs. and rail conditions providing adequate coefficient of adhesion shall be capable of meeting the following table of speed-time and distance-time relationships:

Time from Start Seconds	Speed Attained Miles per hour	Distance Traveled Feet
3	10.2	22
4	14.3	42
5	17.7	65
10	25.2	235
20	31.0	650
40	36.2	1650
60	38.4	2740
120	40.5	6225

The instant of start shall be that at which the control pedal or equivalent attains the position corresponding to maximum acceleration when moved to that position as quickly as possible."

Another section gives the requirements to be met by the braking functions:

"Movement of the brake pedal shall control brake functions in accordance with the following tabulation:

	Brake Function		
Inches Brake Pedal Movement	Tread Brake	Dynamic Brake	Track Brake
½	Starts	Starts	
2½	Maximum	and gradual	
2¾		increase to	Energized
3		3.5 M.P.H./sec.	
5			Maximum
5¾		4.0 M.P.H./sec.	

6—Total Brake Pedal Movement.

"The air brake does not function until the dynamic brake begins to fade."

One of the major items of interest today about the car is whether or not the maker is able to get the necessary materials. Because of the greater traffic due to defense workers and because of the conservation of rubber it is plain that there should be no trouble in getting material for the cars. With the old type of car with the air brake exclusively it was found that a set of brake shoes wore out in about one month. With the dynamic braking, one set lasts now about a year. This is a considerable saving in steel for brake shoes as well as wear on the wheels.

STEAM TURBINES

by Glenn B. Warren, m'19

Designing Engineer, Turbine Engineering Dept.
General Electric Company, Schenectady, N. Y.

Illustrations Courtesy of General Electric Co.

WHEN the historians come to write the history of our present era they will very probably identify it by one of its most outstanding attributes. There has been a Stone Age, a Bronze Age, an Iron Age, etc., but the present and immediate past generations will quite probably and quite properly be called the "Power Age." First, we had water and wind power; then, the steam power of the 19th century in our factories and on our railways and ships; then, transformation of mechanical power into electrical power with the advantages of transmission and subdivision; then, power production in great quantities and at low cost by steam and water turbines; and then, more recently, the light, mobile power of the internal combustion engine that has made the motor car, the truck, the airplane, and the tractor the important factors in our lives which they are today.

A steam turbine is a machine for producing power from steam by pure rotary motion. The invention of the steam engine by Watt about 200 years ago changed the entire complexion of our civilization and ushered in the so-called industrial revolution. From then on until 1885 practically all power was produced by the expansion of steam behind ponderous reciprocating pistons whose motion and power was turned into rotary motion by means of great cranks. This form of engine remains in service today almost solely in the steam locomotive, where so far it has successfully beaten out all challengers.

G. B. WARREN

A turbine is merely a series of windmills on a shaft, arranged so that steam produced in a steam boiler can be directed against the vanes of the windmills so as to turn the wheels, and hence the shaft. The shaft is then connected to an electric generator which it drives if electric power is the desired output, or it is geared to the propeller shaft of a ship if it is intended that the turbine should drive a steamship.

Turbines could be made with one wheel, that is, one windmill on a shaft and could be made to deliver great power, but they would be very wasteful of steam and hence of fuel because with the strength of available materials it is not possible to run a single wheel fast enough to extract the velocity energy of the steam. It becomes necessary therefore to put a number of wheels on the turbine shaft, generally from 15 to 30, through which the steam is passed in series. The pressure drop in the steam can then be broken up into a number of separate drops, each of which is smaller and produces less velocity, and hence the wheels can be made to move fast enough relative to the steam so as to abstract efficiently the energy in the steam velocity.

In order to give one an idea of the power in a modern turbine steam jet, it is helpful to compare it with the power in a fire hose. It is easy to visualize how such a water jet would turn a bucketted wheel at which it might be directed. The illustration of a man attempting to cut a fire hose stream with a steel sword and of having it broken in two in his hand by the force of the jet has been frequently used to give an idea of the power in such a stream. The force of a single steam jet the size of a fire hose coming from a modern steam turbine nozzle may be as much as 10 times as strong as that of the fire hose, and the jets frequently are 10 times as big in total area.

Two of the pictures show turbines in the process of erection. Fig. 1 shows the lowering of the upper shell onto an 80,000 kw. machine now in operation at Oswego, New York, which is now, with its mate that has just been more recently installed, running at full load 24 hours a day producing power to make aluminum for airplanes. This picture shows the heavy bolting of highly heat treated alloy steel required to hold these steel shells together against the tremendous pressure of steam on the inside trying to tear them apart. Fig. 2 shows a rotor with its buckets varying in length from the short buckets in the high pressure section of the machine where the steam is dense and as hot as red hot steel, to the long buckets in the low pressure end of the turbine where the steam is cold and has a weight per cubic foot of about 1/50 that of air at sea level.

In passing through this turbine rotor the steam changes from 900° to 70° F. in less than 1/30 of a second, and gives up its energy to the spinning rotor, some of the buckets of which are moving almost at the speed of a small rifle bullet.

The reliability of these machines is of great importance

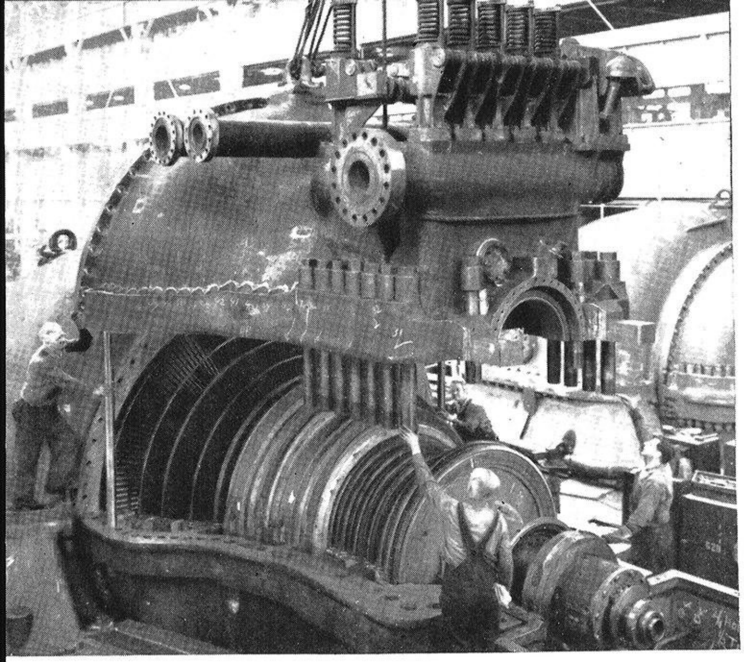


Figure 1 — Lowering the shell onto an 80,000 kw. turbine.

otherwise serious interruptions to the power supply of an industry or an area may result. To be sure, stand-by machines are required to carry peak loads, to carry loads when turbines or boilers unexpectedly require shut-downs, or to carry the load when scheduled over-hauls need to be made. Such stand-by machines, however, must be kept to a minimum because a turbine such as illustrated here, the boilers and auxiliaries which supply it, and the building which houses it represent an investment of some seven million dollars which is idle when the machine is not in use. Looked at another way, the outage of such a machine frequently costs the owners $1,000 to $2,000 a day.

Improvements in the Steam Engine

The early steam engines burned from 20 to 30 lbs. of coal in order to produce one horsepower for one hour. They were so wastful that many learned men wrote papers proving that it would be impossible for a steam ship to carry enough coal to permit it to cross the Atlantic Ocean without re-fueling. By 1900 the steam engine had been refined to such an extent that the best of them in regular commercial service could produce a horsepower for an hour for between 4 and 5 lbs. of coal. Today steam turbines have still further reduced the consumption to such an extent that in the electric power plants of the country as a whole one horsepower hour of electrical energy is produced with 1 lb. of coal, and the newer and more efficent machines use but 60% of the present average.

This reduction in fuel consumption has been made possible by increases in the working steam pressures and temperatures, better boiler and turbine designs and construction resulting from careful and costly research and design work, and improvements in metallurgy which have made metals available which can withstand these higher pressures and temperatures. Modern turbines operate at steam pressures ranging from 800 lbs. per square inch to 2400 lbs. per square inch, and at steam temperatures up to 950 F.

These large machines must be designed and built so accurately that when running at high speed with wheels sometimes 12 ft. in diameter and shafts 15 ft. between bearing centers and with their steel shells expanded by the temperature and the pressure of the steam within, the clearances between the rotating shaft and the packing pieces can be kept at less than 30 one-thousandths of an inch. The buckets must be designed so that their attachments to the wheels can stand the terrific centrifugal loads and they must all be tuned so that they will not vibrate in synchronism with any of the oscillating forces in the machine, or they would break within a few hours.

Marine Turbines

The majority of all large modern ships for both the Navy and Merchant Marine are today driven by steam turbines. These range from the 3,000 horsepower turbines of the small freighter to the tremendous power plants of the great battleships into whose small modern engine rooms is compressed the power of more than 50 large railway locomotives. Fortunately for this country, the Navy began to design and build modern war ships in 1933 after a lapse of a great many years during which little progress has been made in naval construction. As a result, the Navy was able to utilize the experience of the rapid advance in public utility turbines over the preceding decade and a half and to incorporate this experience in marine power plants for naval vessels.

To quote the words of former Secretary of the Navy Charles Edison:* "Into these ships went a distinctive American engineering installation consisting of high-speed turbines, double-reduction gears, an improved boiler feed system, and a cruising turbine that is constantly in gear. The double-reduction gear permits utilization of higher turbine speeds with attendant increase in efficiency.

