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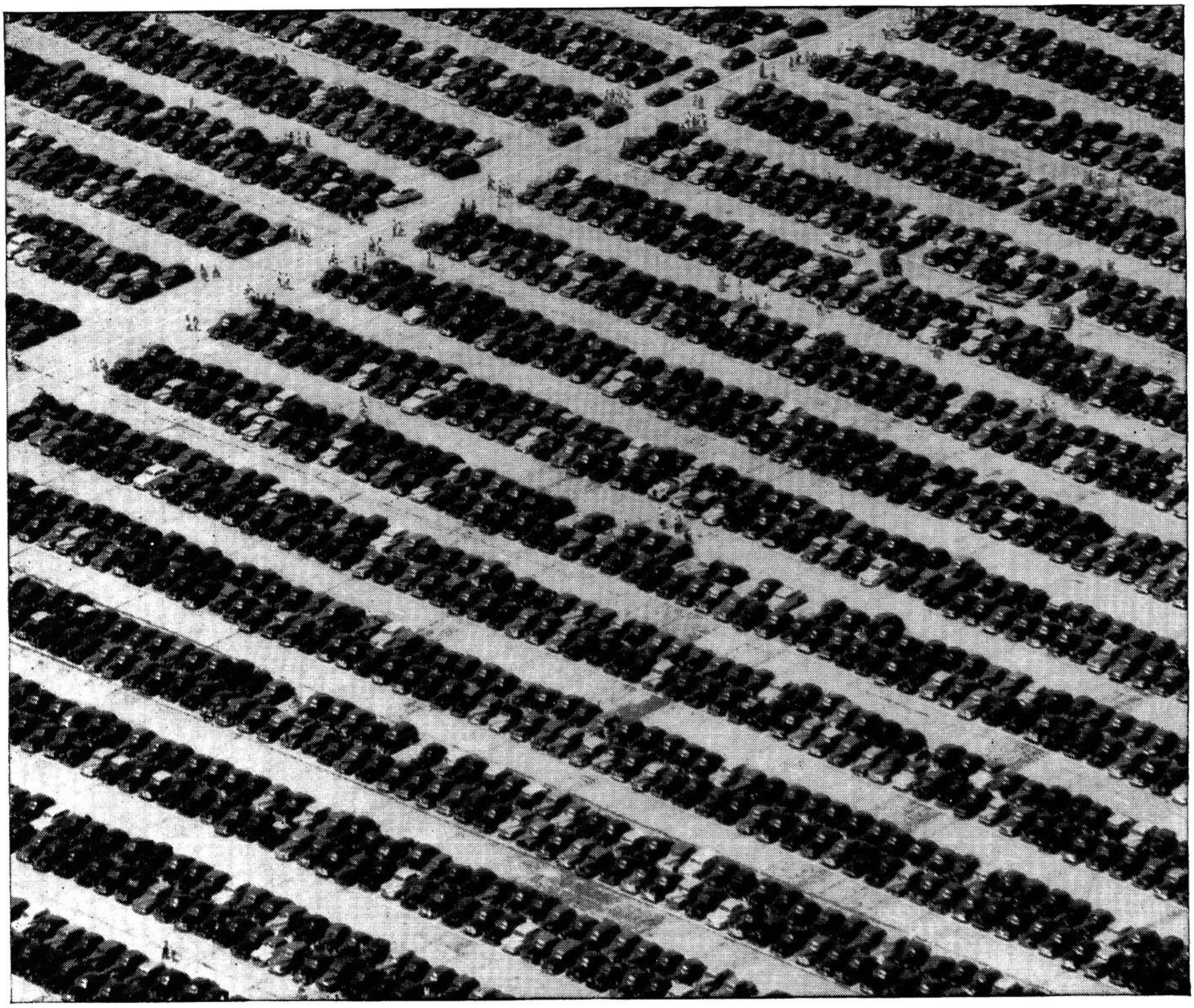
The Wisconsin

engineer

May, 1950

15¢

6,250,000 in 1949—*another new record*



THE automobile industry smashed records again in 1949 as it produced 6,250,000 new passenger cars and trucks —more than in any other year in history. This terrific output of the finest cars ever made climaxed a phenomenal rise in production that began at the war's end.

