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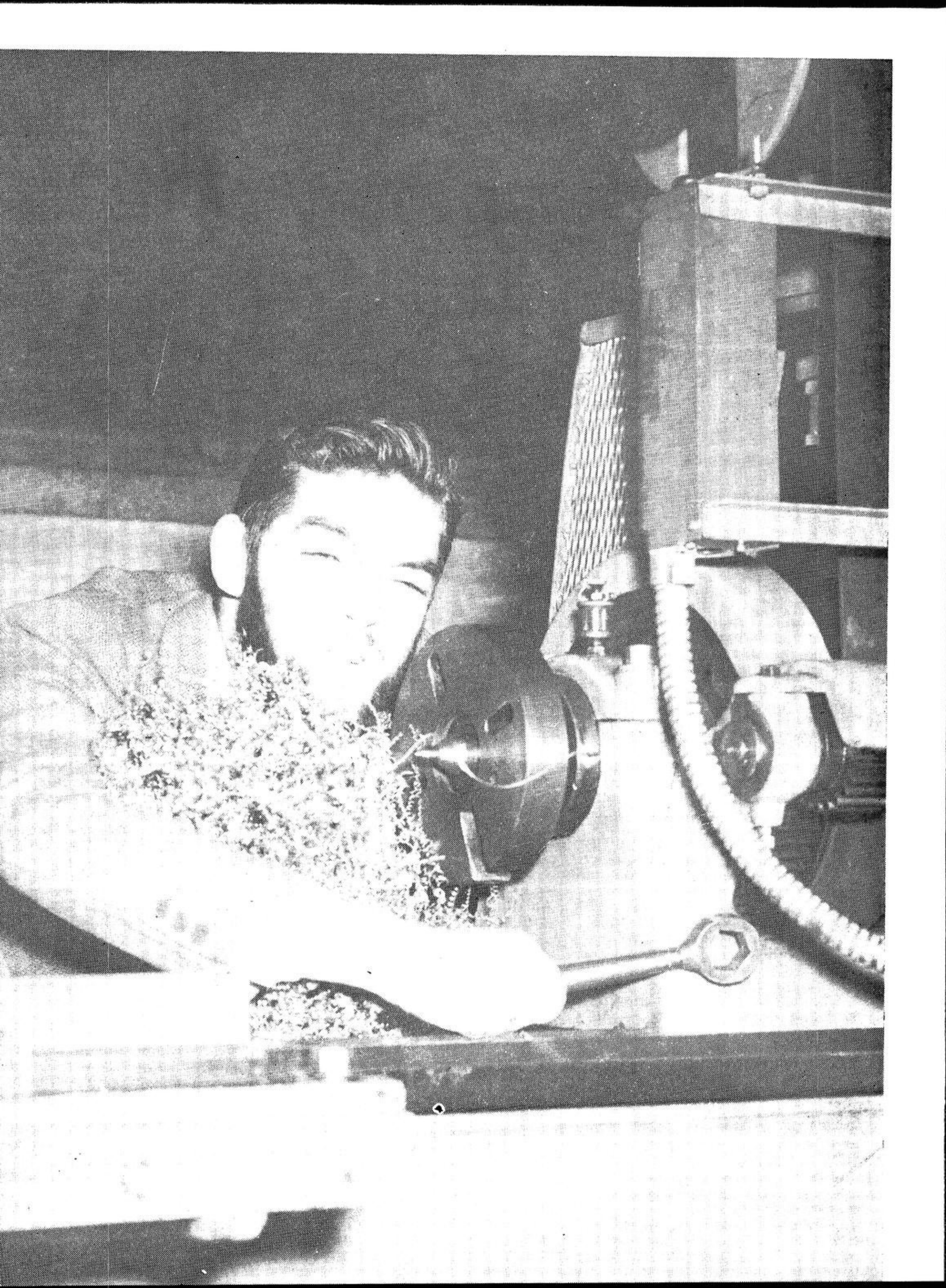
The Wisconsin

Engineer

March, 1950



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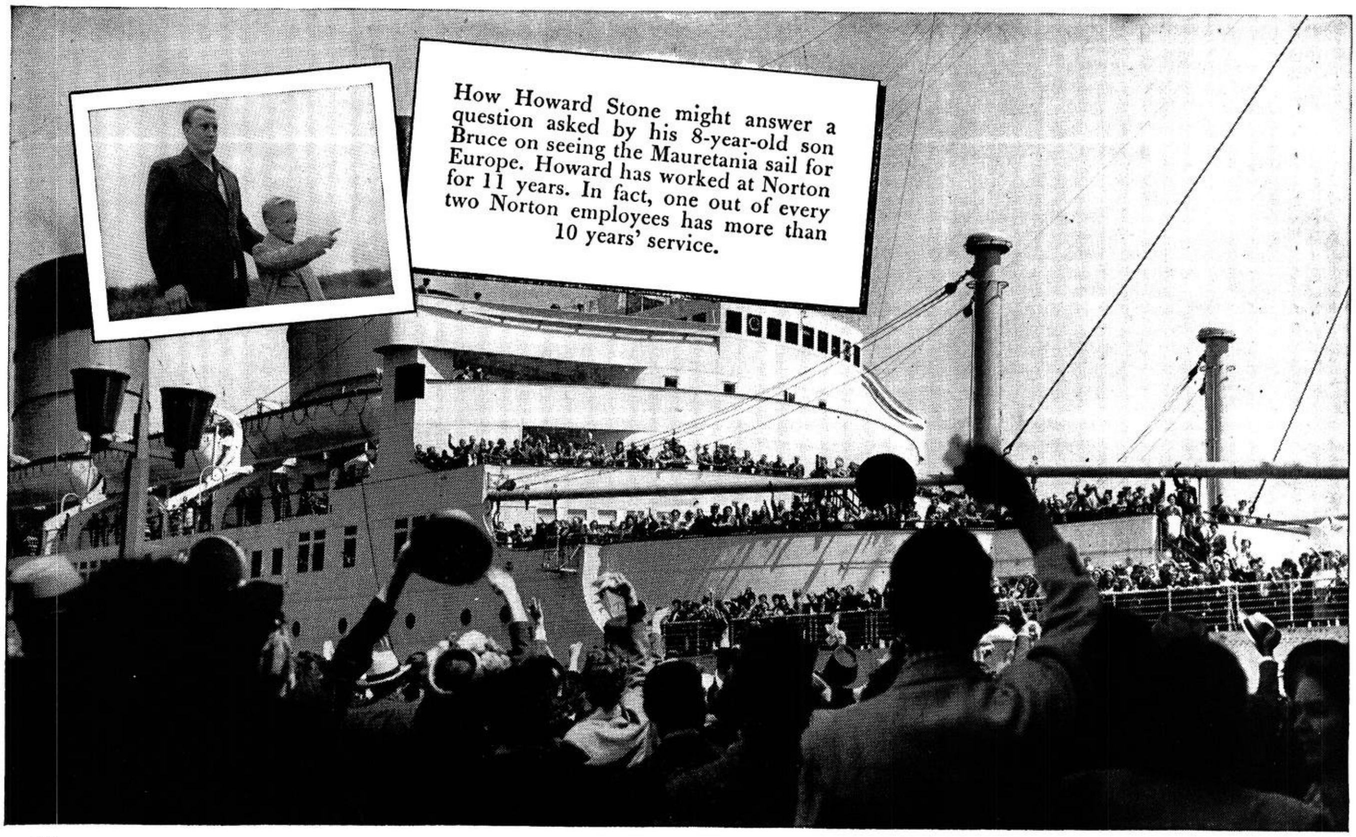
UNITED STATES STEEL



"HOW BIG DO THEY MAKE SHIPS, DAD?"

"Almost no limit, son, as long as the men who design and build them continue to take advantage of scientific progress in all the things that make ships strong, fast and safe.

"Things like the ship's steel plates. They must be just right. That's why the powerful rolls that form them in steel mills are kept smooth and true with big Norton roll grinders and fast-cutting Norton grinding wheels.

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WISCONSIN ENGINEER

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Volume 54 MARCH, 1950 *Number 6*

In This Issue . . .

Cover:

Growing a beard is not all milk and honey, as evidenced by this engineer who caught his beard in a lathe.

(Foton Foto)

Articles:

Departments:

THE WISCONSIN ENGINEER

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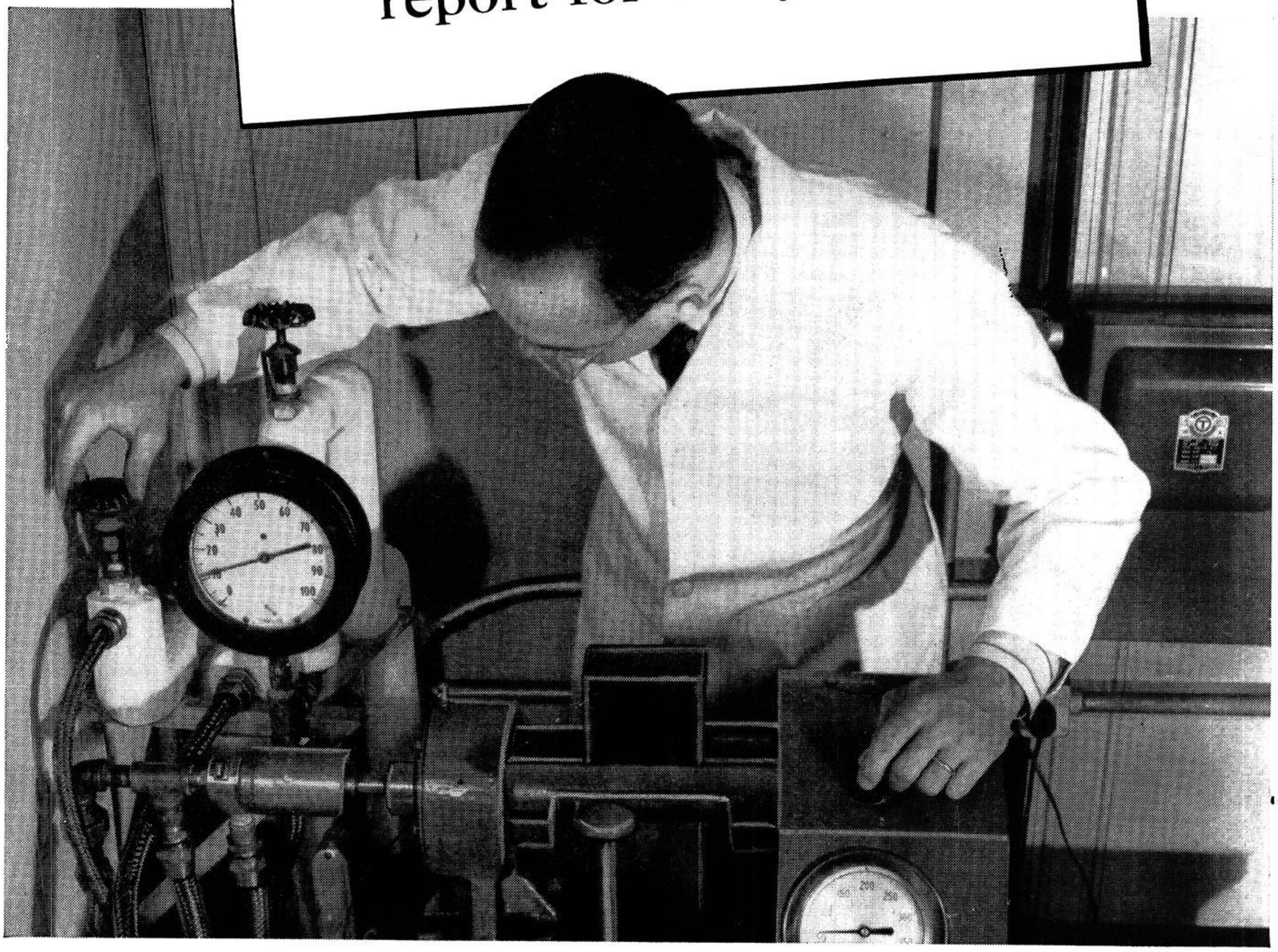
We have good news to report for the journals



SOME JOURNALS are technical publications. Some journals are the parts of rotating shafts that turn in bearings.

For both kinds of journals, there's good news in Standard Oil's performance testing program. One result is a new testing device for mill and locomotive driving-journal grease that enables us to tell more accurately than ever before what our greases will do under actual conditions of use. That, in turn, enables us to proceed more directly with the job of making our greases still better.

Standard Oil took the lead in performance testing, and is a leader today. During the war our tests furnished information that enabled the Army to procure certain products with greatly increased reliability of performance. Some of our tests have become a part of government specifications. Many users of our products are benefiting, both from better products and from more accurate information.

As time goes on, we are doing more and more performance testing. In some cases, we have to develop not only the tests but also the testing equipment. But to Standard Oil researchers and engineers, any effort is worth while if it will help make better, more useful petroleum products.

Standard Oil Company
(INDIANA)

STANDARD

The days when St. Patrick's Day meant egg battles, bruises, and bloody noses as the traditional rivalry between the engineers and the lawyers broke out in open combat.

Erin Go Bragh!

St. Pat's Days

Parades, Eggs, Bruises

by Fritz Kohli e'50

The long awaited Saint Patrick's Day is close at hand; after months of cultivation, the 1950 crop of beards is about to be harvested. Everyone is anxiously awaiting the outcome of 17 hectic days of campaigning by the St. Pat candidates. The rivalry between the five engineering schools has not always been as manifest as in recent years. In the past, the energy of the engineers has been, on many occasions, directed along entirely different lines. It all began with an "archeological" discovery—

Way back in the distant past, the year 1912 to be exact, a number of enterprising Wisconsin engineering students unearthed an odd looking stone bearing a strange inscription. Investigation revealed that, at the University of Missouri, a group of engineering students under the name of The Guard of Saint Patrick had been parading a similarly marked stone annually since 1903, claiming that it was the original Blarney Stone.

Careful study of their recent find led the engineers at Wisconsin to conclude that their stone was actually the original Blarney Stone, the one uncovered at Missouri being merely a very accurate facsimile. The strange inscription had been already determined by a Missouri crytologist as reading "Erin Go Bragh", a broad translation of this being, "Saint Patrick Was An Engineer."