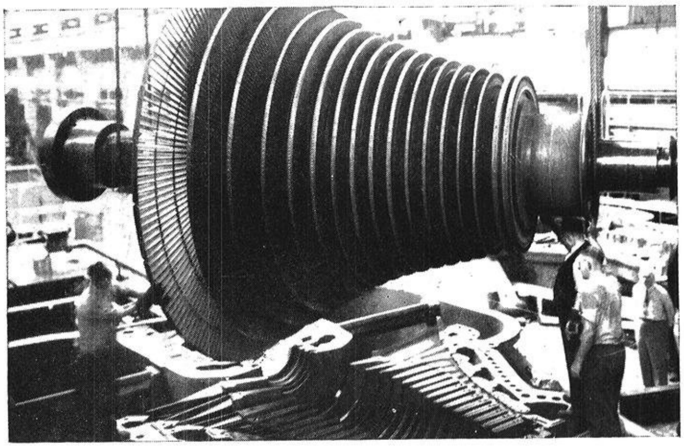
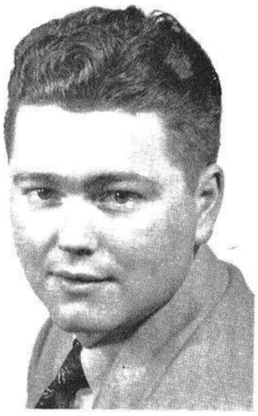


Figure 2 — View of turbine rotor.

High turbine speeds have reduced the number of turbine blades by 75 per cent and the length of the rotor by 25 per cent. This design, however, showed an increase in fuel economy of about 25 per cent with a corresponding increase in cruising radius. The first of these ships was delivered in 1936 and probably represents the greatest progress the American Navy has made in engineering in a generation." The initial difficulties in these designs were worked out in the next year or so following 1936 with the result that at the beginning of this more recent

(continued on page 24)

St. Pat Candidates



WALTER McGUIRE . . .

"Shure and he be a true son of old Eire" is a fitting description of Walt McGuire, the Miners' choice for St. Pat. He is the only real Irishman among the candidates and he is making the most of his heredity in an aggressive campaign.

Mac comes from Portage where he played football and basketball and was active in debating in his high school days. He worked a year before coming to the University. His main interest is Mining Engineering and he is headed for underground work (pick and shovel) at the Oliver Mining Company after graduation. He says he enjoys the rough spirit of mining camps. He should love it, for last summer he worked for Pickands Mathers at Bessemer, Michigan, which is only nine miles from Hurley, Wisconsin. He enjoys hitchhiking so well that he spent one entire summer thumbing his way around the country.

Although a certain girl in Milwaukee claims most of his time every weekend, he has found time to participate in intramural sports and to take an active part in the Mining Club.

It is rumored that he is using hair grower to nurse his beard along, but he declares such stuff is propaganda from the other contestants.

GEORGE ACREE . . .

It is seldom that the Electricals are able to present a candidate so well qualified as George Acree. His heavy beard and his striking Irish brogue have marked him as the AIEE Hibernian hope.

The Acrees have moved about the United States to a great extent —so much so that George has at some time or other called either Syracuse, Montana, Washington, D. C., Virginia, Texas, California or Nevada home.

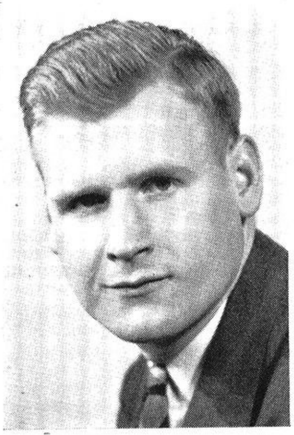
Before studying electrical engineering at the University of Wisconsin Mr. Acree studied psychology and economics at the University of Maryland for three years. His other occupations have included professional boxing and bouncing. George is finishing his third and final year here with a blaze of glory and a few touches of AC machinery and African geography. After graduation he plans to work for General Electric and hopes to end up in personnel work.

George provides an outstanding example of unselfish participation in extra-curriculars, devoting much of his time to the various Quaker projects in the Madison area. He has held offices in the AIEE and in Kappa Eta Kappa, professional EE fraternity.

BILL ARVOLD . . .

Bill Arvold, the Chemical Engineers' choice for Saint Pat, possesses one of the finest curly mats on his cheek and chin that is to be seen in the Engineering School this year. Bill comes from Reedsburg, where he played football and golf and was active in band and orchestra during his prep days. His love for math and chemistry landed him in the University as a Chem Engineer where he has done remarkably well. He is a member of Tau Beta Pi, Phi Lambda Upsilon and Phi Kappa Phi and has also found time to play in the University concert band for four years and participate in intramural football and hockey. Bill has hit the books and come through with high honors.

He is doing undergraduate research for the Wisconsin Alumni Research Foundation on the fixation of nitrogen at high temperatures. After graduation, he is going into Chemical Engineering development for the Standard Oil Company at Baton Rouge, Louisiana. Bill thinks it high time that the Chem Engineers got their St. Pat candidate elected. He regrets there is no parade to lead, but he'll be willing to reign as St. Pat at the Engineers' Ball.



WILLARD WARZYN . . .

With the cry of "A civil-ized man for St. Pat," the Civils have backed Willard Warzyn as their candidate. And a civilized and fair contestant he is, for Will is one of the candidates who kept his beard cropped till the appointed time, (in contrast to one candidate who, probably at the behest of his society, let his beard grow and grow ever since Prom).

Warzyn has been an active member of the ASCE; as a second semester junior he was its treasurer, and as a first semester senior he was the president. Back in high school in South Milwaukee, he played football with a right good will. Here at Madison, Will has played with the University Concert Band for four years. The French horn is his forte.

Should he win the position of sainthood for a night, Miss Jeanne Carroll will share the limelight with him. After June first, Jeanne will share most everything with Will, for they will be married on the first—a Commencement day for certain.

HOWARD DORWARD . . .

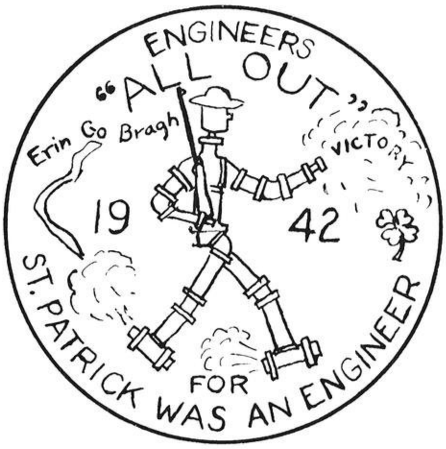
The Mechanicals ran an election, open to the Mechanicals, (and others, it's rumored) from which Howard Dorward emerged victorious. Here's a man from 'way out west—Denver, Colorado, is his home town. Before coming to Madison, Howard spent some time at the Colorado State College of Education. He was a track man there. In the last few years, the feudin' 'twixt the shysters and the Plumbers has been limited to minor skirmishes. Here's a man that thinks that such inactivity speaks ill for the virility of the Engineer. Maybe the Law Building will be padlocked again this year! Dorward is a member of both ASME and SAE. He took both the primary and secondary CAA courses, and was the first one to take the cross-country solo from this school. After graduation, the Navy has a prior claim on him. He will be connected with the Bureau of Aeronautics.

Mr. Dorward expects the full support of the mechanicals. "We did it before and we can do it again," he claims.

ST. PAT DANCE

With "Engineers All Out," the annual St. Pat's dance will be held Saturday, March 28, in the Great Hall of the Union.

Besides the music of Jack Rael's great campus band, the evening will feature the crowning of St. Pat and the final judging of the beard growing contest. Three campus lovelies will select the best beards in the Engineering School from the group of contest finalists, after which free shaves will be offered to those contestants who wish to lose their whiskers.



The decorations committee, headed by Bob Stewart, will carry out the theme of "Engineers All Out" by portraying the part to be played by technical men in the present emergency. Polygon Board members in charge of committees are: Henry Schmalz, General Chairman; John Wilson, Tickets; Paul Sodemann, Buttons; Jim Rogers, Finance; Erv Waulteurs, Arrangements; Art Petschel, Program; Harold Holler, Promotion; Mike Dunford, Beard Growing; and Les Elmergreen, Publicity.

ST. PAT'S OPEN HOUSE AT THE UNION

This year as in the past, the Wisconsin Union will again throw its doors wide open to the students for a spring open house. On the 21st of March, St. Pat will usher spring to the campus in a blaze of shamrocks and green and set up his offices at the Union, and there fun galore will reign. Free games; the usual lawyer-engineer debate as to the origin of St. Pat; kissing of the blarney stone by the St. Pat's candidates at the Mat Dance to bring the luck of the patron saint to them as kisses the hardest; and a world of fun at the "War-Fair" in the rathskeller promise to make the afternoon a world of fun for all you wearers of the green.

General chairmen for the event include: Promotion and Arrangements, Francis Bouda; Entertainment, James Whiting; War-Fair, John Wickam; Games, Murray Crummins; Hosts and Hostesses, Wilton Jenkins; Workshop, Chet Strasser; Panels and Debates, Mary Jane Purcell; and Publicity, Allan Block.

The Polygon Board and the Union Staff have all worked together to insure a grand time for all the engineers and other REAL Irishers.

CAMPUS NOTES

by Don Niles, m'44

NAVAL RADIO SCHOOL

The original organizational staff for the training of radio technicians has been established in room 4A, Chadbourne Hall. In charge of the training program is Lt. E. H. Schubert, U.S.N. His original skeleton staff consists of Chief Boatswain Hupfer, Chief Storekeeper Sutton, Chief Radioman Cozzens, and Yeoman, Second Class J. L. Ragan. Instruction will be directed by Professor Miller, of the extension division, and will be by both professors on our own campus and by other men to be brought in.

Lt. Schubert just came from Indianapolis where he established a similar school for radio technicians. Previous to that he was in district training and personnel work at the Great Lakes Naval Training Station.

The course will start on April 1, at which time 300 boys will be brought in. After that they will come at the rate of 300 a month. They will be housed temporarily in the short course barracks, or the stadium dorms if they are ready in time. As soon as the present university term is completed, some of the boys will be moved to Tripp and Adams Halls. University students in Tripp and Adams at present will not be affected until the end of the school year.