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UNITED STATES STEEL

WISCONSIN ENGINEER

Founded 1896

Volume 54 MAY, 1950 *Number 8*

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A bewildering view of the Torrence Avenue vertical lift bridge in Chicago. (*Photo by Skala*)

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THE WISCONSIN ENGINEER

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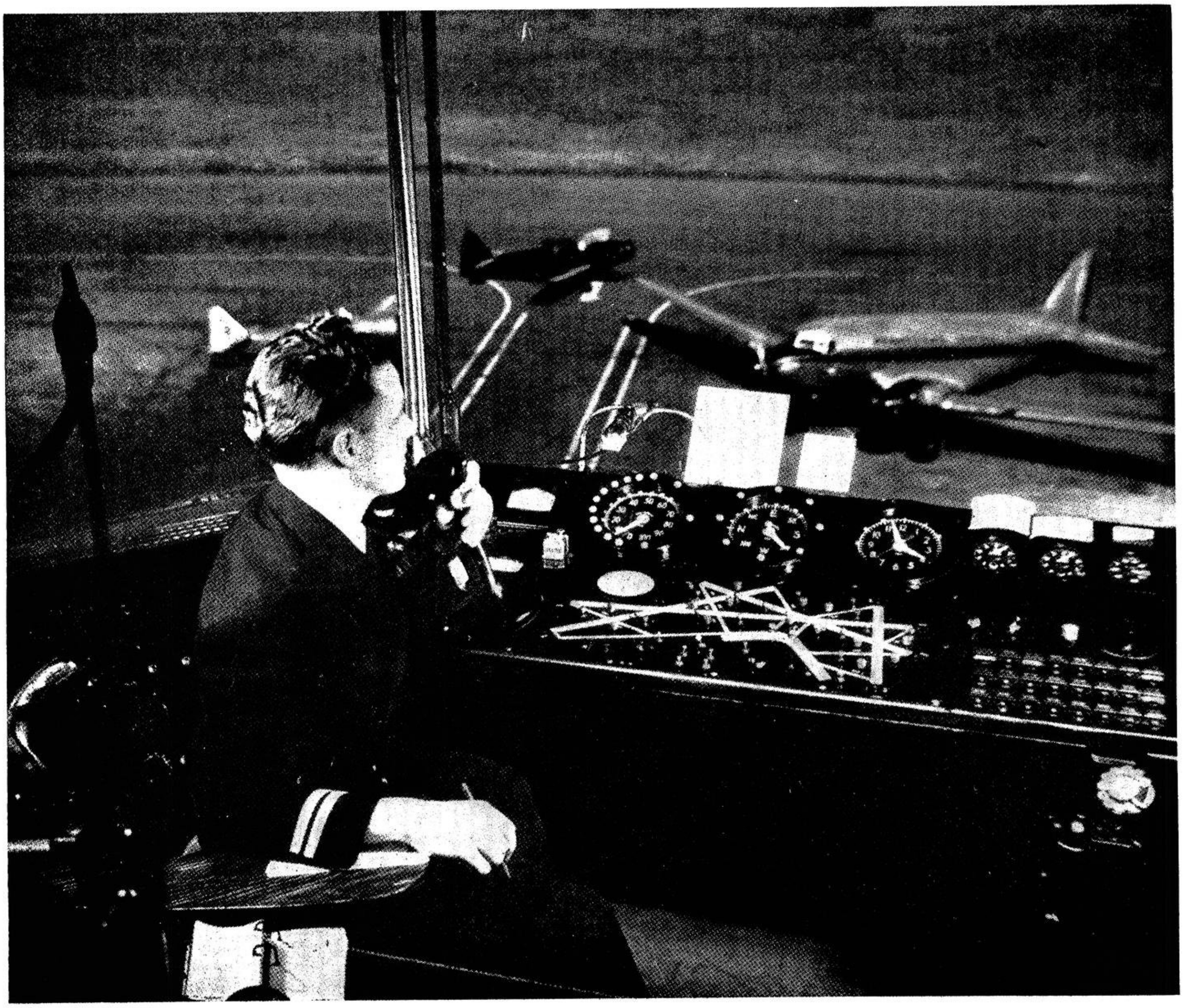
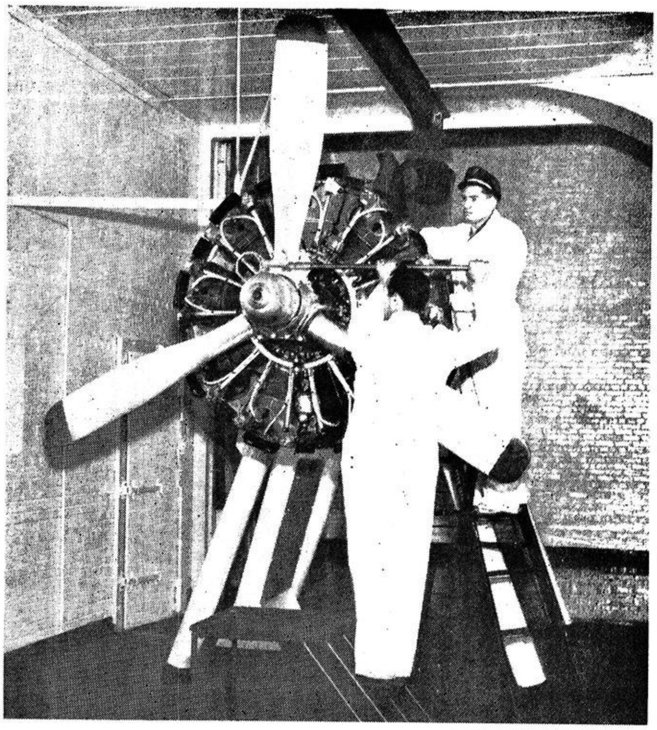


(*Photo courtesy CAA*)

Traffic control operator guiding movement of aircraft from airport tower.