Realizing that their recent discovery should be properly displayed, the engineers of Wisconsin formed their own "Guard of Saint Patrick" and, on St. Patrick's Day, placed the Blarney Stone in an open coach drawn by four white horses and marched up State Street to display their treasure to the city of Madison. In the immediately ensuing years, further research proved that St. Patrick was the original engineer, having, in ridding the "Emerald Isle" of snakes, performed the first feat of modern engineering by inventing the first "worm drive."

By the year 1920, the custom of choosing one of their number to represent Saint Patrick during their celebration in honor of his birthday had arisen among the engineers. The patronship of St. Pat was beginning to be challenged by a few lawyers at this time, but their voices were few and weak. In this same year a monster parade was held on St. Patrick's Day, led by a forty-piece band followed by the snake, St. Pat himself, the Blarney Stone, and many floats displaying relics of the era of St. Patrick, including the "wrench that screwed the lawyers off the bench."

The St. Patrick's Day parade of 1921 was even more elaborate than that of the year before, and the homage to St. Patrick reached a new height in pageantry. The event had, by this time, become firmly established as a tradition on the campus.

However, the ominous forerunner of events to come occurred in the eventful year of 1923. In addition to a libel suit brought against the A.S.C.E. by a local dance hall proprietor because of a panning given his establishment by the society, an open act of war was committed by a group of lawyers. Shortly before the start of the St. Patrick's Day parade, they kidnapped St. Pat and carried him off to Middleton. Undismayed by this flagrant act of hostility, the "Guard of Saint Patrick" secured a substitute and carried on a successful parade.

Although determined to keep peace on the campus, the engineers were forced to retaliate against the lawyers in the year 1925. For when the parade of that year had proceeded about half way down State Street it was met by a barrage of rotten eggs hurled from the roof-tops of the business places along the line of march. This was too much. The buildings were immediately scaled by hordes of angry engineers and the attackers dispersed. In retaliation, the engineers attacked a law fraternity on Langdon Street, using the same type of ammunition which had recently been hurled at them.

Relative peace reigned on the campus by means of successive peace pacts negotiated between the engineers and the lawyers for twelve years, broken only by minor incidents such as that of 1933. A few engineers had neatly sealed up the "little red asylum across the way" by means of a padlock and chain containing a soft lead link which could have been easily pulled apart by hand. The entire collection of great legal minds was prevented from entering their institution until a janitor sawed through one of the steel links.

Full scale warfare broke out between the lawyers and engineers during the parade of 1937. The parade started up Langdon Street and was met by a deluge of water and a barrage of bad eggs directed at it from the armory. After an extended skirmish, the parade proceeded on its way up Langdon Street, during which time the marchers were harassed by sporadic sniping from the sidelines. Having hastily rounded up a supply of ammunition after the armory incident, the engineers were able to dispatch the snipers amid salvos of well aimed hen fruit. As the parade wound its way around the capitol square, it was again attacked by a sizable force of lawyers. The inevitable result was a pitched battle on the capitol lawn which was finally broken up by detachments of "Madison's finest." Determined to carry out their parade as scheduled, the "Guard of Saint Patrick" proceéded down State Street under constant fire from the roof-tops. A final pitched battle was fought when the lawyers attacked from behind Kiekhofer's Wall. All efforts to break up the fight were to no avail until the supplies of ammunition were completely exhausted on both sides.

It was becoming increasingly apparent that the forces of the lawyers were being supplemented each year by more and more outsiders, including many Madison high school students. In the near riot which occurred during the 1938 parade, everyone who was spoiling for a fight or had the urge for a bit of vandalism joined in the fracas.

After their experience of the year before, the engineers were armed and ready for battle at the outset. The parade was delayed an hour and a half by Madison police in hope of dampening the enthusiasm of the prospective combatants. The impatient leaders finally pushed their way forward and the parade rolled up Langdon Street. It was first met by bags of water hurled from the upper floors of Langdon Hall, and was subjected to a constant barrage of eggs along the entire length of Langdon Street. Countless individual battles were fought along the parade route, resulting in scores of black eyes and bloody noses. Fearing a repetition of the damage done to the capitol lawn the year before, the police routed the parade directly down State Street without circumventing the square. The march down State Street went down in history as the worst brawl ever witnessed, barring none. In the wake of the parade was an almost unbelievable litter of splattered pungent eggs, garbage, and all kinds of miscellaneous refuse. As a final gesture, the lawyers raided the Engineering Building, leaving the place strewn with broken glass and dumped waste baskets. The lower hall was covered with water six inches deep when the attackers were repelled with fire hoses manned by the defending engineers.

The violence of 1938 brought about considerable discussion of ending the annual parades. However, it was decided to attempt one more parade with every effort made to prevent any further acts of vandalism. These efforts to maintain the peace were successful, only one incident occurring during the final parade in 1939. As the parade passed Langdon Hall the co-ed residents again hurled bags of water at the marchers. Unfortunately, as the fighting died out, so did the interest in the event. After twenty-eight years, the annual Saint Patrick's Day parade was abandoned in favor of the Engineering Exposition.

The Engineering Exposition which was first attempted in 1940 was an undertaking of considerable proportions, and an extremely commendable effort in contrast to the parades of the immediately preceding years. The exposition lasted three days and consisted of formal programs and exhibits of engineering projects built by students, and many exhibits presented by industrial concerns. The exhibits completely covered the first three floors of the Mechanical Engineering building and a considerable portion of the Mining building. In order to cover the initial expenses of the undertaking, all the organizations partici-

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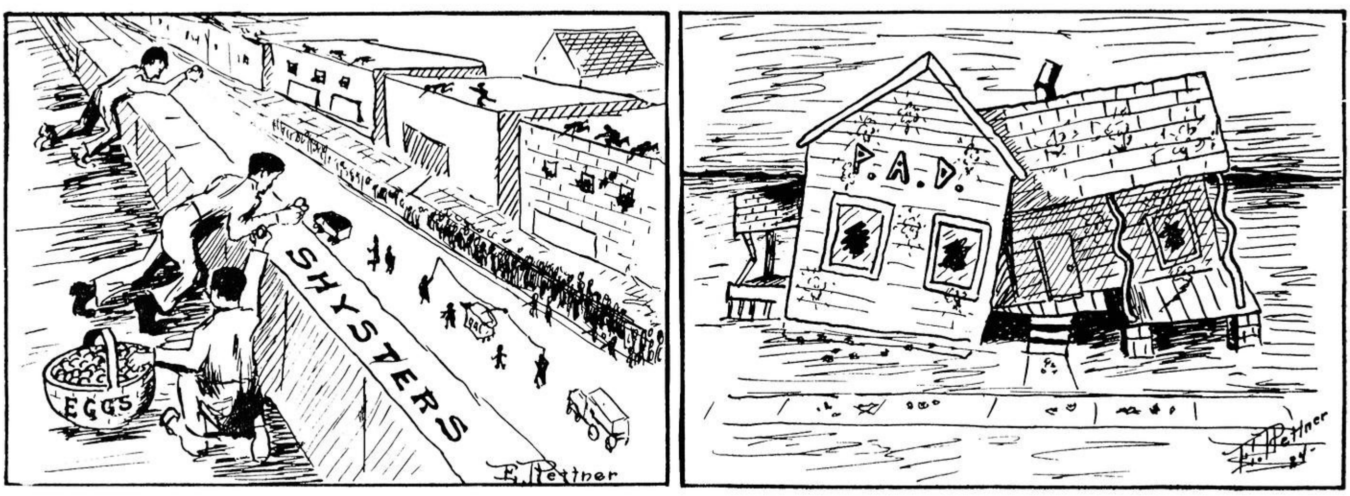

Incidents from St. Patrick's Days of by-gone days. Bombardment of the parading "plumbers" by the "shysters" from the roofs along State Street; and the P.A.D. fraternity house, home of the "shysters'" ring-leaders, in shambles after a retaliation raid by the engineers. The house was literally knocked off its foundation.

Part Two

Lay That Sliderule Down!

by Paul Grogan, me instr.

Continuing a series of articles begun in the last issue. Part three, which we hope to print in the next issue, is entitled "Fun with Primes, or, Life Can Begin Before Forty."

FUN WITH RECIPROCALS (Or, Putting One Over)

Often the solution of a problem will resolve itself to the reciprocal of a certain number. In mathematical subjects it is common to leave the expression in that form, which is of course the exact answer. In engineering problems, however, the decimal fraction form of answer is generally preferred despite the fact that some of the "exactness" might be lost in the conventional three or four significant figures in the answer.

The decimal equivalent of all integer fractions fall into two classes. They are either exact decimal fractions which may be expressed in a finite number of places, or they are never-ending decimals which invariably settle down to the endless repetition of a certain sequence of one or more integers.

$$1/16 = 0.0625.$$
$$1/125 = 0.008.$$
$$1/4096 = 0.000244140625.$$

The exact decimal fractions are relatively uncommon. They stem from just those denominators which contain no prime factors other than two and five.

Some never-ending decimal fractions which repeat the same integer, after one or more decimal places, are:

$$1/3 = 0.333333333\ldots..$$
$$1/45 = 0.022222222\ldots..$$
$$1/576 = 0.001736111\ldots..$$

These decimal fractions appear only if the integer 3 is one of the prime factors of the denominator. However, every denominator containing a factor of three does not necessarily yield a constantly repeating single integer as in the examples above.

Another form of never-ending decimal fraction repeats a certain small group of integers.

$$1/11 = 0.09\ 09\ 09\ 09\ 09\ldots\ldots.$$
$$3/22 = 0.136\ 36\ 36\ 36\ 36\ldots\ldots.$$

More interesting, however, are the never-ending decimals which repeat a somewhat lengthy sequence of integers over and over again. We have reference to decimals of the form:

$$1/7 = 0.142857\ 142857\ 142857\ 142857\ 142857\ 142857$$
$$1/13 = 0.076923\ 076923\ 076923\ 076923\ 076923\ 076923$$

These decimal fractions are particularly unusual. They appear as the reciprocal of a prime number. The preceding statement may be challenged as not applying to the instances of 2, 3, 5, and 11, but it has been found to be true for every other instance investigated by the writer.

Another property exhibited by these repeating decimals is that the fraction begins to repeat itself in the nth place in the example 1/n, providing n is a prime number other than the four exceptions noted above. The decimal fraction 1/13 repeats itself in the thirteenth place, the "double frequency" notwithstanding. Similarly, the decimal fractions representing 1/17 and 1/19 repeat themselves in the seventeenth and nineteenth places, respectively.

So far as is known, the interval of the cycle always involves an even number of decimal places. In fact, this would appear to be a condition imposed upon them by meeting the requirement of repeating in the nth place, where n must necessarily be an odd number if it is to be a prime number.

Having established that these cyclic groups always contain an even number of digits, we may break them equally about the mid-point and demonstrate another property which we shall call "being complementary with respect to nine about the mid-point." For the decimal fraction representing 1/7, we call your attention to the two parts, 142 and 857. The sum of these two parts is 999. The six-figure group which repeats in the instance of 1/13 breaks down to the two parts, 076 and 923. Again, they add to 999. The same may be said for the reciprocals of 17 and 19 which appeal below with the second half of the sequence arranged under the first half.

$$(1/17)\quad \begin{array}{r} 05882352 \\ 94117657 \\ \hline 99999999 \end{array} \qquad (1/19)\quad \begin{array}{r} 052631578 \\ 947368421 \\ \hline 999999999 \end{array}$$

This feature, when put to work, makes it possible to find the last $\dfrac{(n-1)}{2}$ places of the decimal sequence for the prime number n simply by inspection.

From the foregoing it is hoped that a little interest has been aroused which will cause the reader to familiarize himself with the first dozen reciprocals. From a few, a great many others can be found. For instance, the reciprocal of 15 is no more than one-third of the reciprocal of 5. We readily establish 1/15 as being 0.06666......

Similarly,

$$\frac{1}{14} = \left(\frac{1}{2}\right)\left(\frac{1}{7}\right) = \frac{0.142857\ 142857}{2}$$
$$= 0.07\ 142857\ \ldots$$

$$\frac{1}{18} = \left(\frac{1}{2}\right)\left(\frac{1}{9}\right) = \frac{0.1111111111}{2}$$
$$= 0.055555555\ \ldots$$

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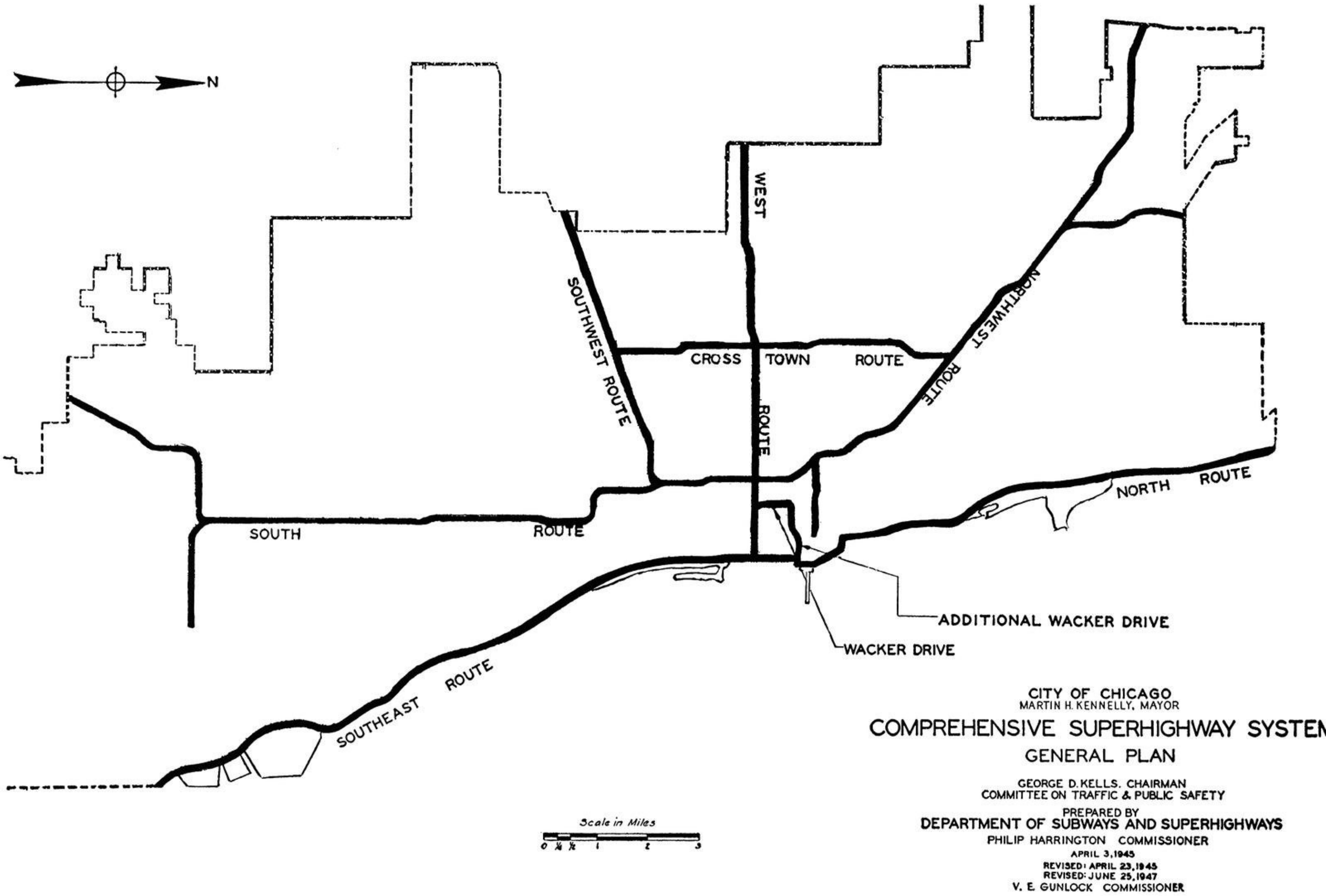


The proposed Chicago expressway plan. All except the Lake Shore road remains to be built.