Classes will be held in university buildings. Some rooms will be taken over in the Mechanical Engineering, Soils, Chemical Engineering, Mining and Metallurgical Engineering, and the stadium. The rooms will be used all the time, and the navy will bring in its own specialized lab equipment to set up a practical lab in the Chemical Engineering building. Classes will be from 8:00-12:00 A.M., 1:30-4:30, and 6:00-8:00 P.M.

The courses will include the international Morse code, typing, spelling, mathematics, radio theory, electron theory, electricity, and some drill. The technical classes will run from Monday through Friday, and Saturday will be reserved for drill and naval procedure. No attempt will be made to teach them electrical engineering, but as much practical and theoretical base work as can be put into four months will be included. When they get in high gear, about July, they will be training 1200 men at a time, with a turnout of 300 graduates per month.

Those eligible are enlisted men in the United States navy. These men specify that they want to go into communications work, and after an eight weeks course (which may be lengthened to twelve) at the Great Lakes Naval Training Station, they will be sent either to Indianapolis or here to Madison. Their educational background will be checked, but it may vary from grammar school to college. Students will be paid $21 a month at first, and at the end of four months will be raised to $30. They will get $36 a month when they go into active service.

Graduates will have the rank of seaman, radioman, second class, and will be in line for petty officer ratings. Any who are eligible can go further and get a commission.

Lt. Schubert said that the cooperation of students, faculty, and Madisonians in general has been of the highest order and even Chief Petty Officers Cozzens and Sutton, in spite of the fact that they were transferred from their jobs and homes in Indianapolis, say they feel at home in Madison.

•

ASCE CONVENTION

The First Annual Regional Conference of the American Society of Civil Engineers will be held May 1 & 2 at the University of Wisconsin. The schools coming here for the Conference include: Marquette University, Michigan School of Mines, Northwestern Institute of Technology, University of Minnesota, Illinois Institute of Technology, University of Illinois, Purdue University, and Rose Polytechnic Institute. On Friday afternoon there will be a symposium on bomb-proof construction. This will be followed by a banquet and dance in the evening at the Union. Student papers will be read Saturday morning.

•

ALUMINUM DISPLAY

The new show case in the Mining Building illustrating the manufacture and fabrication of aluminum was presented to the Department of Mining and Metallurgy by the Aluminum Company of America early this month. It traces the steps in aluminum manufacture from the ore through the electrolytic cell and it shows on a revolving cylinder the various products made of aluminum.

•

CHEMICAL ENGINEERING EXPANSION

Due to a grant from the Wisconsin Alumni Research Foundation, the Chemical Engineering Department has been enabled to conduct some research under the direction of Professor Hougen. Space was not immediately available at the Chemical Engineering building, and for this reason the Metallography laboratory has been moved to the Mining and Metallurgy building. The space it now occupies was formerly the museum.

The new room in the Mining and Metallurgy building is of great improvement over the old. The laboratory will accommodate four more students each period. The grinding and polishing of samples is done in rooms separate from the laboratory, thus keeping the delicate microscopic equipment free from dust and grit.

The space left in the Chemical Engineering building has made it possible to build several laboratories for graduate research, and office, and a large recitation room.

FRESHMAN HONORS

HIGH HONOR RATE

Fischer, David W.	3.00
Hirchert, Walter F., Jr.	3.00
Rowlands, Morris J.	3.00
Hibbard, Frank F.	2.941
Rose, Lewis W.	2.938
Luecker, George E.	2.882
Brenner, Edward J.	2.842
Knight, M. Berwyn	2.833
Earle, David H.	2.824
Johann, John, Jr.	2.824
Wendt, Ernst A.	2.824
Bennett, Donald H.	2.813
McNall, Preston E.	2.813
DeLong, William R.	2.769
Manteufel, Robert J.	2.765
Starke, Glenn O.	2.765
Thompson, Kenneth L.	2.765
Oman, Albert O.	2.750
Steinhart, Victor	2.750

HONOR RATE

Gulli, Frank J.	2.714
Baillargeon, Ralph E.	2.706
Goldbeck, Carl W.	2.692
Mickelson, William R.	2.667
Fein, Richard S.	2.647
Young, Warren C.	2.625
Oleson, Merval W.	2.615
Petrie, Willard C.	2.611
Stabnow, Richard J.	2.611
Adams, Alfred L., Jr.	2.588
Johnson, Martin H., Jr.	2.588
Miller, William S.	2.588
Tanghe, John H.	2.588
Brunsell, Robert F.	2.563
Cochrane, Wesley C.	2.563
March, John W.	2.529
Scheuring, Robert P.	2.529
Ille, William B.	2.500
Koehler, Franklin J.	2.471
Young, Eugene P.	2.471
Howland, Ralph E.	2.444
Brown, Robert C.	2.412
Schulze, Otto A.	2.412
Kaesberg, Paul J.	2.400
Kirkpatrick, Donald L.	2.400
Baumgarth, Verlin H.	2.389
Blackburn, Robert T.	2.389
McMahon, Robert E.	2.353
Tappon, Milo T.	2.353
Jacky, Germaine F.	2.357
Mesmer, Ted C.	2.357
Endrizzi, Gilbert D.	2.333
Farrell, Robert J.	2.333
Kohlhardt, Norman T.	2.333
Wendt, William R., Jr.	2.313
Disman, Solomon	2.286
Smilges, Robert	2.250

BEARDED BADGER BEAUTIES

The engineers are once again taking the lead in offensive production by growing beards in an "All Out" campaign. The savings that are the outcrop of this personal sacrifice are numerous. First and foremost, there is a saving of time. At fifteen minutes a day per shave, it means a week per year per man that can be used for working, studying (?), or possibly sleeping. Then again, the steel that is saved is worth its weight in tanks. Not only is this vital material bypassed into armament production, but the man power can also be converted for similar purposes.

Of course there is a **little** matter of money that is saved which can be utilized for **defense bonds.** Other items of saving are soap, water, alcohol (used in lotions), and electricity. Last but still of prime importance is the uplift of morale acquired by not having to go through the woes of slashing one's features.

Not only is a direct saving effected, but an opportunity for a bit of income on the side presents itself. To cite an example, one of the contestants was offered 35 cents for a shave and a nickel for a cup of coffee while strolling along University Avenue. He's going to continue to "work" the Avenue, but here's good luck to the first contestant and his "tin" cup that can stake a claim on the front steps of the Union.

The beard growing contest, which has always been an integral part of the engineers' St. Pat election, parades of years ago, and the expo's of the last two years, will be the main topic of bull sessions about this year's election of St. Pat and the St. Pat's dance. The contest has been given "All Out" support by Polygon Board, and by the engineering societies. It is rumored that the E. E.'s are going to keep their beards until their man is elected as St. Pat, but the other societies are commenting on the fact that they certainly will look like cave men after a few years.

Not only is beard growing patriotic, but compensation is offered in the form of prizes. The proud possessors of the three best beards will receive respectively, $7.50 in trade at Brown's, a leather zipper notebook from Jerry's, and as a third prize, a General Engineering Handbook from the Co-op. The judging to determine the best looking beards will take place at the St. Pat's dance, Saturday, March 28, and the sprouts of whiskers will be evaluated by popular campus co-eds as chosen by Polygon Board. To promote better relationship between contestants and the subjects of their extra-curricular activities, Polygon board is offering free shaves to be given immediately after the judging.

BEARD GROWING CONTEST RULES

1. The contest is open to all regularly enrolled engineering students excepting members of Polygon Board.
2. To be eligible, all contestants must register before March 7, with Polygon Board.
3. Judgment will be based on length, color, originality of cut, diameter, and curliness.
4. Judging will take place at the 1942 St. Pat's Dance in Great Hall, Memorial Union.
5. Judges will be designated by Polygon Board.
6. The decision of the judges will be final.
7. Prizes are as follows:
1st—$7.50 in trade at Brown's.
2nd—A leather zipper notebook from Jerry's.
3rd—A General Engineering Hand Book from the Co-op.

(continued on page 26)

ALUMNI NOTES

by Arne V. Larson, m'43

Miners and Metallurgists

OESTERLE, JOSEPH F., PhD '29, chairman of the department of Mining & Metallurgy, was elected Vice-Chairman of the Mineral Industry Education Division of the American Institute of Mining & Metallurgical Engineers, at the All-Institute meeting held in New York City Feb. 9-12.

ELLIS, DAVID L., MS '41, was the recipient of the first place award in the graduate division in the national student prize contest, conducted by the American Institute of Mining & Metallurgical Engineers. After receiving his degree Mr. Ellis was commissioned lieutenant, junior grade, in the U. S. Navy and is now stationed at the Naval gun factory, Washington Naval Yard, Washington, D. C. He expects to be transferred to Fort Knox, Ky., in the near future.

•

Civils

ELA, EDWIN S., '96, whose home was in Rochester, Wis., died on October 9, 1941, of injuries received in a traffic accident at Beloit.

McINTOSH, F. C., '13, Pittsburgh, Pa., was appointed by President E. O. Eastwood, Seattle, Wash., at the 48th Annual Meeting of the American Society of Heating and Ventilating Engineers, held in Philadelphia, to serve as Chairman of the Committee on Research during 1942. Mr. McIntosh has been with the Pennsylvania Railroad Company and the Universal Portland Cement Company in Chicago and is now with the Johnson Service Company, being the manager of their Pittsburgh office.

LORD, HERBERT O., '20, chief engineer of the Metropolitan Sewerage District of Madison, has been called to active duty as a lieutenant-commander in the Civil Engineer Corps of the U. S. Naval Reserve. He is located at the Twelfth Naval District headquarters at San Francisco.

SPETZ, RALPH F., '23, a former track star on the Wisconsin track team, died on September 1, 1941, at the Veterans' Hospital at Wood, Wisconsin.

FORD, HENRY M., '21, has been appointed state director for the Public Work Reserve for Wisconsin, with offices at Madison.

BENNETT, KEITH H., ex '36, has enlisted in the U. S. Engineers and reported for duty on March 2.

KUTCHERA, DON H., '37, began work on Feb. 1 with Allis-Chalmers Co. of West Allis, Wis., as design engineer on a special project. Don has been moving around. From November, 1940, to July, 1941, he was with the U. S. Engineers, working out of the Cincinnati office. Then he joined the engineering staff of the Electric Bond and Share Company, as a design engineer, and continued there until he moved to Milwaukee in February.

MALDARI, JOSEPH A., '38, is now at Fort Knox, Ky., with the 25th Armored Engineer Battalion, 8th Armored Division.

BJELAJAC, VASO, '38, is an assistant engineer in the Water Leak Survey Office of the District Engineer of the Utilities Division in Atlanta, Ga. He is living at 498 Spring St., N.W., in the same city.

HARRISON, CHESTER J., '40, left Consolidated Aircraft in the middle of February to go to Fort Sam Houston at San Antonio, Texas, as water waste inspector, under Prof. Kessler's general direction. He has a civil service rating as assistant engineer.

MILLER, MALCOLM A., '40, began work on Feb. 1, 1942, as assistant hydraulic engineer with the U. S. Engineer Office at Mobile, Ala. He was married on Feb. 14, 1941, to Mary Ann Case of Kansas City.

SMALL, ALVAN L., '40, is a junior bridge draftsman with the Wisconsin Highway Commission at Madison.

FINTAK, G. G., '41, is an assistant engineer in the Water Leak Survey Office of the District Engineer of the Utilities Division in Atlanta, Ga. He is living at 498 Spring St., N.W., Atlanta Ga.

TENNEY, VERN W., '41, has left Lockheed Aircraft Corp. to serve as water waste inspector in a western corps area under the general direction of Prof. Kessler.

WERREN, FRED, '41, ensign in the USNR, is stationed at the U. S. Navy Yard at Mare Island, California, following four months of training in the East. He was ordered to report at Mare Island at the end of January.

•

Chemicals

HIGLEY, HARVEY V., '15, who is the Commander of the American Legion for the state of Wisconsin, is President of the Ansul Chemical Co. of Marinette, Wis.

TYRRELL, DONALD W., '17, returns to Madison, Wis., to be Vice-President of the Ray-O-Vac Co., manufacturers of dry batteries. He comes to Madison from Clinton, Mass., where he was President of the Blake Manufacturing Co.

HOTALING, EUGENE C., '23, died at the home of his parents in Fond du Lac, Wis., on Oct. 21, 1941, after a long illness. Upon graduation he took employment with the W. A. Baehr organization, Chicago; later he transferred to the Illinois Power & Light; and his last engineering work was with Lucas & Luick, Consulting Engineers, Chicago, both of whom are alumni of Wisconsin, Class 1906.

NELSON, E. F., '24, was married to Helen O'Brian of Chicago December 6, 1941. He is with the Universal Oil Products Company of Chicago. They are living at 77 East Cedar Street, Chicago.

KNECHTGES, RICHARD G., '33, was married to Bernice L. Labergn of Green Bay January 10, 1942. Mr. Knechtges supervises the technical phases of sulphate pulp manufacture in the Northern Paper Mills at Green Bay.

JUSTL, OTTO, '34, formerly gas plant superintendent at Portage, Wis., for the Wisconsin Power & Light Co., is now with the Illinois Ordnance Plant at Dover, New Jersey.

NIENOW, FLOYD, '34, is with the Pennsylvania Salt Manufacturing Co. of Philadelphia, Pennsylvania. He is living at the Widener Bldg., in Philadelphia.

MOHAUPT, ALVIN A., '36, was married to Ruth Steitz in February, 1941. He had been at the Milwaukee Water Purification Plant until last November when he came to the Forest Products Laboratory in Madison where is is now working on material containers.

(continued on page 26)


More aluminum up there, less in new telephones
—for victory!
Many materials used in telephone making are listed as "critical" for war purposes. Bell Telephone Laboratories and Western Electric have redesigned apparatus and changed manufacturing methods to employ available materials.
Take aluminum. The reduction in its use in a year's telephone output is enough to build 294 combat planes. This program has been replacing critical materials at an annual rate of 7,747,000 pounds. Though it grows steadily more difficult to maintain as shortages increase, the program helps to meet the greatest demand in history for military and civilian communication equipment.
"THOSE PLANES WILL HELP DADDY LICK 'EM!"
Western Electric
... is back of your
Bell Telephone service

FRANK M. WOLF

Presenting . . .

STATIC

for the miners and metallurgists

by Roger Robbins, e'42

The Mining and Metallurgy department would not be complete without the mechanician, Frank M. Wolf, the man who knows where everything is, how it runs, and the way to fix it when it breaks. He is the bald-headed gentleman with a slight bulge about his midriff and a twinkle in his eye—who has invented more gadgets and has more ideas than any student could ever hope to do or have. His enthusiasm and ingenuity for inventing helpful gadgets is unsurpassed. He has made innumerable parts in his machine shop, as well as repairing many others. As part of his work he built the x-ray machine and several electric furnaces in the Mining Building. Above, you see him inspecting his latest contraption, a beltless conveyor that moves material at a uniform rate by vibration of an eccentric wheel. It can be used as a control in supplying materials to a chemical process, such as the addition of sodium carbonate to the flotation cells. Frank is familiar to everyone in the Mining Building for he is the one person who has an answer to any mechanical problem you might have. He is willing to help you in any way, from lending a screw driver to making delicate research apparatus. Being a good-natured fellow, he gave us a few of his prize jokes which appear in the following Static.

•

An army recruiting officer asking a young man questions to ascertain if he was mentally fit:

Officer: What would happen to you if you had one ear shot off?

Recruit: I wouldn't be able to see out of one eye.

Officer: That's strange; what would you do if you had both ears shot off?

Recruit: I wouldn't be able to see out of either eye because my hat would have slid down over both of them.

•

The other day we noticed one of the Ag students who is taking surveying. It seems that he has found a new way to level a transit. He carefully centers both bubbles, and then to make the final, minute hair-line adjustment he leans on the transit leg as if it were a pitchfork.

The villain struck her, yet she stifled the cry that wracked her beautiful lips.

Again he struck her, and yet again she made no sound.

Once more he hit her on the head, but she did not so much as whimper.

Then, enraged beyond all reason at her stoic unconcern, the dastardly brute gave vent to a low malediction, and began raining blows on her pretty little head, even striking her in his madness.

Even through this she held her peace.

But at length, her feeling at the blazing point, she burst into flame.

For she, poor thing, was only a match.

•

Husband answering the phone said, "I don't know; call up the weather bureau."

"What was that?" asked his wife.

"Some fellow asked if the coast is clear?"

•

I think that I shall never see
An auto like the Model-T;
A car whose three-inch tires are pressed
against the earth's rough, stony breast
A can who looks for gas all day,
And blows a radiator spray;
A crate that in the summer goes
And freezes up when first it snows;
A crank with which we often toil;
Four cylinders that eat up oil;
Poems are made by fools like we,
But only Ford can make a T.

•

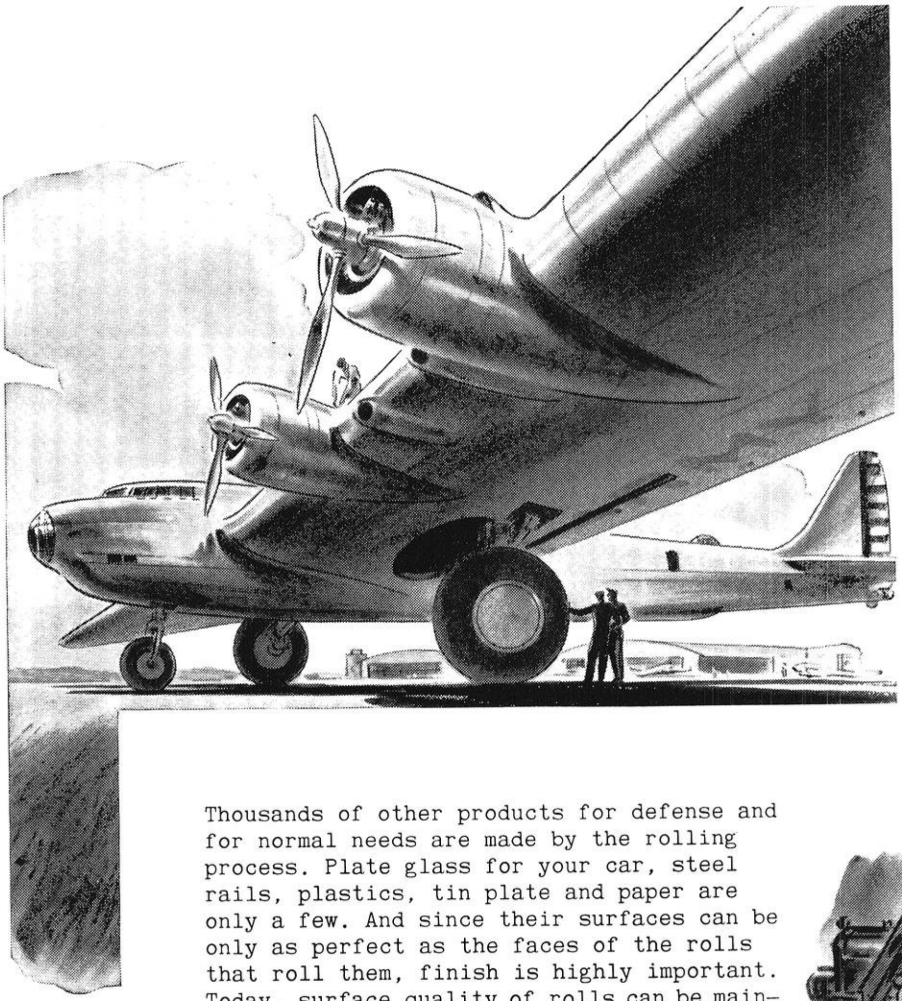
The brain of a college student is one of the most amazing things known to man. It starts to function the moment he jumps out of bed and doesn't stop until he reaches the classroom.