The Chicago Superhighway Plan

by Harry Bridwell c'51

Nearly every major city in the country is today faced with a growing traffic problem. With the number of cars on the road increasing every year many cities are finding it more and more difficult to accommodate traffic over existing facilities. Coupled with this the rapid development of outlying suburban areas is the necessity to provide more rapid means of automobile access to the downtown districts. The number of persons driving to and from work have added to the problem by creating greater rush hour traffic snarls than ever before.

There is not one general solution which will work for every city, as each city has its own problem. Many cities have already done a great deal to remedy the situation by constructing better and safer roads, and by utilizing

Traffic jams on the outer drive in Chicago. An extension to the drive is planned to alleviate this condition.

more efficient traffic control methods.

The best solution is a far reaching coordinated plan embracing the entire city and environs, and tied in with the general city plan if one exists. A number of cities have adopted such plans, among which is the city of Chicago. Although the Chicago plan is, of course, a particular solution it contains many features which are common to the best plans everywhere. Therefore, by examining this plan, a better understanding will be gained of all such plans.

As indicated on the accompanying map the various sections of the city are to be served by expressways, starting at the city limits and converging near the Loop. In addition the cross-town route is planned to facilitate traffic flow between the northwestern and southwestern portions of the city. Already under construction is the Edens branch of the northwest route which will connect with the road to Milwaukee, thereby facilitating the trip between the two cities.

The expressways which are planned may vary somewhat, but in general they will consist of two forty-eight foot traffic lanes separated by a twenty-four foot parkway. The existing street or the new service roads will lie on each side and will be separated from the main roads by parkways of variable width. A typical cross section is shown for a depressed section of road.

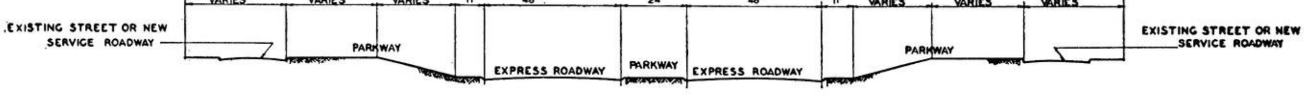
The forty-eight foot roadway will be divided into four twelve foot lanes, a generous size when it is considered that ten foot lanes will allow trucks to pass each other in safety. All cross streets will either be elevated or depressed to eliminate the danger of intersections. Approaches to the expressway will be by means of parallel merging service roads or by the use of cloverleaf systems so that entering or leaving cars will not interfere with the flow of traffic.

When the roads are completed motorists from any section of the city will have quick, easy access to the downtown area. Great volumes of traffic can flow steadily along the expressways at speeds of forty to forty-five miles per hour with increased safety and without time-consuming tie-ups. Compare this with ordinary twenty-five mile per hour, two or four lane city streets with their frequent stop lights and numerous intersections.

The present outer drive in Chicago is an outstanding example of the type of efficient and beautiful expressways which ultimately will serve the entire city. This is an eight lane road running parallel to the lake from Foster Ave. on the north to about 57th Street on the south. Use is made of hydraulic lane separators on portions of the drive north of the loop to facilitate rush hour traffic. Thus during morning rush hours the hydraulic lifts are operated so as to provide six lanes toward town and two lanes away from town while in the evening the arrangement is reversed.

The present outer drive is not without flaws as the accompanying pictures of traffic jams near Foster Ave. at the northern extremity of the drive, indicate. To alleviate this situation, caused by eight lanes of express traffic merging into five lanes at ordinary city speeds, an extension of the drive will be built north to the city limits on a causeway in Lake Michigan.

As time goes on there will be a greater and greater need for the construction of such a comprehensive system of intra-city super roads in many places. What Chicago has done and is planning to do may well serve as an excellent example.



TYPICAL SECTION OF DEPRESSED HIGHWAY

SCALE 0 10 20 40 FEET

THE SCINTILLATION COUNTER

by Robert Gesteland e'52

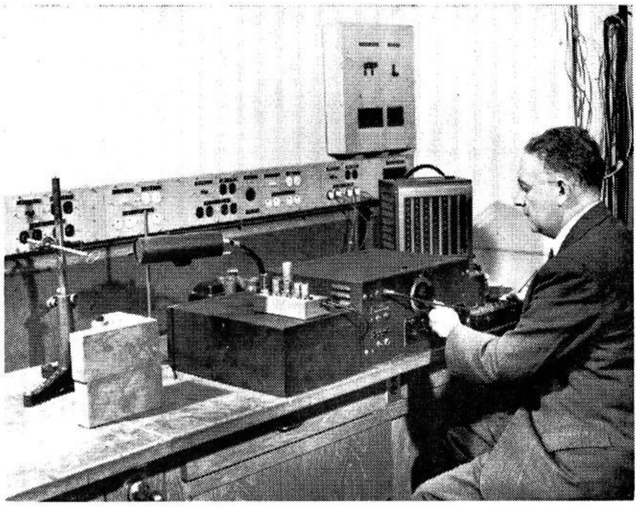
Type 5819 is the designtion of a new multiplier phototube, which far exceeds all previous types, recently developed by Radio Corporation of America engineers. Designed specifically for use in conjunction with a scintillation counter that detects radio activity, it is capable of discriminating radioactive particles arriving less than a 100 millionth of a second apart and multiplying the voltage produced by a factor of one-million.

The scintillation counter, which is fast replacing the Geiger Counter as a means of detecting and counting radiation, is much simpler and more flexible than the latter machine. In the scintillation counter, use is made of the many fluorescent crystals and phosphors which will emit light when activated by a particular type of radiation. All known atomic radiation will activate at least one phosphor or crystal that we have discovered. The fluorescent light emitted from these sensitive compounds when energized is then passed into the multiplier phototube for detection and amplification. The pulses from the tube are then fed to the associated amplifiers and counters to be observed and recorded.

The 5819 tube is especially useful with this type of scintillation counter because it can amplify the signal so much before it is subjected to external circuit losses and distortion. The heart of the tube is a light sensitive photo cathode and a series of ten "dynodes" or amplifier stages, all enclosed in one glass bulb.

The newly developed RCA multiplier phototube, the heart of the counter.

(Photo courtesy RCA)



(Photo courtesy RCA)

Dr. George Morton, RCA Laboratories, operating an experimental scintillation counter.

Dependent entirely on the well known effect of secondary emission, the tube is very efficient and has infinitesimally little inertia to limit the rapidity of its counting rate. As the flash of light caused by a radioactive particle striking the fluorescent screen hits the photocathode of the tube, electrons are released which are electrically focused to the first dynode, where a new shower of electrons is dislodged by each of the impinging electrons from the photocathode. Each of these electrons in turn dislodge more electrons from the second dynode stage, and so on through all ten stages. The number of electrons arriving at the last stage approaches a factor of 106 times as many as were dislodged by the light from the fluorescent screen striking the photocathode.

Other characteristics of the tube also help explain why its announcement has caused such a stir in the radiation research fields. Using suitable phosphors, the new detector is sensitive to all known atomic radiation, including the so-called "soft" radiations such as alpha particles, soft beta rays, and x rays. Detection of these has always been difficult with a Geiger Counter because the glass enclosing the Geiger-Mueller tube absorbs much of the radiation. This meant that the tubes had to be made as thin as possible, making them much more fragile than the scintillation counter, with its sensitive fluorescent screen on the outside of the glass.

In the new tube the photocathode measures one and one-half inches in diameter, providing a much greater sensitized area than previous types of multiplier phototubes. This permits effective collection of light from large area fluorescent screens which can sweep a broad area for the radio-particles.

JOBS in Small Industry

by Charles Manske c'50

After the war, the large pent-up demand for engineers which had developed made it very easy for new graduates to find jobs. But, as we are all aware, the happy days when jobs went begging for engineers to fill them are over. In spite of the fact that jobs are becoming scarce, the enrollment in engineering schools remains high, and this year 58,000 students are expected to graduate from engineering colleges throughout the country. Most of the engineering graduates are absorbed by the larger corporations and by the government. Yet, over half of the total number of manufacturing workers in this country are employed in **small** industry, and ninety-five percent of the total number of industries employ less than four hundred workers. It is not possible to determine how many of these industries are employing or could employ engineers, or in what quantity, but it would seem that there would be many positions for engineers merely by reason of the great number of these companies that exist. Evidently small industry is a market for engineering talent which has not been properly exploited.

Small industry offers outstanding opportunity for individual enterprise. In a small-sized organization an able person with a lot of energy will soon come to the attention of the management, and can work himself into a top position and become very valuable to the company. Employment for the government or in a large concern offers less chance for individual initiative and less personal recognition, advancement, or compensation. But small industry also can offer the opportunity for real participation in management and for at least partial ownership of a company (although it does not always do so, especially if it has become well established). The operations of small industry require the exercise of a great deal of engineering skill and know-how. There is no reason why more such businesses could not be operated or owned by engineers. The compensation received as merely a member of the technical staff of a large corporation would probably be a steady and fairly satisfactory income, but the rewards for ability and hard work as an owner may be truly great.

An engineer employed in a small industry must have more versatility. He must be able to perform a great variety of tasks, and to take on the responsibility of a major division of the company. The increased personal relations and the lessened amount of pure paper work in this type of job appeal to some people. But it is not an easy life. The young engineer in a small company must be patient with the non-engineering aspects of his work. He must be willing to give up certain privileges of working hours and take on more responsibility for the successful operation of the plant. But he generally has more freedom in changing and improving the product, because of the small plant's more flexible economic and engineering structure.

Large companies are generally considered to offer more security of employment, but in hard times the small companies tend to retain their technical men longer, although the company itself is more likely to fail. However, it is not true that large companies are gradually buying out or taking over the business of small industry. The proportion of small plants to the total has remained nearly constant for over half a century. Large and small businesses are not necessarily mutually competitive. They tend to perform different functions. The small concern may be the customer of the large, performing the latter steps in the processing or distribution of a product which would not be economical for the large company to perform. Or the small plant may produce special parts which are purchased by a large company. In general, small companies tend to be producers of specilties in manufacture or in services such as those performed by consulting, contracting, and research engineering firms.

Most small companies want the young engineer to earn his salary as soon as possible, and it is difficult for the engineering graduate without any experience to offer some service that the company needs badly. But as an industry develops from a young enterprise into a mature business it must take on new men to act as understudies for the heads of departments and to fill new positions opened up by expansion. During the pioneering period of a new industry, the perfecting and marketing of the new product opens the way for an ambitious designer or sales engineer. During the next phase of the life of the industry, when the plant is being expanded, there is also opportunity for a good production man or a designer of machines. When the business has matured and become stabilized, management is the important thing, and then the ambitious engineer who has worked his way up through the young company may have a chance to participate in the operation and eventually perhaps the ownership of the means of production.