•

Protect the birds. The dove brings peace and the stork brings tax exemptions.

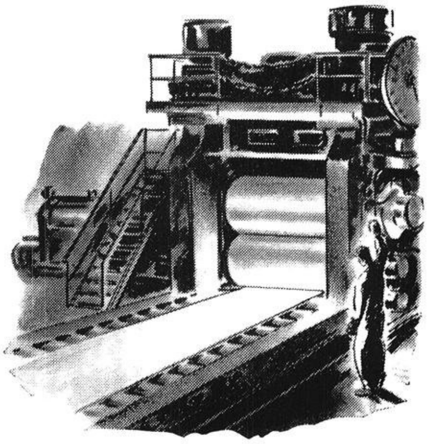
(continued on page 29)

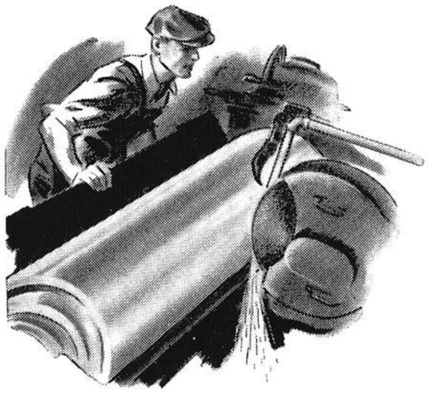
What does it take to smooth a Warbird's Feathers?



A wingspread of 212 feet ...every inch preened sleek as satin! The perfect smoothness of the metal sheathing on American warbirds like the B-19, world's mightiest bomber, isn't there for looks. It's essential to top performance. How do they get the flawless sheets of metal used to make airplanes? They're rolled out by the ton by giant steel rolls. And keeping the surfaces of these rolls ground to almost perfect accuracy and finish is another of the vital contributions of Carborundum-made wheels to America's defense.

Thousands of other products for defense and for normal needs are made by the rolling process. Plate glass for your car, steel rails, plastics, tin plate and paper are only a few. And since their surfaces can be only as perfect as the faces of the rolls that roll them, finish is highly important. Today, surface quality of rolls can be maintained to within a few millionths of an inch by the use of Carborundum-made grinding wheels.





The same skill and experience that have helped develop modern roll grinding technique will be at your disposal in any industry with which you may become associated. Whatever the use of grinding wheels or coated abrasives, Carborundum engineers are ready at all times to advise and help. The Carborundum Company, Niagara Falls, New York.

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ABRASIVE PRODUCTS

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SOUTH AMERICA . . .

(continued from page 7)

One question people invariably ask me is, "Did you see a bullfight?" I did, fortunately, the day before I left Peru. It was quite impressive and to give you the benefit of fresh impressions, I'll quote from some notes jotted down at the time:

"Despite its ancient and renowned reputation, the Plaza del Torros in Lima is unimpressive to one accustomed to the huge athletic stadiums in the States. It is a circular arena, perhaps seventy-five yards in diameter, surrounded with a covered grand stand which seats about 10,000 people. It is old and dilapidated, reminding one of the stock judging yards at a county fair.

"Sweltering while waiting for the performance to begin, we were supposedly entertained by a military band which seemed to consist, from the sound of it, of only a bass drum and a tuba which thumped monotonously over the noises of the crowd. We were constantly annoyed by people climbing over us to their seats much as at football games at home, only more so. Peddlers tossing ice-cream bars and candy to spectators and snatching coins from the air added a familiar touch.

"After a number of fan-fares the bull fighters marched into the arena, with their red, green, and gold uniforms flashing back the glaring mid-afternoon sun. These were followed by the picadors on their blind-folded horses. Bringing up the rear were a number of negroes leading two handsome horses used to drag dead bulls from the field.

"From then on the performance moved fast. A gate opened almost as soon as the men had taken their stations about the field. A noble but bewildered-looking bull trotted into the ring, stopped, looked around, stood still. One of the stooges (I don't know his technical name) provoked the bull and deftly dodges a charge. Several more charges of this kind were provoked to give the matador a chance to study any peculiarity of the bull, such as favoring one horn or blindness of one eye.

"At this point the picadors entered on their horses. The horses are blind-folded and their bodies are protected by a heavy leather shield passing around their chest and mid-sections. The picador provokes the bull to charge the horse. As the bull strikes, the picador attempts to wound the bull in the neck with his lance. The idea is to injure the bull's neck to make him carry his head low, thus giving the matador an opportunity to slip his sword through the shoulder into the heart.

"In the second fight a tremendously powerful bull managed to knock horse and rider backwards to the ground and gore the horse, which was then led from the field with his entrails dragging on the ground. All through the performance one felt sorry for these poor horses, which, from the character of the fight, had to be attacked by the bull to give the picador an opportunity to use his lance.

"The next step is the placing of the bandrillos, steel barbed sticks gaily decorated. The matador provokes a direct charge from the bull. Then just as the bull reaches him, he thrusts the bandrillos over the bull's head into the shoulders, at the same time side-stepping quickly. It is a daring feat requiring courage and skill. The purpose is to correct any peculiarity of the bull which might result in his acting in an unpredictable manner and so injure the matador.

"After further play by the matadors with their colored capes, the man who is to make the kill approaches with his razor sharp sword. He uses a small red flag to lead the bull into the desired position. Standing directly in the bull's path, sword leveled at shoulder height, he awaits the charge. As the bull stamps toward him, the matador inserts the point of the sword just above the shoulder, and thrusts home. A well aimed thrust pierces the bull's heart. If the sword has struck home, the bull looks surprised, staggers backward and makes a few weak charges before he finally collapses.

"After the kill, the matador circles the field, taking bows. Enthusiastic fans toss their hats at him, which he obligingly tosses back—that is, he tosses back the first few. The rest are tossed back by a stooge who follows him around for this purpose.

"In the mean time, the negroes come out on the field, hitch the bull's head to a little cart drawn by the two huge horses, and drag the carcass around the arena and out If the bull has been especially game, the crowd applauds the carcass which, I fear, is beyond taking a bow. However, the owner of the hacienda at which the bull was bred takes care of this detail.

"The usual program consists of six bulls, two for each of the three matadors. When three have been killed, the remainder of the program is apt to become **just a bit nauseating."**

This was supposed to be an article on living and on working conditions, though so far I haven't mentioned work, which is supposedly the reason for going down to South America. The amount and quality of work one does is pretty much up to the man himself. Companies usually are loathe to discharge a man for any but very serious offenses of negligence or ignorance, since this involves paying him three months' salary and his passage home. As a result a lot of slip-shod work gets by.

As far as experience goes, that gained in South America is applicable there but must be discounted to a large extent upon return to the States. Because of the inaccessibility of the country and the cheapness of labor (30c to 40c a day, American money) mining methods are often years behind best practice in this country. Innovations are accepted slowly by a fairly conscientious but hardly progressive working population.

Should the young engineer go to South America? For experience I say, "No." Probably at least fifty per cent of the fellows go down with the idea of staying long enough to make a substantial stake, yet about nine out of ten stay one contract or less.

But you can't satisfy itchy feet by scratching them!

FLAME THROWER OF THE PRODUCTION OFFENSE

LEADING the attack on the production backlog by shaping steel and building it into ships, tanks, armored trucks any many other defense items, is industry's modern production tool — the Airco Oxyacetylene Flame. It slices its way through steel of any thickness up to 30″ and more, cutting it to the desired contour with unrivalled speed and accuracy. This versatile tool flame machines metal with astonishing speed; hardens steel to any desired degree and depth; cleans metal surfaces for quicker and longer lasting paint jobs and welds metal into a homogeneous lastingly strong structure.

To assure the maximum efficiency from this modern production tool, Airco has developed a complete line of machines and apparatus. Airco has increased its manufacturing of oxygen and acetylene and distributing facilities to meet the accelerating demand. So that the Airco Oxyacetylene Flame may be used most efficiently and economically, Air Reduction offers industry the cooperation of a staff of experienced engineers, skilled in the use of this modern tool.

An interesting booklet, "Airco in the News", tells a picture of this Airco production tool and the numerous ways in which it is aiding the defense program. If you want a copy write to the Airco Public Relations Department, Room 1656, 60 E. 42nd St., New York, N. Y.

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ANYTHING AND EVERYTHING FOR GAS WELDING OR CUTTING AND ARC WELDING

TURBINES

(continued from page 13)

naval expansion program a modern, well-proved type of power plant was available for naval vessels.

Relation Between Steam and Water Power

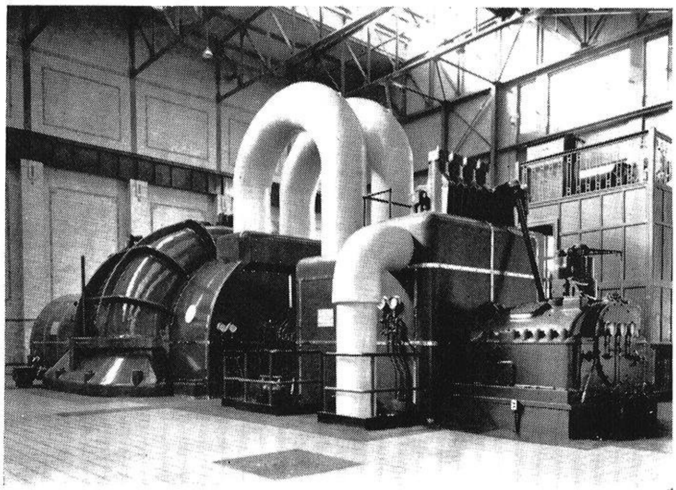
With respect to water power, many people make the mistake of thinking that water power is the cheapest power. It is if the dam and the falls are furnished by nature and close to the need for power as at Niagara.