An engineering graduate who immediately entered the employ of a small company would have to see a great deal to his own training and would have to absorb the training much faster than young engineers working for a large corporation which offers a long course of study and training before entrusting them with any responsi-

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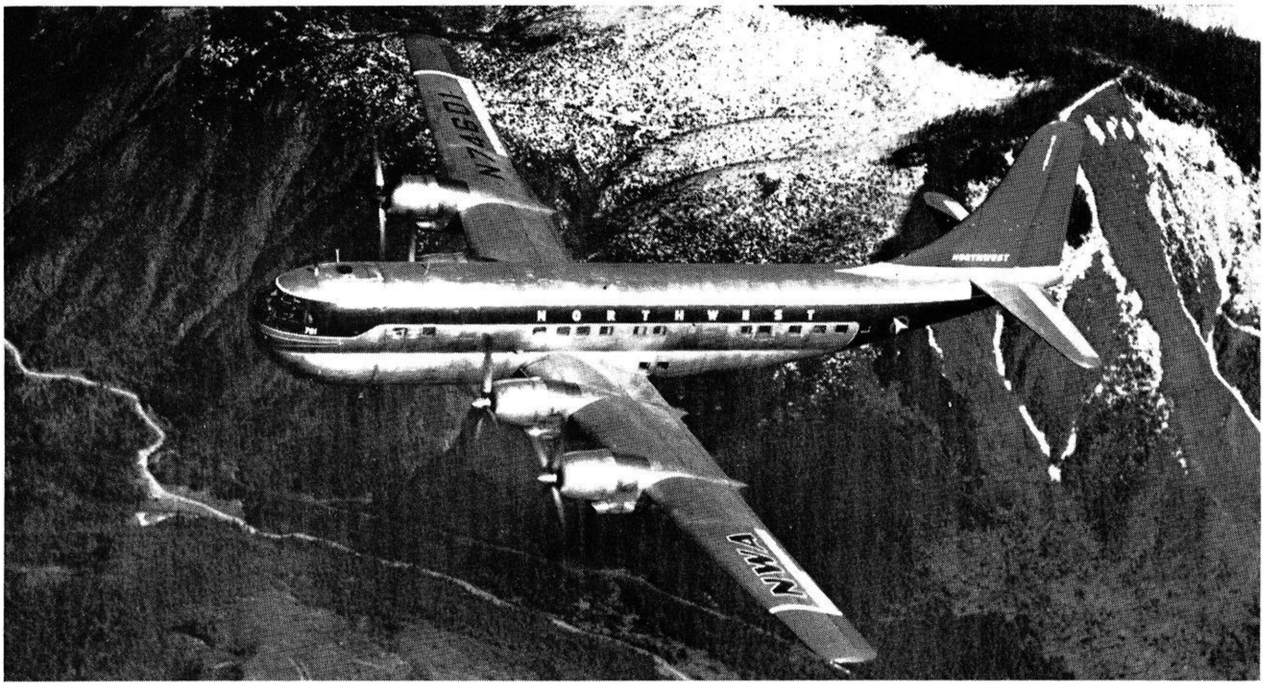
Cruise Control

by Charles White m'50



(Photo courtesy N.W.A.)

Fig. 1. 14,000 HP N.W.A. Boeing Stratocruiser on transcontinental cruise controlled flight.

Long range flights, both over water and trans-continental, are now taken for granted by the general public. Twenty years ago a non-stop flight between Newfoundland and Portugal would have made headlines, yet today our modern four engine commercial air liners are making these trips a routine day's work. If one were to stop and ask someone why these long range flights are possible the answer would probably be, "Why, the modern airplanes are designed to fly distances". This answer would be true in part, but there are two important contributing factors that the average layman does not know exist. These two factors which have opened up the field of long range commercial flying are cruise control and operating curves.

What Is Cruise Control?

Cruise control and the use of operating curves are often thought of as the least glamorous and most academic phase of aircraft operations, and yet no modern long distance flight could be run without an intimate knowledge of both items. Cruise control is nothing more than power control or controlled combustion, so as to gain optimum pwer at minimum cost. Operating or power curves are tools of cruise control and are used in calculating flight plans and in checking engine performance during flight.

The basic principle of cruise control is to obtain as many miles out of each gallon of gasoline as possible and still stay well within the safe operating limits of the aircraft's power plants. To accomplish the most efficient results the operating curves are used to determine the proper settings of the throttle, mixture and propeller controls. A typical operating chart, as used by Eastern Air Lines in the operation of their Lockheed Constellations, is shown in Fig. 2. Cruise control and operating curves may also be used to check performance of an engine that is not delivering the proper power. By proper interpretation of the curves and data obtained from the engine instruments malfunctions may be determined.

A typical cruise control plan is usually set up prior to a flight so that the crew may have a general idea of the power settings to be used and the fuel consumption to be expected. This plan will include information on power settings and fuel consumption rates fort ake-off, climb, cruise and let down. This plan, while not strictly adhered to during the actual flight, does give a basic outline from which to work. The accurate use of the operating curves and cruise control planning comes during the actual flight, when the information may be checked by means of the engine instruments. Once a flight has started the pilots or flight engineers can compute and revise his cruise control plan as the trip progresses. At any time during the flight a crew should know how much fuel has been used, how much is left and the flight time and mileage remaining based on the fuel that has not yet been used. In modern commercial aircraft, the information set up in the cruise control plan, from the operating curves, may be cross checked by the following instruments:

1. Tachometer (engine crankshaft RPM)
2. Manifold pressure gage
3. Altimeters
4. Carburetor intake air temperature
5. Fuel quantity gages
6. Fuel flow meter
7. Torque meters (BMEP)

Fifteen years ago, when the idea of a controlled power plan for a long distance flight was started, a lot of guess work was necessary. In the beginning the engineers and pilots had only the first five instruments listed above to go by, and the fuel quantity gages used at that time were usually little better than no gages at all. During the last few years, however, the addition of fuel flow meters, BMEP gages and accurate fuel quantity gages have taken the guesswork out of the problem and made cruise control a science. Today the modern flight engineer has only to take a quick glance at his instrument panel to check and see if his gages check his calculations on fuel consumption and power being developed.

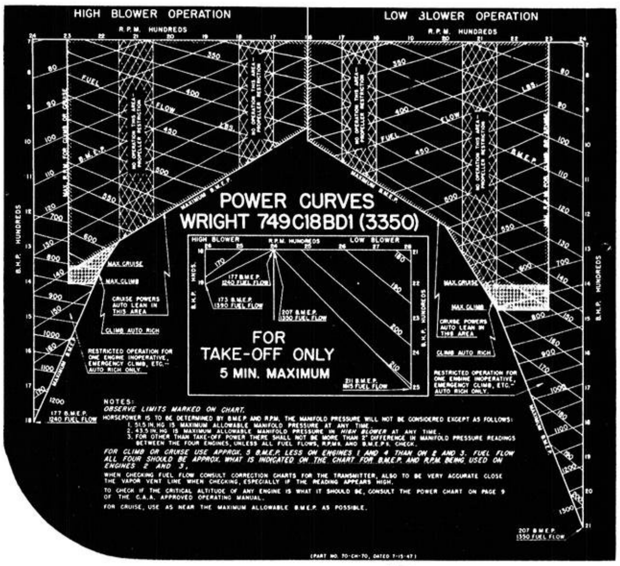
Use of the Operating Curves

The operating chart shown in Fig. 2 is composed of four general sections:

1. Curves covering take-off operations in low or high blower
2. Curves covering low blower operation—except take-off
3. Curves covering high blower operation—except take-off
4. Notes on operating limits and restrictions

The vertical lines represent engine RPM in hundreds and the horizontal lines represent BHP in hundreds. The diagonally slanting lines from the center to the outer edges show BMEP in psi, while those sloping from the outside towards the center show fuel flow in pounds per hour per engine.

A typical example of how the chart could be used is as follows: It is desired by the crew to use 1350 BHP in low blower operation at maximumBMEP. The chart is entered on the right margin of low blower operation at 1350 BHP and followed horizontally till the Max. BMEP line is intersected. This intersection occurs at 2200 RPM and 145 BMEP. The fuel flow, according to the chart, should be approximately 590 lbs./hr./engine or 100 gals./hr./engine.



(*Photo courtesy E.A.L.*)

Fig. 2.

Past History of Cruise Control

The ideas behind cruise control are not new by any means. Such trans-oceanic airlines as Pan American and KLM (Netherland Air Line) have been applying cruise control and operating curves to their operations for many years. These companies and others like them have their flight personnel trained to the point where they can tell within 50 gallons how much gasoline has been used on a 10 hour flight in a four engine aircraft.

During World War II, the Army began to stress the employment of cruise control for their heavy bombardment operations. At the beginning some of the bolder pilots still insisted on flying their own way, but it usually took only one "out-of-gas" crash landing to convert these individuals. The advent of the B-29's made flight crews gasoline conscious and interested in cruise control and use of operating curves. Near the end of the war most of the Army flight engineers were coming as close on their calculations as the commercial crews.

The importance of cruise control has been brought out since the war by the Air Force in their training program. During the last two years or so, each crew in heavy bombardment aviation has had to make what was jokingly referred to as a 4000 mile trip on 3000 miles worth of gas, once every six months. Even though this may be laughed at it is not far from wrong although actual figures can not be obtained for security reasons.

This year will find a greater number of people traveling long distances by air than ever before. The modern religious pilgrims flying from New York to Rome (4273 miles) for the Holy Year celebrations can sit back and relax in complete safety, and rest assured that the crews handling the ship on which they are riding are operating by a carefully planned cruise controlled flight.

Science Highlights

by Donald Miller m'50

HIGH-SPEED MICROTOME

What is believed to be the thinnest slice ever made by man has recently been accomplished by a GE Research Laboratory scientist.

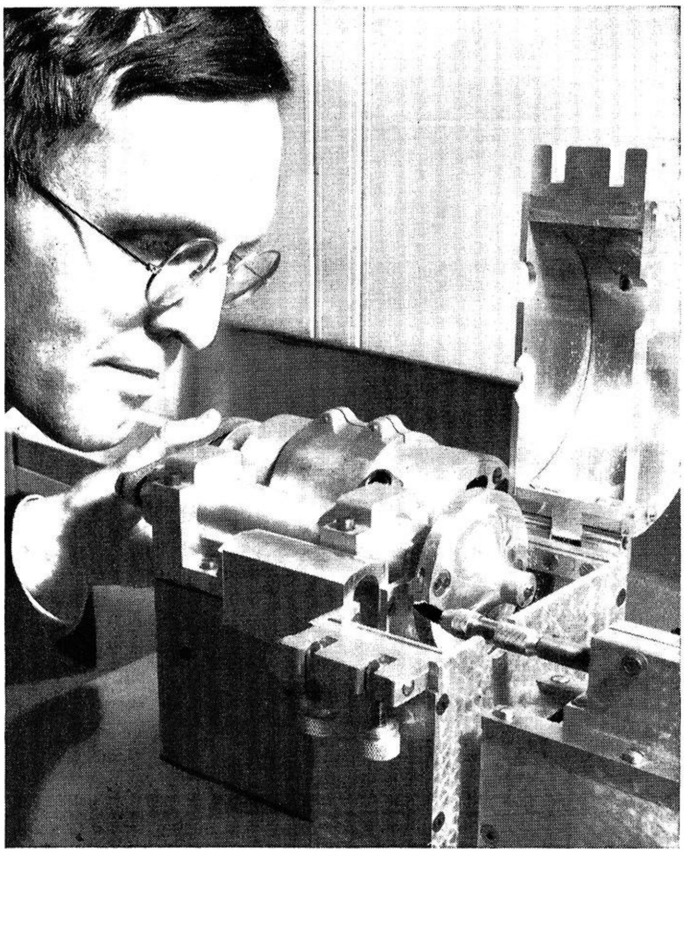
The slice, a piece of metal less than two millionths of an inch thick, was cut by a shock-wave which formed in the sample ahead of a knife-blade moving with the speed of sound. Shock waves are areas of extremely high compression which build up in air or solids in front of objects moving at high speeds.

Using a shock-wave instead of a cutting edge to do the slicing, ultra-thin specimens of everything from delicate animal and plant tissues to teeth and metal have been made. According to theory, conventional slicers which depend upon a keen-edged knife for their thin cuts cannot make slices thinner than one-half of their blade's radius of curvature. To make ultra-thin slices it would be necessary to have a blade with a radius of curvature of two-millionths of an inch, or practically an impossibility.

The new slicing device, called a "high-speed microtome", consists of a delicately-balanced metal wheel, three and three-eighths inches in diameter, spun at 5,000 rpm by a 3 horsepower motor. Projecting one-half inch beyond the wheel's edge is a small steel blade, which is driven through the air at speeds up to 750 miles per hour. A screw device feeds the specimen, usually embedded in wax, into the path of the knife.

Since it is the shock wave which makes the slice ahead of the blade, the inventor claims the blade's sharpness is not of primary importance. In fact, the inventor believes that in theory, slices as thin could be made with a crowbar.

G.E. High-Speed Microtome



QUICK SWITCH

Electric switching equipment capable of halting short circuits in a two and a half million horsepower electric generating station in less than one-twentieth of a second is being built by General Electric Company for the U. S. Bureau of Reclamation.

The equipment, which is being installed at Grand Coulee Dam, will have almost three times the short-circuit interrupting capacity of any switchgear system in use.

Composed of 13 separate switching units, rated at ten million kilo-volt-amperes, the equipment will be used to carry power from 18 generators at Grand Coulee to transmission lines of the Northwest Power Pool.

If a short circuit occurs, the generators could generate almost 25,000 amperes, which would cause extensive damage to equipment. The new switchgear prevents this by cutting off the current in less time than it takes to flick a light switch. It is even possible for a short circuit to occur and correct itself during which time the circuit breakers would open and reclose, the system coming back into normal operation in less than one quarter of a second.

FLUORESCENT PHOSPHORS

More natural complexions under fluorescent lighting is claimed by General Electric scientists for a new phosphor to be used in a new series of fluorescent tubes. This special fluorescent powder, designated as "DR" phosphor, was developed after exhaustive search for a fluorescent powder which would eliminate the color-rendering deficiencies which have characterized fluorescent lamps in the past.

The new line of lamps are of two types named "de luxe cool white" and "de luxe warm white" derived from the fact that the color produces either a cool or a warm atmosphere.

These two new lamps are described as "the most important fluorescent lamp improvement since the introduction of fluorescent lighting in 1938".

The "de luxe" lamps will be preferred for the most part in living areas—the home, restaurants, lounges, club rooms—where it is important that colors and complexions appear at their best, but highest efficiency lighting is not vital. On the other hand, "standard" lamps will be most effective in working areas, such as factories, offices, schools, and most stores, where the need is for high efficiency lighting with reasonable color rendition.

SPEED SKIS

Micarta, the same tough plastic used in Army helmet liners during the war, now promises to enable American ski champions to set new speed records.

A new ski is now being manufactured with bottoms made of Micarta, a laminated plastic developed and produced by Westinghouse Corporation. Micarta has a high gloss and smoothness and is best lubricated by water. For this reason the skis so produced are faster than the finest skis made entirely of hickory.

Micarta is said to be as strong as structural steel for equal weights of cross-section, and adds greatly to the strength of the natural hickory to which it is bonded. The plastic is lighter than aluminum for equal strength. It was the use of Micarta for ship propeller shaft bearings that brought the ski application to light. These bearings are most easily lubricated by water and in this service Micarta gives excellent results.

The Micarta bottomed skis, because of their toughness, need not be sanded, regrooved, refinished or relaquered over years of normal service.