Altogether water power now furnishes about 1/3 of the electrical power we use, steam turbines the other 2/3. The remaining water power sites generally require the building of great dams as at Norris, Boulder, or Coulee, costing millions of dollars, and are usually hundreds of miles from a market for the power. As a result they must either have the power they generate transmitted to the market over costly transmission lines, or else they must have their markets moved to them, as is being done with the building of great aluminum reduction plants in the West near some of these new water power developments.

The increased efficiency of modern steam plants has reduced the fuel cost, which is the principal part of the operating charges, to about equal the fixed charges on the initial investment cost of a steam plant. The available water power developments, however, will apparently now cost, plus the transmission lines required to deliver the power to a market as based on authorities' estimates, from 1½ to 4 times the cost of a steam power plant for the same capacity, and generally a large amount of steam plant capacity is required in addition as stand-by to take care of low water periods. It is easy to see therefore that the fixed costs of such plants will be much greater than that of a steam plant, and will generally more than offset the present low fuel and operating costs of the steam plants. In general, therefore, if power is to be obtained quickly and cheaply, it can be done best in this country with our huge coal resources by the building of steam plants near the load. On the other hand, of course, in periods of depression with great unemployment, there is probably no better way of investing our unused labor and capital than in great water power developments.

Two New Developments Which Are Still Further Reducing the cost of Power from Fuel

About one-half of the capacity of steam power plants in service in this country was installed prior to 1925. These plants are not so efficient as those installed in more recent years, since they generally operate at low or moderate pressures and temperatures. In fact, they use about twice as much fuel as a modern plant per unit of electrical output. With the perfection of the high pressure turbines and more efficient high pressure boilers, it has become possible to replace the old boilers in these plants with new high steam pressure boilers and to run this high pressure steam first through a so-called superposed or topping turbine, and exhaust this steam into the steam pipes feeding the older turbines at their original steam pressure and temperature. Thus, out of this steam, the superposed or topping turbine will generate a considerable amount of



Typical Modern Turbine Installation.

power before the steam is exhausted into the older low pressure turbines. Taking into account the increased efficiency of the new boilers, this has permitted the capacity of many old power stations to be increased by from 50% to 80% at no increase in the total fuel consumption per original turbine.

A large power plant in New York has been re-built along these lines and has four large superposed or topping turbines in operation which in the aggregate are able to generate 236,000 kw. of such low cost power, the exhaust steam of which will be all discharged into existing low pressure turbines or heating mains. You might say, therefore, that this new plant is getting almost a quarter of a million kilowatts without the expenditure of additional fuel as compared to what was previously necessary to generate the low pressure steam that is now supplied by the exhausts of these turbines. The first cost per kw. is almost as low as that of a new steam plant. This is far cheaper power than most water power sites which can now be developed; in fact, it is the lowest cost power which can possibly be supplied to industry today.

In addition to cooperating with many utilities in the development of these high pressure steam cycles described above, the company with which the writer is associated has been carrying out over the past 25 years, under Mr. W. L. R. Emmet's original leadership, the development of the mercury vapor-steam system of power generation. This system utilizes turbines running on both hot mercury vapor and on water steam. This development has already cost several millions of dollars. It has resulted in a practical operating process now in commercial service in three large power plants whereby power can be produced from the burning of coal, the cheapest of fuels, at a higher overall thermal efficiency than was ever attained by any other known process and with a very high degree of reliability. Work is progressing toward making the first cost of such efficient plants comparable to that of present steam plants. When the world returns to normal, this process may make a very substantial contribution to our national wealth.

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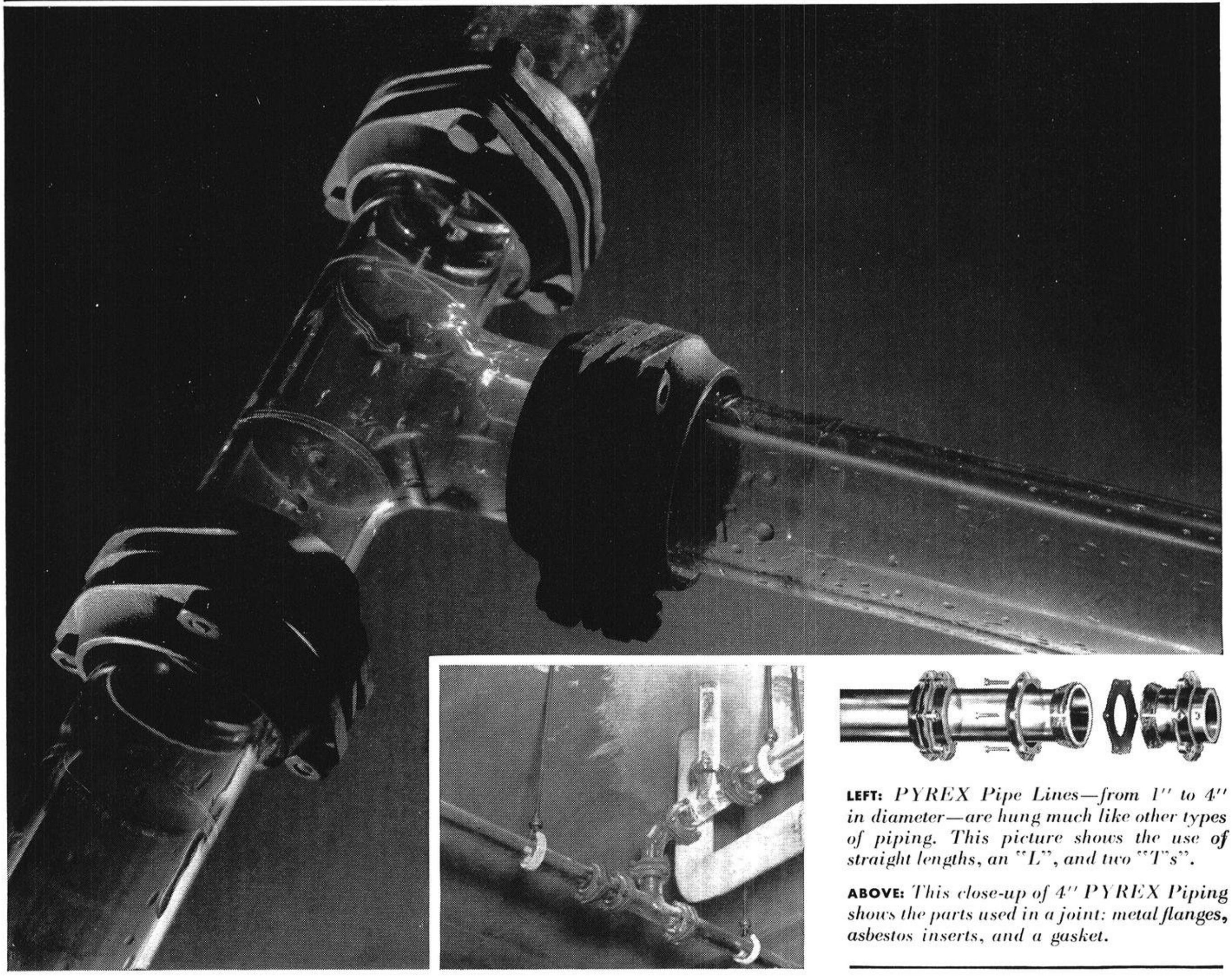
*"New Engineering in the Navy" by Charles Edison, Scientific American, March 1940, pp 138-39.

The pipe that can't keep a secret...



LEFT: *PYREX Pipe Lines—from 1″ to 4″ in diameter—are hung much like other types of piping. This picture shows the use of straight lengths, an "L", and two "T"s".*

ABOVE: *This close-up of 4″ PYREX Piping shows the parts used in a joint: metal flanges, asbestos inserts, and a gasket.*

THIS ginger ale maker is as finicky as a New England housewife. (Probably why his ginger ale is an Eastern best-seller.)

"I want pipe I can see through", he said, "so I know it's clean. Pipe that can't alter the flavor of my product any more than the glass bottles it is sold in. Darn it, I want glass pipe!"

Glass pipe lines, made by Corning, are a familiar sight in food, beverage, and chemical plants . . . paper mills, refineries, explosives factories . . . drug, medicine, and cosmetic plants . . . in short, wherever product purity is vital.

Highly resistant to corrosion attack, Corning's PYREX Piping eliminates this cause of contamination. Transparent, it keeps no secrets . . . a glance tells of flow, cleanliness, color, sedimentation. And freedom from pitting and scaling means long life for these pipe lines, with low maintenance costs.

Important? Yes. For in today's urgent program there's no place for impure products, production stoppage, high maintenance costs, or wasted materials. And in many instances, glass has proved it can outperform metals, do an essential job better and at a lower cost.

To the engineer, this glass piping is important as an example of the many-sidedness of glass in industry and of Corning research in glass . . . research that takes in its stride such divergent tasks as the making of a tiny chemical-resistant glass spring, smaller than your thumb, or the casting of the world's largest telescope mirror, a giant one-piece disc 20 tons in weight. Today more than ever Corning is headquarters for research in glass. Industrial Division, Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

Alumni Notes

(continued from page 18)

GILBERT, JULES, Feb. '42, has accepted a position with the Westvaco Chlorine Products Co. of South Charleston, West Virginia.

MUELLER, FLOYD F., Feb. '42, has a position in the explosives division of the Hercules Powder Co. in Wilmington, Delaware.

•

Electricals

McKNIGHT, BOYD, '41, who was with the Wisconsin Power & Light Co. of Madison, is now with General Electric at Erie, Pennsylvania.

O'NEILL, LT. JOSEPH T., ex '41, was killed Feb. 24, 1942, in a motor accident in Hawaii. He was the business manager of the Wisconsin Engineer while he attended the University and was a member of Kappa Eta Kappa and Scabbard and Blade.