Quartz Fibers in a Balance *(Cut courtesy GE)*

QUARTZ FIBERS

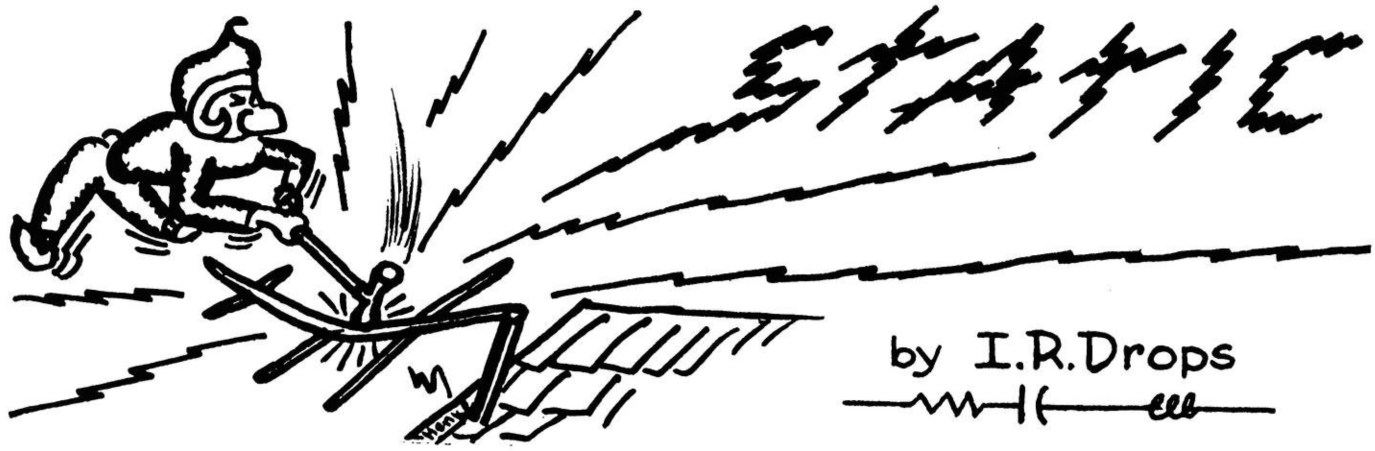
Delicate fibers of quartz, only 1/50th the thickness of a human hair, are being produced by General Electric engineers for use in sensitive balances and various electric measuring intsruments.

Some of the fibers produced are so fine that miles of them could be wound on an ordinary-size spool that holds only 250 yards of common cotton thread.

The threads are almost invisible to the naked eye, appearing somewhat like superfine spider web.

The delicate threads are drawn from the molten ends of quartz rods and attached to a revolving wheel, which winds a continuous fiber. An ancient method of obtaining quartz fibers was to draw a thread from a piece of molten quartz and attach it to the end of an arrow, which

(please turn to page 30)



The bride was extremely embarrassed when she saw twin beds in the hotel room.

"What's the matter, Dear?" asked her husband.

"I thought that we were going to have a room all to ourselves."

* * *

"What a wonderful view," said the explorer as he stepped into the women's shower room by mistake.

* * *

Ch.E.: "You ought to take chloroform."

Lawyer: "Who teaches the course?"

* * *

He fascinated me so I kissed him. Then he started to unfascinate me, so I slapped him.

* * *

Then there was the trapeze artist who caught his wife in the act.

The M.E.'s wife found her husband in a bar, sampled the highball he was drinking, and demanded, "How can you drink such horrible stuff?"

"See," said the husband, "and all the time you thought I was out having fun!"

* * *

Drunk in phone booth: "Number, hell! I want my peanuts."

We understand they are wearing the same things in sweaters this year.

* * *

"In some parts of India a wife can be bought for $2. Isn't that awful!"

"Oh, I don't know; a good wife might be worth it."

(please turn to page 20)

Static

(continued from page 18)

A married man returned home one night at a late hour and, finding difficulty with his equilibrium, made considerable noise in the hallway. Suddenly there was a sound of crashing glass which awakened his wife.

"John," she called, "what's the matter?"

From downstairs came a low mumble, "I'll teach those goldfish to snap at me."

* * *

Little dog, looking at a parking meter: "Heck, you have to pay now."

* * *

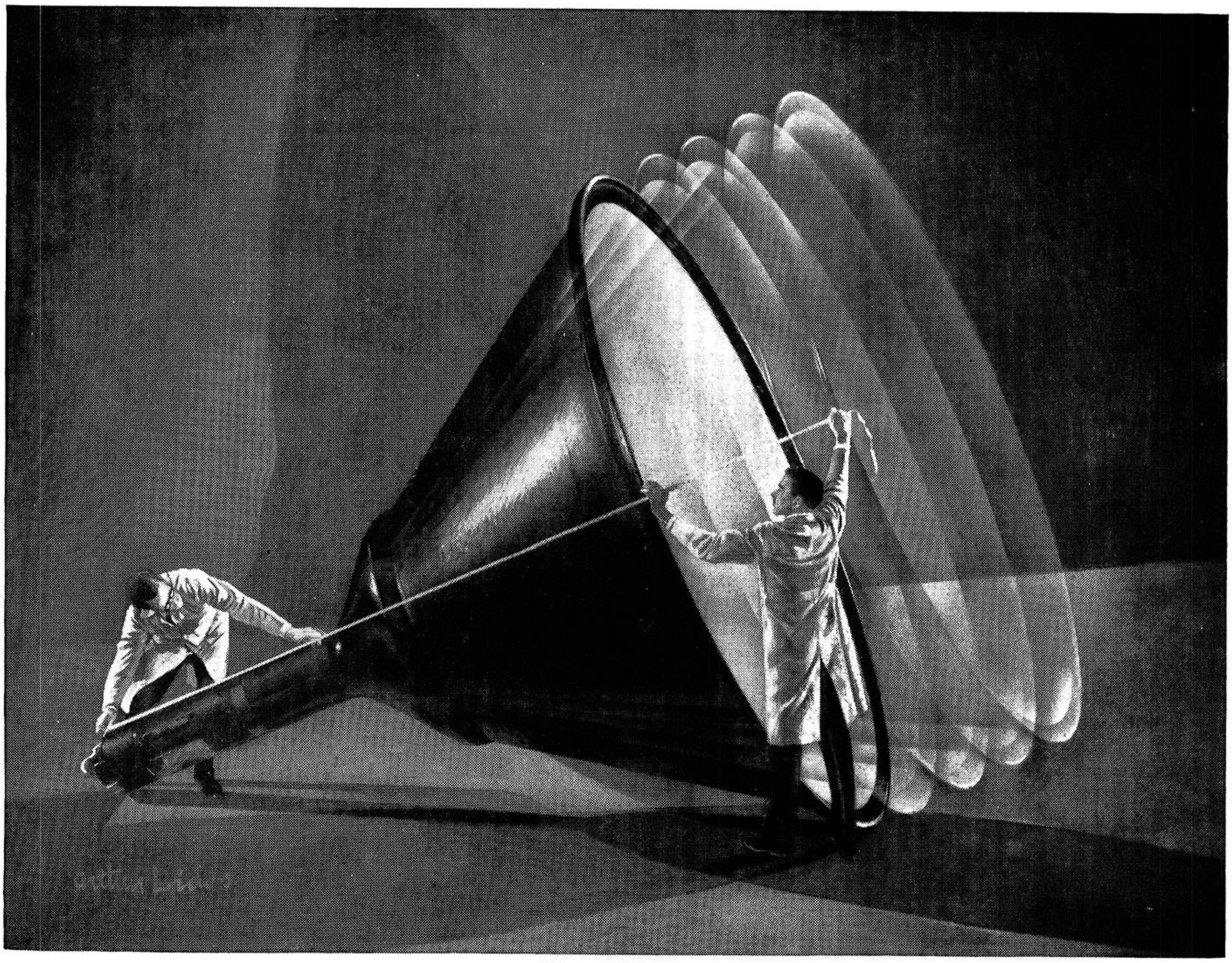
Warning: He who horses around too much will one day find himself a groom.

* * *

On the rolling boat, far out on the white-capped lake, stood a solitary drunk with his gun on his shoulder. Vainly he attempted to bead on the single fast-flying duck passing overhead. Finally, to the keen delight of an observer some distance away, a single shot brought the duck down. As the boat and occupant approached the shore, the following conversation took place:

Observer: "Mighty fine shooting, my good man. I have never seen such fine marksmanship under such adverse conditions."

Drunk: "Waal, outa the whole flock I oughta get a least one."



New and shorter big screen 16-inch kinescope developed by RCA scientists.

ON *the Campus*

by Fritz Kohli e'50

SAE

At the March 1 meeting, a talk, "How European Production and Engineering Look to An American," was presented by Mr. T. L. Swanson, general superintendent of the Ladish Company. Mr. Swanson has traveled extensively in Europe.

Mr. C. N. Bentley, vice-president of Deluxe Products Corporation, is scheduled to speak at the April meeting of SAE. He will talk and give demonstrations on "The Relation of Lubrication and Filtration to Engine Life."

AIEE STUDENT PAPER CONTEST

A cash prize of $10 and an allowance of 7c a mile, one way, to the Great Lakes District Conference of AIEE is offered as first prize in the student branch competition for the best engineering paper submitted by a student member of AIEE. The second prize is $7.50 cash.

The District Conference will be held at Jackson, Michigan, on May 11. The winner of the District contest will be awarded $25 cash and allowance of 9c a mile, one way, and a daily maintenance allowance for the Summer General Meeting at Swampscott, Mass. The second and third prizes are $15 and $10 in cash, respectively.

ASCE STUDENT PAPER CONTEST

The National ASCE is offering a prize of $25 cash and an engraved certificate for the best student paper on the subject, "The Junior Engineer's Idea of His Employer's Ethical Responsibility to Him." The paper is not to exceed 2,000 words, and must be written by a student member of ASCE. One paper only is allowed from each student branch, and that paper must be presented at a branch meeting and then submitted to the Executive Secretary of ASCE before June 1, 1950. The papers are judged by the ASCE committee on professional conduct.

IRE

The student branch of IRE joined with the Madison Section of AIEE in a meeting on March 2. After a dinner meeting in the Memorial Union, the group moved to the Mechanical Engineering building to witness a lecture and demonstration on "Electronic Computors," given by Mr. C. Hoyler, representative of the Radio Corporation of America.

KAPPA ETA KAPPA

The Top-Flight room of the Memorial Union was the scene of Kappa Eta Kappa's spring initiation ceremonies on March 11. The initiates were: John W. Armstrong, Robert B. Beaumont, Delmar D. Desens, William H. Discher, Elmer A. Goetsch, Arthur Howarth, Theodore E. Martin, Howard M. Sanderson, and Norman P. Suplinski.

(please turn to page 32)

The five St. Pat candidates for 1950. Left to right: John F. Atkins, ME; Robert G. Poetsch, EE; Peter O. Kirchhoff, M&M; Robert R. Claypool, CE; and Thomas E. Torphy, ChE.

Electronics GLAMOUR GIRL—OR PRODUCTION WORKER?

by H. A. BARTLING
Manager, Electronics Section
General Machinery Division
ALLIS-CHALMERS MANUFACTURING COMPANY
(*Graduate Training Course 1927*)

Hardening 2200 trimmer blades per hour, this Allis-Chalmers Induction Heater is stepping up production for a Southern manufacturer of textile machinery.

SO MANY near-miracles, actual, experimental or imaginary, are being attributed to electronics that it's quite the glamour girl of the electrical industry.

H. A. BARTLING

Working closely with this infant prodigy, we find it is indeed fascinating and astonishingly versatile. We find, too, that it is a terrific worker. Applying electronic principles to tough, matter-of-fact industrial jobs is the work of this section.

It rewards us with some really amazing success stories, and with abundant opportunity. The field has hardly been touched.

New Field

This field of industrial electronics was completely unknown, of course, when I received my degree in Electrical Engineering from Illinois and entered the Graduate Training Course at Allis-Chalmers in 1925. During the 2-year course I stuck pretty close to electrical work—and at its completion, I was on the electrical test floor helping run tests on some of the first big blooming mill motors the company ever built.

Next, I worked in the Basic Industries Department on electric mine hoists. In 1931, I moved back to the Electrical Department, doing sales application work for the Motor and Generator Section. I worked, successively, on unit sub-stations, had charge of the Mixed Apparatus Section, was in Industrial Sales, handled contract negotiations and sales liaison work during the war, and in 1947 took charge of the company's growing Electronics Section.

Here we develop and apply four main classes of industrial electronic equipment: Rectifiers, Induction Heaters, Dielectric Heaters and Metal Detectors. With the exception of Rectifiers, this equipment is relatively new to industry. We're turning up new uses and applications every day. It's an absorbing line of work, and pioneers an entirely new frontier of industrial methods.

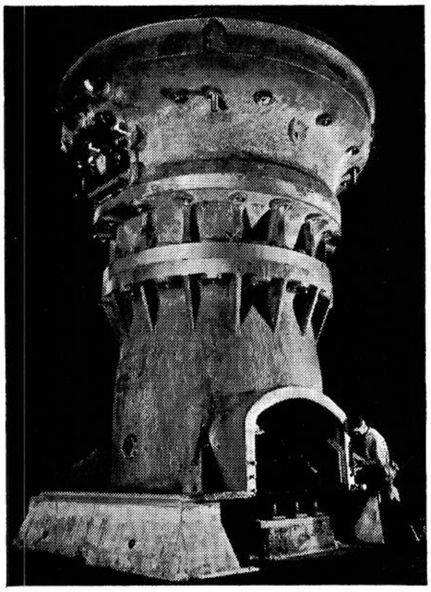
Wide Choice of Interests

I've traced this brief personal history to illustrate the widely varied opportunities a young engineer finds at Allis-Chalmers even within a single field such as electricity. I never got far from the Electrical Department, because I found what I wanted right there. But I wouldn't be giving a true picture of Allis-Chalmers if I didn't touch on the other great departments, covering just about every major industry.

Many GTC students find their greatest interest and opportunity in the Basic Industries Department. There they design, build and install the machinery for mining, smelting, cement making, flour milling, oil extraction, food and chemical processing. Others become interested in hydraulic or steam turbines, the complexities of centrifugal pumps and the engineering problems of small motors or V-belt drives.

Some fit into engineering and design. Some find themselves most interested in manufacturing or in field work such as service and erection. Many like selling, and find their engineering training pays off best in a District Sales Office.

Whatever a man may eventually find most to his liking and advantage, the Allis-Chalmers Graduate Training Course is a wonderful vantage point from which to start. It offers contact with all major industries, and a chance at many types of work: design, manufacture, research, testing, installation, selling, advertising, export. There is no other organization that can offer a graduate engineer such a wide range of activities.



Massive castings for a 60-inch Superior-McCully crusher being assembled in the A-C West Allis plant. Machine will reduce 5-foot boulders to crushed rock—handle 2500 tons of ore per hour!

ALLIS-CHALMERS A-C ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

Alumni Notes

by Hank Williams e'50

C.E.

George H. Stanchfield, ('92), at 81 years of age, is Fond du Lac's oldest municipal employee and holds the position of assistant to the Water Department superintendent. He was first appointed city engineer in 1894 and has served three different terms in that capacity for a total of about 20 years, interspersed with contracting and sales jobs. As a contractor in 1907, he constructed the state's first all-concrete pavement.

Robert C. Johnson, ('17), executive vice president of the Siesel Construction Company, Milwaukee, has been appointed to the Wisconsin Registration Board of Architects and Professional Engineers to fill the vacancy left by the resignation of James L. Ferebee.

William J. Rheingans, ('20), assistant manager of the Allis Chalmers Hydraulics Department, is an authority an cavitation and pitting of hydraulic turbines. He talked recently on this subject to the Milwaukee Section of ASME. Mr. Rheingans holds several patents on improvements of hydraulic machinery and is the author of numerous publications.

Eugene W. Odbert, Jr., ('29), has been appointed director of public works for Portage. For five years he was project superintendent for the National Park Service at Devil's Lake State Park and since 1940 he has been superintendent of maintenance and construction for the city of Sturgeon Bay.

Four out of seven sections of the Wisconsin Society of Professional Engineers have elected University civil engineering graduates as president for 1950. They are:

Southwest Section — **W. S. Cottingham,** ('25), professor of civil engineering at U. of W. Northwest Section — **H. T. Hagestad,** ('32), consulting engineer of River Falls. Fox River Valley Section — **Francis J. Euclide,** ('31), city engineer of Green Bay. Southeast Section — **Frank I. Vilen,** ('31), superintendent of sewage treatment plant at Kenosha.

William S. Boyd, ('49), is junior engineer on construction with Peter Kiewits Sons Company, general contractors on Garrison Dam under construction on the Missouri River at Riverdale, North Dakota, which is about 50 miles south of Minot.

William L. Olsen, ('47), is convalescing in Milwaukee from injuries received on September 23 at Oak Ridge, Tenn., where he was engineer on a job for the Merritt, Chapman and Scott Corporation of New York. A truck, loaded with asphalt, backed over him, breaking his collar bone, six ribs, and his back and puncturing a lung. He was moved to Milwaukee on December 1, after a series of operations at Oak Ridge. He reports that he is getting on fairly well.

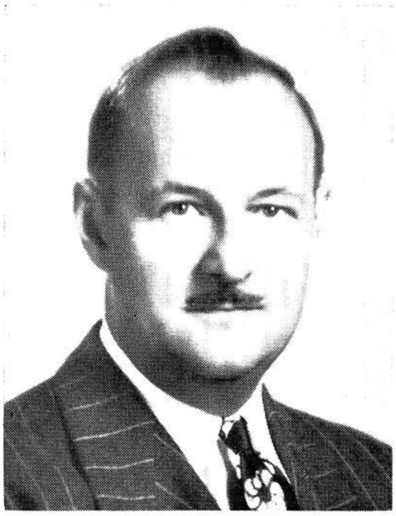
Robert L. Van Hagen, ('32), suffered a crushed right forearm on February 1 at the plant of the Lehon Company at Wilmington, Illinois. The sleeve of his jacket caught in the gears of a new machine that was being installed. Only prompt action in stopping the machine prevented more serious injuries. There is hope that the arm can be saved. During his senior year at the University, Van Hagan was editor of the Wisconsin Engineer.

Spaulding A. Norris, ('37), has been appointed assistant sales managed of the pump division of Yeomans Brothers Co., Chicago, makers of pumps and sewage treatment equipment.

Jane Marie Strosina, ('46), and Arthur J. Schallock, Jr., ('49), were married on February 25 at Milwaukee. Jane has been on the staff of the Milwaukee Center, teaching Curves.

M. & M.E.

G. J. Storatz is engineer in charge of the Road Machinery Division of The Heil Company, Milwaukee. Mr. Storatz will speak on "The Steering of the Rubber Tired, Hi-Speed, Off the Road Earthmoving Units" to an Earthmoving Industry Conference of the SAE in Peoria, Ill., April 11 and 12.

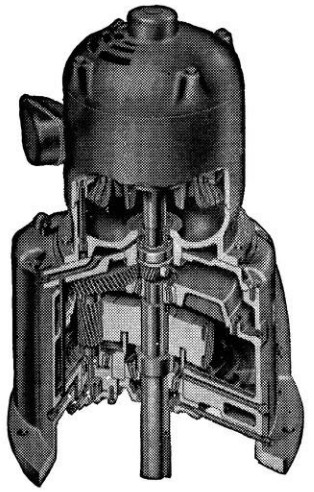


G. J. Storatz

M.E.

Erling J. Bligard, (MS'49), has resigned as instructor in mechanical engineering as of February 1, to take employment with the M. B. Manufacturing Company of New Haven, Conn. Bligard plans to be married July 8. His fiancee is Inez Hefty, a psychology senior from New Glarus, Wisconsin.

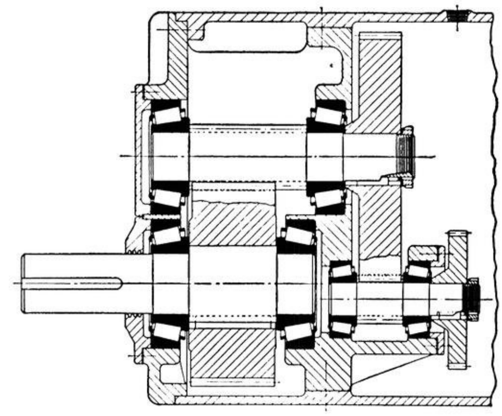
Another page for **YOUR BEARING NOTEBOOK**



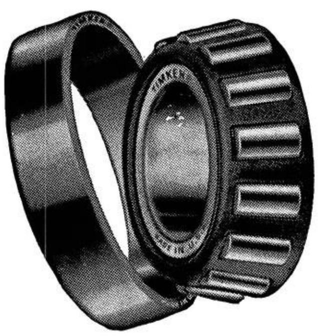
How to help a gearmotor take care of its teeth

To minimize wear on the teeth and to insure smooth, quiet operation, reduction gears in motors like this must be held in perfect mesh, no matter what the load. That's one reason why engineers mount the gear shafts on Timken® tapered roller bearings. Timken bearings hold the shafts in accurate alignment. Gears are kept perfectly positioned, with each tooth meshing smoothly and carrying its full share of the load.

Gears mesh smoothly, wear longer, with shafts on TIMKEN® bearings



Here is a typical gear-case countershaft showing a common method of mounting Timken bearings. Due to the line contact between the rolls and races, Timken bearings give the shaft maximum support. There's less chance of deflection under load. The tapered bearing design takes both radial and thrust loads in any combination. End-movement of the shaft is kept to a minimum. Gears wear longer—work better.



TIMKEN

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

TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

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

Sliderule . . .

(continued from page 9)

Once the key combinations have been established, they often may be applied when expressing decimal fractions where the numerator is an integer other than one. The following sequences are illustrative:

1/14	=	0.07 142857 142857	1/18	=	0.0555555 . . . .
1/7	=	0.142857 142857	1/9	=	0.1111111 . . . .
3/14	=	0.2 142857 142857	1/6	=	0.1666666 . . . .
2/7	=	0.2857 142857	2/9	=	0.2222222 . . . .
5/14	=	0.3 57 142857	5/18	=	0.2777777 . . . .
3/7	=	0.42857 142857	1/3	=	0.3333333 . . . .

Thus, once the repetitive sequence is recognized, the result may be written down to any desired number of places.

A working knowledge of the decimal equivalent of integer fractions may be used to good advantage in a great many instances. We will recall PART I where it was pointed out that the difference between the squares of two consecutive integers is simply the sum of the two integers. Turning the statement around to help us find square roots rather than squares, we might reason that $\sqrt{13}$ lies somewhere between three and four. Being very nearly $\frac{4}{3+4}$, or 4/7, of the interval from three to four. Our experience with decimal fractions would indicate the answer to be closely 3.6. We would not dare to extend the approximation into the third significant figure since our solution method involves only one and two place numbers. The actual root, to five significant figures, is 3.6056.

Another example might be $\sqrt{158}$. This number lies between 12 and 13. We expect it lies nearly $\frac{14}{12+13}$, or 14/25, of the interval toward 13. Expressing three significant figures, the answer is quickly estimated to be 12.6. Attempting to stretch out a fourth significant figure yields 12.56. The actual root is 12.5698.

We sense now that our method results in answers that are consistently low, a fact which can be veried by comparing the actual function of $y = x^2$ between any pair of consecutive integers with the straight-line approximation method we are substituting in its place. The comparison will also reveal that the accuracy improves when bigger numbers are involved.

A corrective, as well as simplifying, step which we may apply when working with larger numbers, such as $\sqrt{927}$, is to assume that (30 + 30) in the fractional denominator is little different than (30 + 31). Hence $\sqrt{927} \cong 30\ 27/60 \cong 30.45$. Actually, to four decimal places, the answer is 30.4467.

Similarly, if we desire the solution of $\sqrt{888}$, we may conclude the number lies closely to 30, but is nearly 12/60 of the interval removed toward 29. Our solution suggests 29.8. 29.7993 is the more exact solution obtained by the actual process of extracting the square root. A typical slide rule answer for the above problem will be no better than the result obtained by the suggested method.

As a general rule, better results will be obtained when working from the perfect square nearest to the number given under the radical. As an example, $\sqrt{96}$ may be estimated as being $9 \times 15/18$, $9 \times 15/19$, $10 - 4/20$, or $10 - 4/19$. The four solutions are, respectively, 9.83, 9.79, 9.80, and 9.79. The actual root is 9.7980. Either method, working from 10, is close.

Having observed that the accuracy of the approximation method improves when working with bigger numbers, we would like to return to the original example of $\sqrt{13}$. Should we be able to extract the square root of 1,300, additional significant figures will be obtained. Being a little familiar with the perfect squares from Part I, we will recall $35^2 = 1{,}225$. And, $36^2 = 1{,}225 + 35 + 36 = 1{,}296$. Thus, $\sqrt{1{,}300} \cong 36\ 2/72 \cong 36\ 1/18 \cong 36{,}0555\ ..$ $\cong 36.056$.

Removing the factor of ten, our solution for the square root of 13 gives 3.6056. This is in agreement with the long-hand answer through four decimal places.

Two other types of reciprocals which can be handled with relative ease after a little practice are those of the form

$$\frac{1}{1-x} \quad \text{and} \quad \frac{1}{1+x}$$

where x is a small number when compared with one.

We may establish the following identities by carrying out the indicated division in each of the fractions above:

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ ....\ + x^n + \ ....$$

$$\frac{1}{1 \times x} = 1 - x + x^2 - x^3 + x^4 + \ ...\ + (-x)^n + \ ....$$

Thus,

$$\frac{1}{0.99} = \frac{1}{1.00 - 0.01} = 1 + 0.01 + 0.0001 + 0.000001 +$$

$$....\frac{1}{0.99} = 1.010101\ ....$$

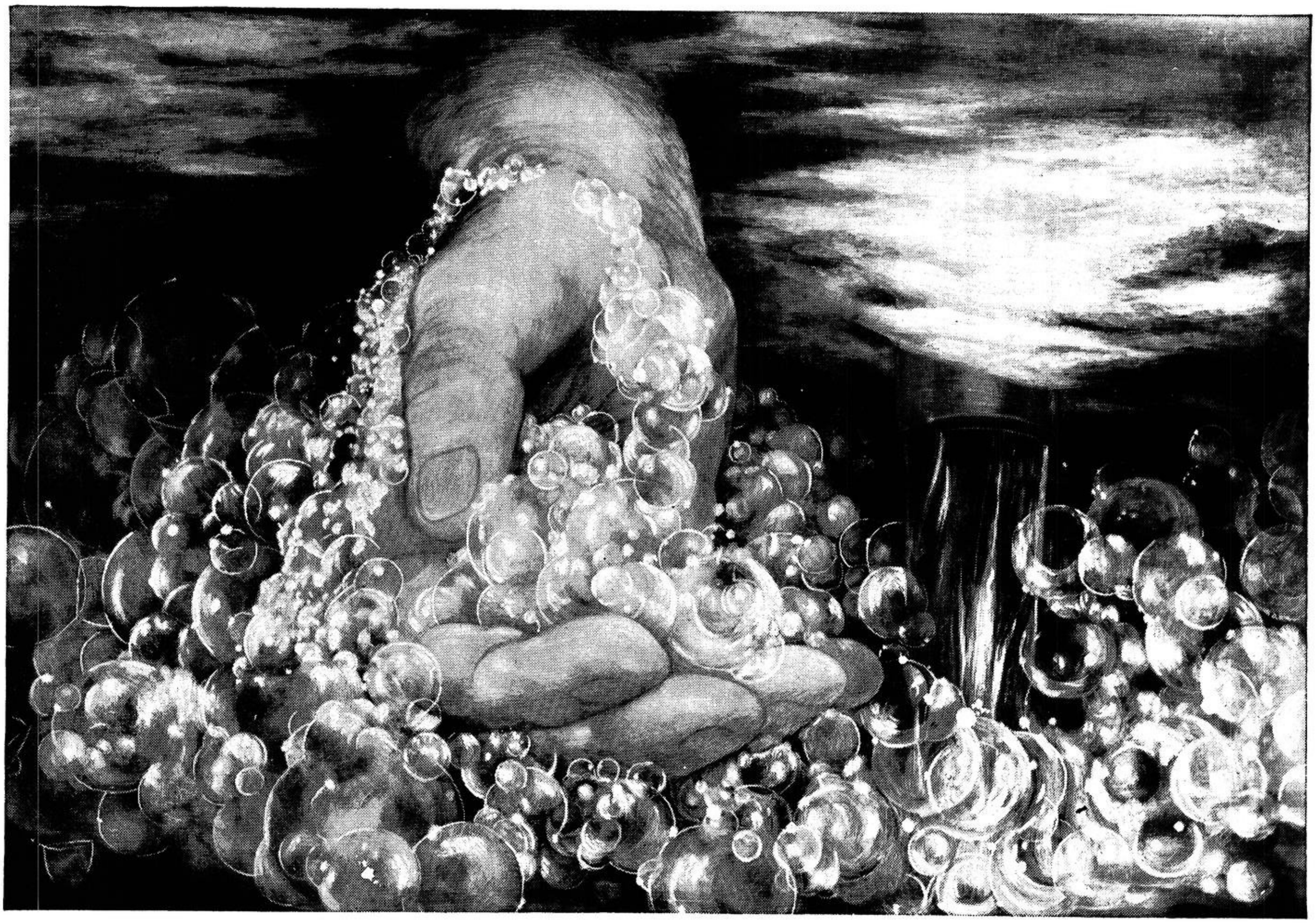
And,

$$\frac{1}{102} = \frac{1}{100} \cdot \frac{1}{1.00 + 0.02} = \frac{1 - 0.02 + 0.0004 - 0.000008}{100}$$

$$....\frac{1}{102} = \frac{0.9804\ ...}{100} = 0.009804\ ....$$

To show the limit of application for the foregoing meth-

(please turn to page 36)



Coming cleaner

SUCH QUICK EASY CLEANING . . . practically no scrubbing . . . no fading of colors . . . no irritation for tender skins—sounds like a new and better soap, doesn't it? But it isn't soap at all!