•

Mechanicals

DETTMANN, CHARLES E., '40, is a Lieutenant in the Augusta Arsenal in Augusta, Georgia.

FISHER, E. L., Feb. '42, has a position with Fairbanks Morse.

GOEDJIN, R. C., Feb. '42, is in the United States Naval Reserve.

KAISER, CLYDE L., Feb. '42, has a position with the Electromotive Corporation in La Grange, Illinois.

KNUTSEN, H. K., Feb. '42, is working with the Sturgeon Bay Shipbuilding Co.

WIBBERT, G. A., Feb. '42, is in the United States Naval Reserve.

CAMPUS NOTES

(continued from page 17)

FOUNDRY CONFERENCE

The Fifth Annual Foundry Conference of Wisconsin was held at the Hotel Schroeder in Milwaukee, February 26 and 27. Professor J. F. Oesterle of the Mining and Metallurgy department and H. C. Waldron of Milwaukee were co-chairmen. Dean F. Ellis Johnson gave the welcoming address. President C. A. Dykstra and Brigadier General Henry J. Reilly were the luncheon speakers.

The conference was divided into four sections: gray iron, malleable, steel, and non-ferrous so that each man could hear the latest developments in his particular field. Each of the four meetings of each section was begun by an informal talk on a certain foundry development and was followed by an open forum.

Carl Joseph, Metallurgist with General Motors, discussed the increased use of Armasteel in ordnance work. This material, which is pearlitic malleable iron, has replaced some forgings for certain machine gun parts because it is cast to closer dimensions, requires much less machining, and is easier to obtain. Before automobile production was halted, Armasteel was used in camshafts and rocker arms because of its excellent hardenability and was being successfully substituted for aluminum in the pistons.

One of the outstanding contributions available to the steel foundry was the 1,000,000 volt portable x-ray machine. Its enormous penatrability speeds up inspection work by giving better radiographs with very short exposures. There has also been a pronounced substitution of steel castings for forgings. There were 800 steel castings in one large tank during the past year. Due to the war the steel foundries have undergone an enormous expansion and are swamped with ordnance work while the malleable and gray iron foundries have only a small portion of the military work.

•

C.E. IS PAPA

Ralph Gribble, senior civil, has a new daughter, Sara Jane, born March first, at the Methodist Hospital.

•

ENGINEERS INVITED

All engineers are invited to the combined open house and mat dance at the Pine Room of the Men's Residence Halls on Saturday, March 28. The girls of Barnard, Chadbourne, and Elizabeth Waters, and all the engineers are to be special guests. Music will be served by the nation's top bands off the platters. The Pine Room is located in Van Hise Hall across from Tripp and Adams. **Admission is free!**

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CAMPUS ELECTIONS

Last semester a polling place was established in the lobby of the Mechanical Engineering building for the campus student elections. The spring elections will be held on March 24, and the engineers' poll will be again established. The procedure will be the same — bring your fee card and try to vote during the noon hour rather than between classes when the desks are crowded. Last time the voting appeared heavy during the ten minutes between classes, but only two hundred votes were cast all day.

The Elections committee did not expect a 100 per cent vote from the engineers at the new polling place, and they expect to wait a few semesters for a sizeable vote. However, despite the fact that many of the engineers may have voted at other polls, two hundred votes was too small a response. A third year mechanical, Herb Stone, is finding time to run for the position of junior man on student board. Certainly if he can find time to run, the rest of us—freshmen to seniors inclusive—can find time enough to participate in student government to the extent of voting.

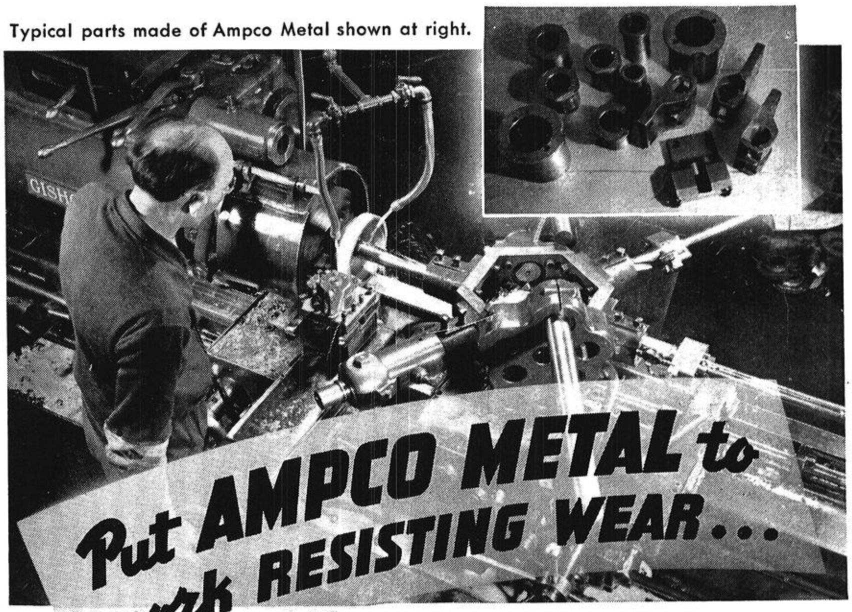
POLYGON BOARD

Polygon Board's attempt at the earlier part of this year to find a substitute for the Engineering Exposition met with no success after all possibilities had been considered. Foremost of these was an engineering convention to be sponsored jointly by the Wisconsin Engineering Society and Polygon Board. The Wisconsin Engineering Society is a state-wide organization made up of the professional engineers in Wisconsin. However, since no definite plans had been or could be made by the organizations concerned at a date early enough to insure the success of such a venture this spring, all plans for such a student-professional convention were abandoned. In addition, with the uncertain war conditions as they now exist, the wisdom of any such ambitious program was highly questionable.

Instead, Polygon Board is concentrating on presenting what it hopes will be one of the most successful St. Pat's campaign and dance in recent years. For this we would like to enlist the "all-out" support of every engineer in our College. There is no reason why this year shouldn't be the best in a long time for the support of the respective candidates for St. Pat. A little support from all the men is better than all the work by a few men. St. Pat is one of the oldest traditions on Wisconsin's campus and deserves to remain the outstanding social activity of the engineers as long as the college exists. We hope your loyalty to your candidate can be measured by the number of buttons and tickets you sell and **not** by the quantity and quality of rough-house you can cause.

Henry Schmalz,
Chairman

Typical parts made of Ampco Metal shown at right.



Longer service life of machine parts becomes imperative when a war production line may depend upon the smooth functioning of a machine tool. Today, many vital frictional parts have been redesigned to include Ampco Metal, an alloy of the aluminum bronze class, because of its marked wear-resistance.

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Not only machine tools, but aircraft, ordnance, heavy machinery, and other important war equipment include parts of Ampco bronzes. Ampco engineers are at your service. Ask for Catalog No. 22.

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X-RAYS

(continued from page 9)

ceramics, concrete, mica, coal, asbestos, meat, candy, canned goods and other packed products, wood, glassware, and hundreds of other miscellaneous articles is becoming more and more common. A novel use is the radiographing of food oysters to determine whether they contain seed pearls—if they do they are put back to develop the pearl.

Radiography, nevertheless, is not the most important application of x-rays by any means, although it is the phase the engineer usually is most interested in.

When a thin beam of x-rays impinges on a powdered crystalline material, a strip of film arranged in a cylindrical form with the powder sample at the center will show lines of varying degrees of darkening at certain distances from each other. The relative line intensities and their spacings are characteristic of the crystal structure of the material (or materials) the powder consists of. The use of this easily obtained diffraction pattern is practically unlimited. Their use as a standard method of chemical analysis along with the spectroscope and microscope is rapidly developing. The Department of Geology of this University has one of the most complete collections of diffraction patterns of minerals in the country.

The application of diffraction patterns to the determination of varying degrees of cold working, preferred orientation, recrystallization, lattice structure and alloy structure of metals by the metallurgist is indispensable. The determination of composition and structure of organic fibers and animal and vegetable tissues is rapidly increasing in zoology, botany, physiology, and a host of other allied sciences.

The use of x-rays to gain greater insight of the ultimate structure of matter, the atomic arrangement, and the crystal lattices of substances, allotropy, particle size and orientation, and many other complicated problems cannot even be touched upon in an article of this length. Let it suffice to say that the application of x-rays to practical problems confronting technologists in all fields is advancing rapidly, and the next few years will see even more startling developments in the use of this most versatile and easily manipulated tool of modern science.

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HERE'S STATIC AGAIN . . .

(continued from page 20)

Eskimo: "What would you say, darling, if I told you I pushed my dog team for a thousand miles through ice and snow, just to tell you I love you?"

Eskimoette: "I'd say that was a lot of mush."

•

CHINESE TOMBSTONE

Me in person
No movie
No talkie

•

Listen collegians and you shall hear,
The sad, sad tale of an engineer.
All the day long he meets in his classes,
The male of the species, no beautiful lasses.
No astonishing babes frolickin' with 'em,
Just sliding the rule of the logarithm.
The electrical man may love a new circuit,
But the problem of women! They'll never work it.
The theory of mechanics is mastered by many.
The masters of women! Gosh, there ain't any.
The civils are always blazing new trails,
But they're not so hot at praising the frails.
A bunch of the boys are studying the mines,
And they find no faults with the female designs.
The rest of the gang is messing with chemicals
Which leaves little time for testing the femmy-gals.
'Tis a bleak dismal outlook to the engineer,
To go through school without feminine cheer.
Can nothing be done about this deplorable state?
Ah me, no! 'Tis the engineer's fate.

•

FRESHMAN DEFINITIONS

Chlorine—a dancer in a night club.

Carbon—a storage place for street cars.

Barium—what you do to dead people.

Boron—a person of low mentality.

Mole—a subterranean fur-bearing animal.

Catalyst—a western ranch owner.

Centimeter—a hundred-legged worm-like animal.

Flask—a measuring vessel carried on the hip and graduated in fingers.

Electrolyte—a thing which when it is dark you turn on and it gets light.

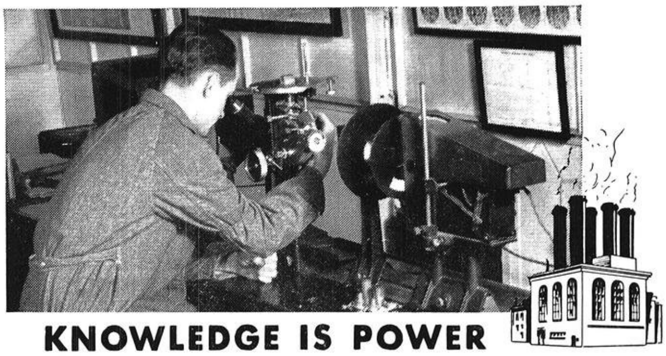
Nitrate—special price on telegrams and telephone calls after dark.

•

PROBLEM OF THE MONTH

A squirrel is in a cage one yard long with openings at each end large enough for him to stick his head through. He traverses the length of the cage in one second. He becomes excited when someone approaches the cage and then covers the course faster and faster, taking one-half the time each successive run. How long will it be until he will have his head sticking out both ends of the cage at the same time?

(continued on page 30)



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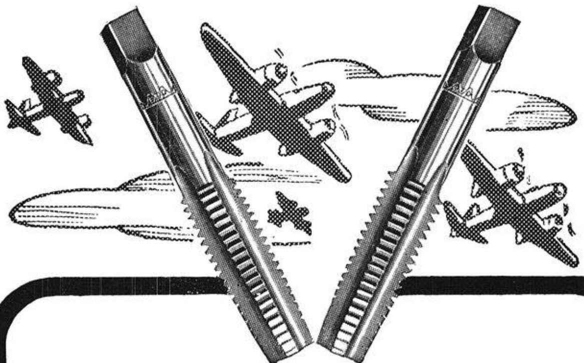

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MORE AND MORE STATIC . . .

(continued from page 29)

A newly married couple on a honeymoon put up at a skyscraper hotel. The bridegroom felt indisposed and the bride said she would slip out and do a little shopping. In due time she returned and tripped blithely up to her room a little awed by the number of doors that looked alike. But she was sure of her own and tapped gently on the panel.

"I'm back, honey! Let me in!" she whispered. No answer.

"Honey, honey! It's Mabel. Let me in!"

There was silence for several seconds. Then a man's voice, cold and full of dignity, came from the other side of the door.

"Madam, this is not a beehive, it's a bathroom."

•

I'm all done with dames,
They cheat and they lie;
They prey on us males
To the day that we die.
They tease and torment us
And drive us to sin—
Say—look at the blonde
That just breezed in!

•

Overheard during exam week: "Please take three seats apart on alternate rows."

First Mosquito: "Hooray! Here comes the new arrival."

Second Mosquito: "Good! Let's stick him for the drinks."

•

On his way home, a drunk stopped at a lamppost and pulled out his house key.

A passing policeman noticed his fumbling around, trying to insert the key into the post, and asked politely, "Nobody home?"

"You're crazy," said the drunk. "There's a light upstairs."

•

A traveler, who believed himself to be the sole survivor of a shipwreck, landed on a cannibal island and hid for three days in terror of his life. Driven out by hunger, he discovered a thin wisp of smoke rising from a clump of bushes, so he crawled carefully to study the type of savages about it. Just as he reached the clump he heard a voice say: "Why in hell did you play that card?"

He dropped on his knees, and devoutly raising his hands he cried: "Thank the Lord, they are Christians."

•

Whatever trouble Adam had,
No man could make him sore
By saying when he told a joke,
"I've heard that one before."

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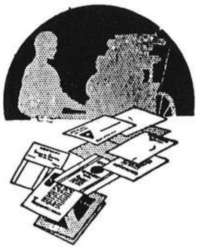

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Editorially Speaking

Use the Engineer!

As WE see it, the Wisconsin Engineer is and should be the students' magazine. The opportunity is yours to express yourself through the Engineer, on any subject associated with the activities within the College of Engineering. All too few of the organized groups on the engineering campus avail themselves of the Engineer staffs' willingness to cooperate. Seldom if ever do individual students come to the offices with ideas, pet plans, or criticisms. We find it hard to believe that there aren't a few things that the Engineer can do for the student and the college which haven't been tried all ready.

Effective now, as it has been for some time, is our invitation to all of you to use our facilities as extensively and as often as you will.

There are several things the Engineer will try to do in the next months. For our perennial headache, campus circulation, a new system is due. We're sincerely sorry that all of our subscribers haven't gotten their magazines on time.

For the editorial material, we would like very much to have a much larger percentage of student written material. Contrary to the popular conception, there are a number of things of interest to all of us, the presentation of which any student so inclined can handle effectively. Bring in your ideas and opinions about the engineers' place in the economic world; on the need for lamps in the Mechanical Engineering building lobby; or your newly developed rat trap. The Wisconsin Engineer is your magazine—use it!

Professional Societies . . .

THE aggressive young engineer must look to the future to anticipate the problems and work in his chosen field. The student branches of the technical societies offer a young man in the University a means of learning the trends and developments in industry. For a nominal fee he receives membership in his national engineering society and their technical publications. These national organizations send speakers to student meetings and sponsor essay contests to stir up the students' interest in industry. The young engineer is entitled to attend their annual conventions to meet and listen to the leaders of industry. He learns the problems that confront the man out on the job, the trends as to the increase or decline of a certain process and the latest developments from the research laboratories along with their applications to industry. No finer opportunity could be presented to a young man who is interested in his future. By knowing what to expect and what lines of endeavor to follow after graduation, he will readily adapt himself to his field of work and become a valuable asset to the company which employs him. These national engineering societies form the bridge that spans the chasm between college and industry.

ST. PAT'S DANCE

MARCH 28, 1942 • UNION, 9 - 12

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Jack Rael's Campus Band

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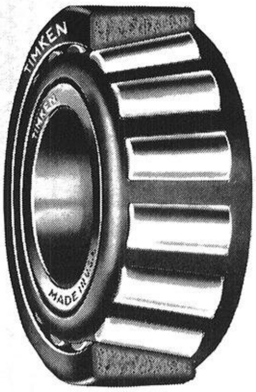

Student engineers of today will have a terrific responsibility in the future; for upon their shoulders to a very great extent will fall the responsibility of developing new and better machines of all kinds to help in the reconstruction of the economic fabric of the nation.

A thorough knowledge of Timken Tapered Roller Bearings will be a valuable asset to every young engineer starting out on his career during the next two or three years—probably the most critical period our country has ever had to face.

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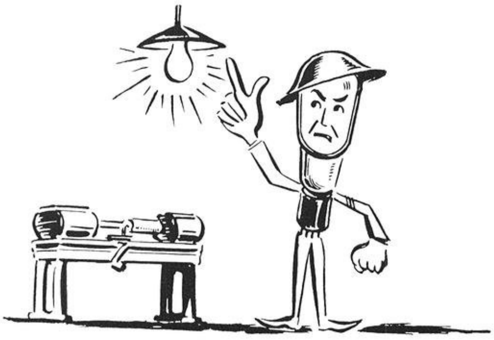
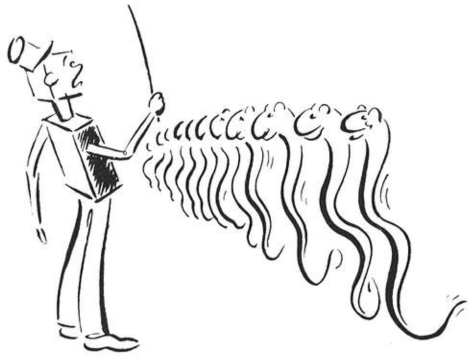
G-E Campus News



BLACKOUT WATCHMAN

THE problem of maintaining a night light in his place of business and at the same time complying with blackout regulations was solved by a Schenectady machine-shop owner by means of a G-E photo tube, or "electric eye." Rules required that all lights be extinguished within five minutes of an air-raid warning. That meant either hiring a watchman or turning out all lights at closing time.

The first night that the lights were turned out, the shop was broken into. So the owner, Andrew Tessier, put the "electric eye" to work. He installed the tube in an upstairs window, pointing at the nearest street light. When, during a practice blackout or raid warning, the street light is extinguished, the tube immediately turns out all lights in the shop. When the street lights go on again, so do the night lights. The "eye" provides a watchman who doesn't go to sleep on his job, and whose total cost is about two weeks' pay for an actual watchman.



MOLECULES MARCH!

WITH the increasing use of plastics and of artificial silk and rubber in defense activities, the structural qualities of the molecules that make up these materials is all-important to the scientists who are doing the research work.

Dr. Raymond M. Fuoss, of the General Electric Research Laboratory, in Schenectady, has found that some molecules wiggle like worms when an alternating electric field is applied to them. Such molecules are electrically lopsided, and when in an electric field they tend to line up, just as compass needles line up with the magnetic field of the earth.

From this tendency of the molecules to move to and fro in an electric field, scientists are able to determine how the various molecules are built. With this information, new molecules can be designed to meet specific needs. Since artificial silk and rubber and many plastics are composed of these worm-like molecules which react in an electrical field, materials of a wide variety of properties may be expected as a result of these researches.

NOT FOR WILLIE—

THE General Electric Company is proud of the variety of services it renders its customers. Nevertheless, company officials were surprised by one recent request from a woman who had seen a G-E advertisement in a magazine.

The illustration in the advertisement contained a picture of a young boy. The woman also had a boy, and her boy looked very much like the boy in the photograph.

Mother and son had only recently moved to New York. Since then, she had taken her son to a number of different barbers, but none of them had produced a haircut that suited her. And so, in desperation, she wrote to General Electric to find where the boy in the advertisement had his hair cut. It was just the type of cut she had vainly tried to get.

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