Now you can have a *modern* cleaner that removes dirt with unbelievable speed, yet is completely mild to the skin and to the sheerest fabrics. Modern cleaners carry the dirt away with them, and form no ring in the dishpan or tub.

These new cleaners are made from organic chemicals. They are scientifically prepared to work equally well in soft, hard, even salt water.

For washing dishes or clothes, for housecleaning, for industrial uses, better cleaners are here right now—and they are improving every day.

Today's modern synthetic detergents are not soaps . . . they are entirely different chemically, and work in a different manner.

The people of Union Carbide have a hand in making many of the organic chemicals that go into these modern, efficient cleaners. Producing better materials for science and industry—to aid in meeting the demand for better things and better performance—is the work of Union Carbide.

FREE: *If you would like to know more about many of the things you use every day, send for the illustrated booklet "Products and Processes." It tells how science and industry use UCC's Alloys, Chemicals, Carbons, Gases, and Plastics. Write for free Booklet A.*

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ACHESON Electrodes • PRESTONE and TREK Anti-Freezes • ELECTROMET Alloys and Metals • HAYNES STELLITE Alloys

Jobs . . .

(*continued from page* 18)

bility. His position would require intelligence, industry, and versatility, but would give him more diversified training, and would offer him the chance to see the relationship between the various departments and to meet and associate with the heads of the departments. His employer would be more aware of his progress and of his ability to fill various positions.

However, it is difficult for an engineer who has just graduated to find a job with a small company. Very few such concerns hire engineers through the placement offices of colleges. Well over seventy-five percent of the engineers who graduate from college find their first employment with large or medium-sized companies. The reputations and advertising of the large companies, coupled with their programs for recruiting and training engineers, enable them to employ all the seniors they want. The personnel officers of the large concerns regularly visit the schools, while few representatives of small companies interview prospects, or even take the trouble to make information about their companies available.

Although the smaller companies are actually able to train young engineers and are a potential place of employment for a large portion of our graduates, they hire relatively few engineers just out of college. Therefore it might be best for most seniors to follow the usual procedure of entering the training program of some relatively large organization. There the graduate could complete his education through study-courses, and by learning technical details, production methods, cooperation, and leadership. This would also give him time to evaluate himself and his opportunities. If his is the type of personality that would be satisfied only by a position of leadership, management, and ownership, and if his present job holds no promise of satisfaction along that line, his best opportunity is probably with a small company. After having been trained in a large company he would probably be in a better position to find openings that might be available in small industry, and would be much better equipped to bargain for and to handle a responsible position than a young and green graduate.

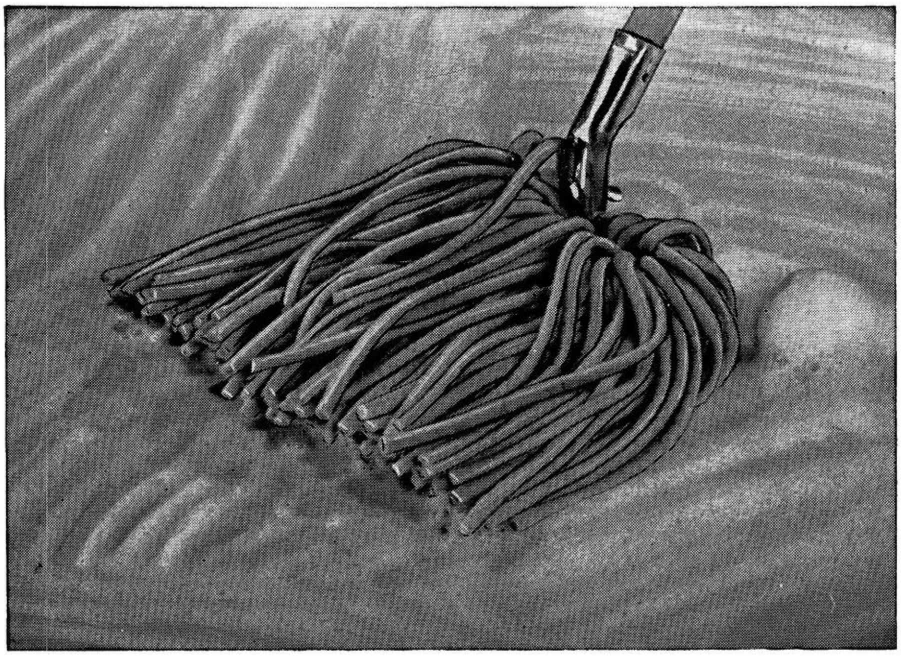
Technical graduates are too prone to take the easiest and most obvious way out by settling down as part of the large staff of a large corporation. They don't want the kind of life that managing or starting a business would require, and they are afraid of failure. The rugged individual who ventures into a small business must be alert in finding new opportunities when his path is barred, and, in spite of all his efforts, so often **does** fail. But after a few failures we find the same individual a successful business man. In small industries and engineering firms there lies the opportunity for many engineers to gain well-paid and responsible positions if they are willig to take the risks and put forth the needed effort to attain them.

THE DU PONT DIGEST

CROSS-SECTION *of the new mop yarn. Each cotton fiber strand is jacketed with cellulose sponge material.*

Science Makes a Better Mop

Cleaning tasks lightened by new Du Pont cellulose sponge yarn



An ordinary mop has a bad habit of unraveling. It often leaves a trail of lint. And it wears out fast. A man who sold yarn to mop manufacturers decided to do something about these nuisances. Perhaps some reinforcing material might be combined with the yarn. He did some experimental work of his own but more and more he wondered if it might be possible to use a cellulose sponge coating.

THREE YEARS OF RESEARCH

So the man called on Du Pont, the company that had introduced the cellulose sponge to America in 1936. The suggestion of a sponge yarn presented a challenging problem.

Some way would have to be found to extrude a tightly fitting cellulose sponge jacket around each strand of the yarn. The whole sponge process would have to be adjusted for use in an especially designed machine. Du Pont chemists and engineers tackled these problems.

Even the very first cellulose sponge yarn produced experimentally made mops that were strong, absorbent and durable. But the process had to be changed and improved time and time again. Then the mops were tested in places where they would get the hardest usage—railroad stations, for example.

The mops performed so well that Du Pont built a pilot plant near Buffalo and, under a license from the man who had the original idea, manufactured the yarn on a small scale. Only after three years of study and testing was Du Pont able to offer mop manufacturers the yarn in commercial quantities.

FASTER AND CLEANER

Mops made with cellulose sponge yarn pick up and retain so much water they need wringing less often. You can mop a floor with them in far less time than it formerly took. They dry quickly, leave no lint. They outwear other mops three to five times. Best of all, perhaps, they stay dirt-free longer than ordinary mops. Here is something women will appreciate—a *clean* mop!

The introduction of these new cleaning tools is another example of how business firms of all sizes depend on each other. The Du Pont Company had facilities for specialized research on cellulose sponge. Because Du Pont could supply sponge yarn economically, some twenty mop manufacturers today have a better product that saves maintenance people and the American housewife time, labor and money.

★ ★ ★

Science . . .

(continued from page 17)

drew a long quartz fiber when the arrow was shot from a bow. The fiber, as it trailed, was cooled by the air.

The quartz fibers produced in the laboratory are used in making sensitive balances for use in microchemistry, in which minute weight differences of less than one thirty-millionth of an ounce are measured. The fibers are strong enough to hold weights one million times greater. They are ideal material for use in measuring instruments, because they are not affected by temperature changes and do not lose elasticity when under continued strain.

METALLURGICAL MOUNTINGS

A simple, inexpensive method for mounting metallurgical specimens at temperatures only slightly above room temperature and without the external use of heat has been developed at the National Bureau of Standards. The technique employs a material which, when mixed in proper proportions, will set under pressure at room temperature.

Several methods have been in use for mounting specimens which are so small that they must be imbedded in another material before they may be polished. However, in all of these methods the specimen has been heated to a high temperature under pressure, which often caused a change in grain structure of the metal. The methods used also required heavy, expensive equipment. The new method uses only an inexpensive mold and a vise.

The mold used consists of a hollow cylinder, which fits into an anvil, and a piston. The specimen and resin are placed in the cylinder and pressure is applied between the anvil and piston. A thermocouple entering the resin through the cylinder wall measures the temperature rise during the reaction.

A block of resin one-eighth of an inch thick requires a temperature rise of only 10°C. As one-eighth of an inch is not very thick, it is possible to fuse this resin to another larger block in the same process.

LAMINATED PLASTICS

Laminated plastics made of sheets of paper or fabric impregnated with resins and bonded together by heat and pressure are seeing greater use. Currently, widespread use is being made of these plastics in the refrigerator and home freezer industry, because of their high impact strengths at low temperatures and their low thermal conductivity. They are also being used in aircraft applications because of their light weight and high strength. In spite of the more recent uses, little is known about their mechanical properties at high and low temperatures.

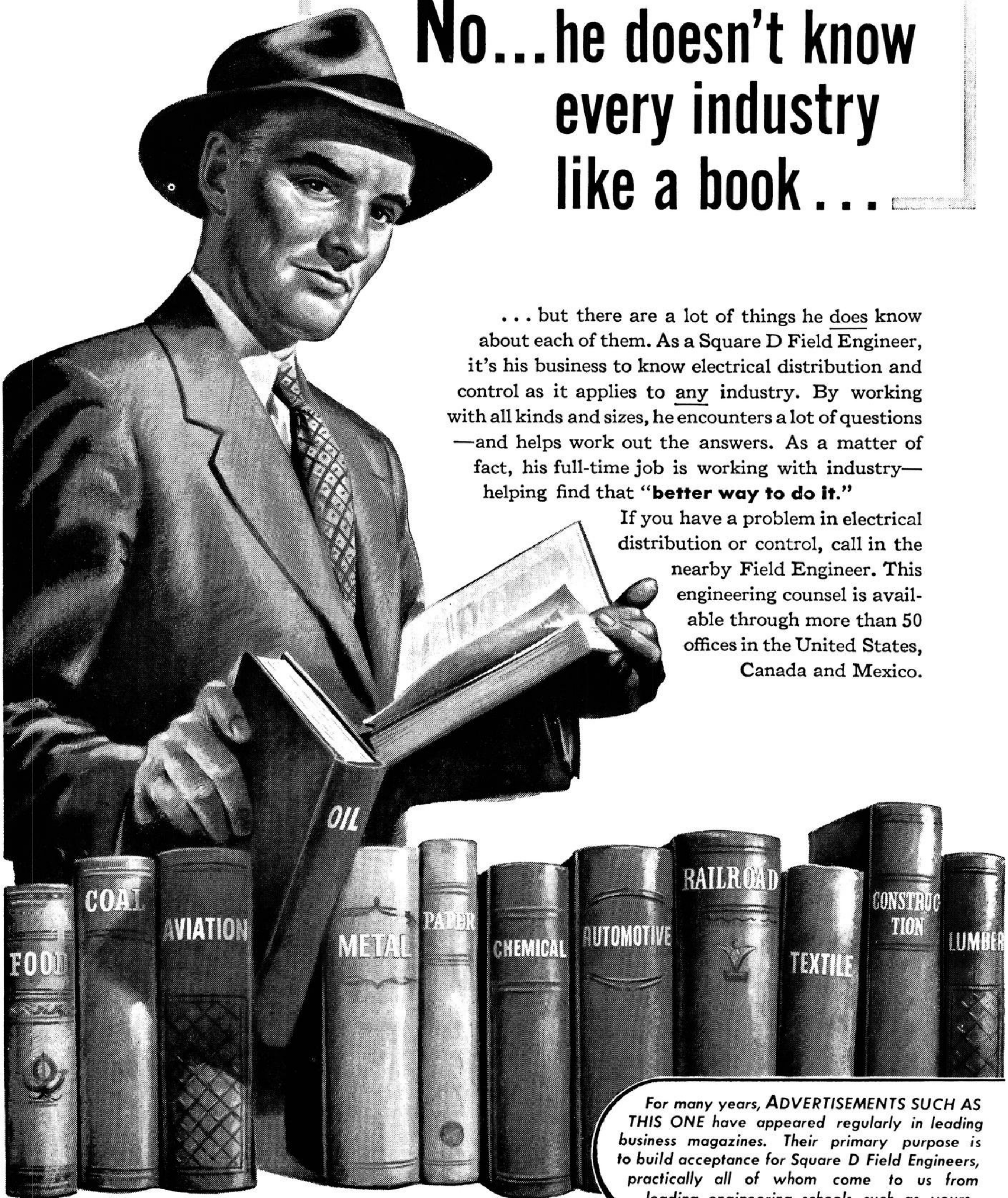
To provide such information, eight representative laminated plastics were tested at extremes of temperature in a project at the National Bureau of Standards sponsored by the National Advisory Committee for Aeronautics. Impact, flexural, tensile, and compressive strengths, and elastic moduli were measured at —70°, 77°, and 200°F. The laminates studied were a glass fabric reinforced polyester resin and phenolic resins reinforced with asbestos fabric, paper, cotton, and rayon fabric.

It was found that the tensile and compressive strengths and moduli of elasticity of all the laminates increased at low temperature and decreased at high temperature. The strengths at 200°F. were only half of those at —70°F.

The impact strength values were much greater for the rayon and glass fabric laminates than for the other materials. The glass laminates showed decreasing impact strength with temperature while the cotton laminates showed increasing strength with increasing temperature. The other laminates showed little variation with temperature.

The flexural properties of the glass and paper laminates were superior. An increase in flexural properties was noted for all samples at low temperatures.

No... he doesn't know every industry like a book...



... but there are a lot of things he does know about each of them. As a Square D Field Engineer, it's his business to know electrical distribution and control as it applies to any industry. By working with all kinds and sizes, he encounters a lot of questions —and helps work out the answers. As a matter of fact, his full-time job is working with industry— helping find that "**better way to do it.**"

If you have a problem in electrical distribution or control, call in the nearby Field Engineer. This engineering counsel is available through more than 50 offices in the United States, Canada and Mexico.

For many years, ADVERTISEMENTS SUCH AS THIS ONE have appeared regularly in leading business magazines. Their primary purpose is to build acceptance for Square D Field Engineers, practically all of whom come to us from leading engineering schools such as yours.

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Campus . . .

(continued from page 22)

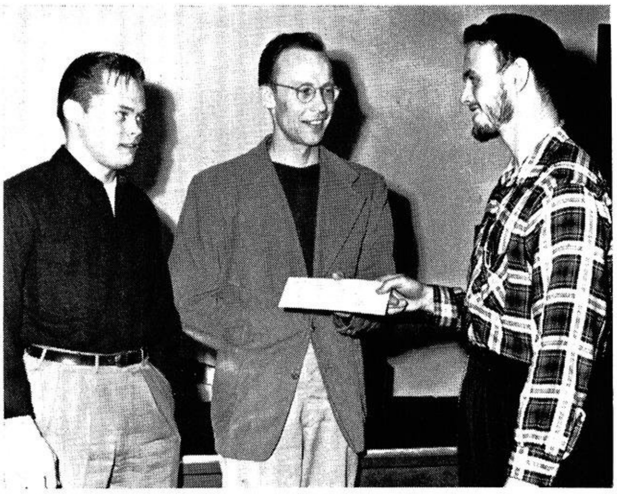
A banquet was held following the initiation ceremonies in the Round Table room of the Union. Alumnus, Bernard A. Sword, past president of the chapter, presided as master of ceremonies. The guest speaker of the evening was Dr. Svend Riemer, professor of sociology, who talked on "The Social Aspects of City Planning."

AIEE

A joint meeting of the Student Branch and Madison Section of AIEE at West High School Auditorium on February 21, featured the Westinghouse March of Research. The lecture and demonstration were presented by Dr. Richard C. Hitchcock, research engineer and lecturer for the Westinghouse Corporation.

POLYGON BOARD

New members on Polygon Board for the spring and fall semesters of 1950 are: William J. Beranek, AIEE; Robert Binning, ASCE; George Fried, ASME; S. James Horn, AIChE; Norman W. Johnson, M&Met; Al Pertmer, SAE; and Dale Walker, IRE.



Button design prizes awarded—Arnold W. Johnson, 2nd prize; John M. Frase, 1st prize; and Keith Jensen, president of Polygon Board.

ASME

A lecture on the "Engineering Aspects of the T.V.A." was presented at the February meeting of ASME by Mr. Roberts, chairman of the hydraulics department of Allis Chalmers.

The Rock River Section of ASME will award $25 as first prize and $10 as second prize in the ASME Student Paper contest which begins April 1.

St. Pat . . .

(continued from page 8)

pating in the exposition had to pool their resources. Happily the exposition was a financial success.

Another exposition was presented the following year with even greater success, drawing over nine thousand spectators. Because of the tremendous amount of work required in the preparations for the expositions, it was decided in 1942 that they should be held every two years instead of annually. Unfortunately, the general austerity demanded by the war effort prevented the staging of an exposition in 1943 and the project has never been resumed.

In the years following the abandonment of the St. Patrick's Day parades, the focus of attention has been drawn more and more toward the St. Pat's Dance, the growing of beards, and the rivalry among the schools in the St. Pat's Contest. The societies representing each of the five engineering schools nominate a St. Pat candidate who leads his fellow members in selling buttons and dance tickets. Polygon Board, who sponsors the contest and the dance, awards 500 points to each candidate who sells a number of buttons equal to 3/4 of his school's enrollment, and 500 points for the sale of tickets equalling 1/6 of the school's enrollment. Each additional button sold is worth 1 point, and each additional ticket, 8 points. The winning candidate is, of course, the one having made the most points. The winner is crowned St. Pat and presides as King of the St. Pat's Dance, and is awarded an engraved loving cup. The candidates chosen by the societies for the 1950 contest are:

Chemical—Thomas E. Torphy
Civil—Robert R. Claypool
Electrical—Robert G. Poetsch
Mechanical—John F. Atkins
Mining—Peter O. Kirchhoff

The beard-growing contest has developed into a colorful event, the contestants wearing their beards anywhere from two to three months before the final judging on St. Patrick's Day. Prizes are awarded for the Best, the Longest, the Curliest, the Thickest and Densest, the Best Colored, and the Puniest beards. The judging of the beards is done in two steps. The first step is the preliminary judging held the afternoon before the St. Pat's Dance. This judging is necessary in order to save time during the final judging at the Dance, and makes the decisions of the judges more fair by providing a means of taking accurate measurements. The final judging takes place at the St. Pat's Dance and is conducted by the Badger Beauties.

The days of the egg throwing are probably gone forever, and in their place is an annual basketball game between the lawyers and the engineers. The change is deeply appreciated by the merchants along State Street and the citizenry of Madison as a whole. However, looking back at the history of the St. Patrick's Day celebrations, the example set by the enterprising students in 1940 and 1941 is worthy of note.

Sliderule . . .

(*continued from page 26*)

od where four significant figures are desired, the table appearing below is established. These are simply geometric series pro-positions where each additional term adds two new decimal places to the answer. We are bracketing what amounts to be the third term of the series so that we may appraise its affect upon the significance of the third decimal place.

$1/0.94 = 1.0636(216) \ldots = 1.064$
$1/0.93 = 1.0749(343) \ldots = 1.075$
$1/0.92 = 1.0864(512) \ldots = 1.087$
$1/0.91 = 1.0981(729) \ldots = 1.099$
$1/0.90 = 1.1111 \ldots\ldots\ldots = 1.111$ (By inspection)

By improvising, we can extend the method into a great many other situations. For the next two terms of the table above, we suggest the following method.

$1/0.89 = 1.11$	$1/0.88 = 1.12$
0.0121	0.0144
0.001331	0.001728
$1/0.89 = 1.123$	$1/0.88 = 1.136$

One more method for determining reciprocals merits mentioning at this time. Given the example 1/41, we might reason that the desired reciprocal is close to 1/40. The latter, we readily express as being 0.25000. How far removed from 1/40 are we? Performing the subtraction to see what difference there actually is,

$$\frac{1}{40} - \frac{1}{41} = \frac{41 - 40}{41 \times 40} = \frac{1}{1,640} \cong 0.006$$

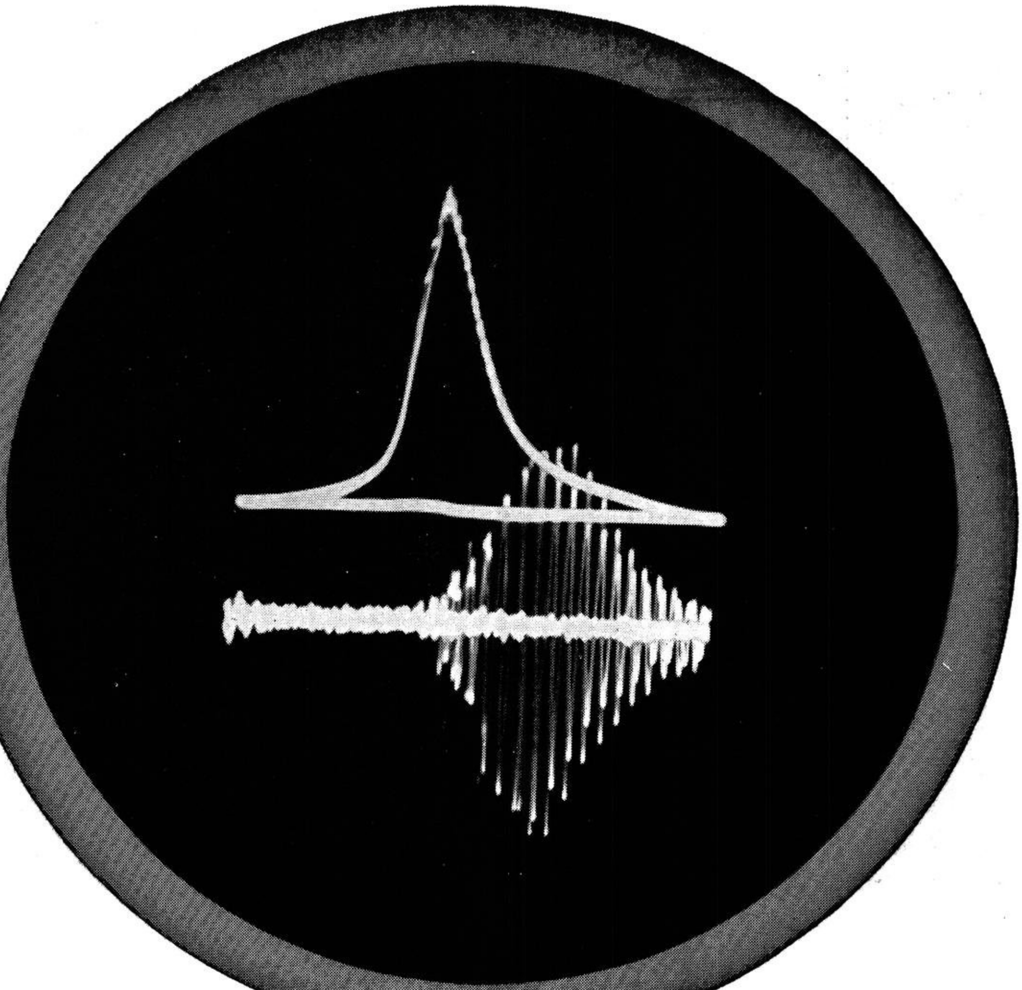
Therefore,

$$\frac{1}{41} = \frac{1}{40} - \frac{1}{1,640} \cong 0.0250 - 0.006 \cong 0.0244.$$

The actual reciprocal, expressed to more places, is 0.024390.

Similarly, we may estimate the reciprocal of 79.

$$\frac{1}{79} \cong \frac{1}{80} + \frac{1}{6400} = 0.012500 + 0.00016 = 0.01266$$



This is a picture of "PING"

It's a picture that gives automotive engineers clear-cut facts on performance—a picture that suggests how photography with its ability to record, its accuracy and its speed, can play important roles in all modern business and industry.

No, this is not the "doodling" of a man on the telephone. Far from it. It's the photographic record of an oscilloscope trace that shows, and times, detonation in a "knocking" engine. It all happens in a few hundred-thousandths of a second—yet photography gets it clearly and accurately as nothing else can.

Oscillograph recording is but one of countless functional uses of photography in bettering products and improving manufacturing methods. High speed "stills" can freeze fast action at just the crucial moment—and the design or operation of a part can be adjusted to best advantage.

And high speed movies can expand a second of action into several minutes so that fast motion can be slowed down for observation—and products be made more dependable, more durable.

Such uses of photography—and many more—can help you improve your product, your tools, your production methods. For every day, functional photography is proving a valuable and important adjunct in more and more modern enterprises.

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"Nothing is stronger than public opinion. Given the facts, nothing is wiser."

On Competition

Hatch a good idea and you hatch competitors.

It works this way—to take General Electric as an example:

In 1934, the automatic blanket was initially developed by General Electric. Today there are twelve other companies making electric blankets in competition with G. E.

In 1935, General Electric first demonstrated fluorescent lamps to a group of Navy officers. In 1938, the first fluorescent lamps were offered for sale. Today they are being manufactured by a number of companies.

The first turbine-electric drive for ships was proposed and designed by G-E engineers. Today four companies in this country build this type of ship-propulsion equipment.

After several years of laboratory development, General Electric began production and sale of the Disposall kitchen-waste unit in 1935. Today fourteen other companies are in this field.

The first practical x-ray tube, developed at General Electric years ago, is now a highly competitive business for seven manufacturers.

In 1926, a practical household refrigerator with a hermetically sealed unit was put on the market by General Electric. Today 34 companies are manufacturing household refrigerators with hermetically sealed mechanisms.

* * *

Research and engineering snowplow the way, not only for new public conveniences, but also for new companies, new jobs.

There are 20% more businesses today than there were immediately after the war.

Industry furnishes over 10,000,000 more jobs than ten years ago.

The average family owns more and better products of industry than ten years ago.

Any American company that plows back money into research and engineering development makes new business not only for itself, but for others.

The economy that does most to foster competition is the one that makes easiest the establishment and growth of business.

You can put your confidence in—

GENERAL ELECTRIC