Engineer and mechanic preparing engine for test stand run.
(Photo courtesy CAL)



Jobs in Aviation

by C. A. White m'50

This year another record class of college graduates will be turned loose to find jobs in the business world and industry. Each year the positions available have decreased and this year is no exception. The 1950 graduate and those who will follow will find that they will have to get out and sell their services and engineers will find this more true than any other profession.

Many air force veterans and college graduates have wondered what chances there are for finding satisfactory jobs in aviation. Despite the rapidly expanding employment opportunities in the aviation industry there will be a surplus of qualified applicants for the next few years and any individual who plans on entering the field will find mighty stiff competition. It is estimated that more young people are anxious to make their living in aviation than any other field due to the fascination and chances for advancement that aviation holds. It must be remembered though, that aviation is not as exciting and daring as it seems and that the climb to success may get dull and routine in spots, just as in any business.

It is hard to say how many jobs do exist in aviation for an engineering graduate this year or next· The aviation industry still has not settled down to a peace time basis mainly because the industry has never really existed so strongly in a peace time economy before. It is estimated by both liberalists and conservatives that the trend will be upward till past 1955. It must be remembered though that there are some 1,500,000 air force veterans who expressed a desire to stay in aviation and that a great many of these individuals have a background of experience and training that is priceless as far as the industry is concerned.

The engineering graduate thinking of aviation as a career should consider all the different branches open and his qualifications and interests for each of these branches, Aviation can be roughly broken down into the following three phases: government, airlines, and manufacturers. Each of these three phases and the opportunities offered will be discussed.

GOVERNMENT

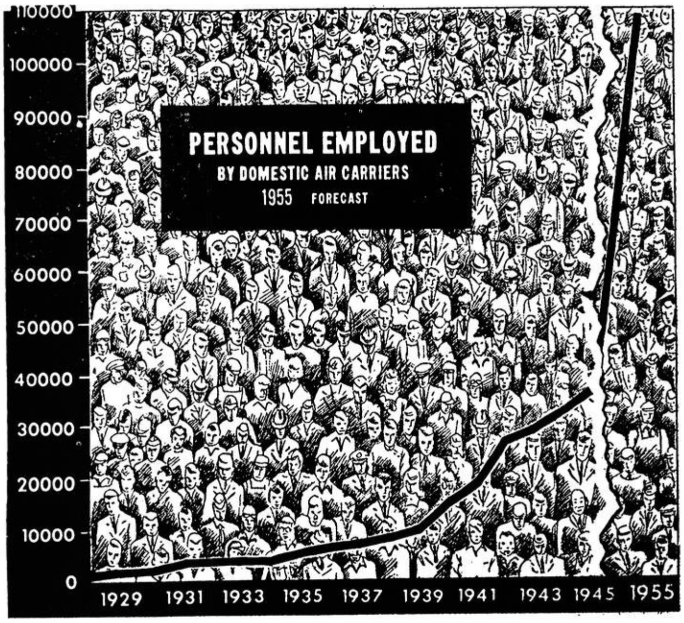
Most all aviation jobs with government are with the Civil Aeronautics Administration and are Civil Service positions. It has just been in the past year that positions with the CAA have started to open up again. The engineer would find most opportunities in the technical or operational functions of the CAA.

Technical jobs usually require only four years of college with some experience while most of the operational jobs require not only the usual college education, but wide experience as a pilot.

Civil engineers are widely used by the CAA for airport and airway construction and repair. Engineers hired for these positions usually act only as technical advisors to concerns that have contracted to do the work for the CAA. Aeronautical engineers are always in demand with this agency providing they have some experience.

The pay scales for CAA jobs run anywhere from $2,400 to $8,000 a year depending upon the responsibilities assumed.

One other agency of the government also employs a number of engineers and that is the National Advisory Committee for Aeronautics. (NACA). This agency is interested in all types of engineers as their work is mainly concerned with all kinds of research problems encountered in aviation. Positions with the NACA are open at the present time for any engineers who are acceptable and can meet the scholastic standards. These positions



(Chart courtesy CAA)

pay anywhere from $3,100 to $10,000 a year depending upon the type of work performed.

MANUFACTURING

Aviation manufacturing will probably be the most difficult field for a graduating engineer to get into. Following V-J day the aircraft industry found itself with contracts cancelled and a surplus of personnel. Manufacturers of airplanes, engines and airframes unlike other industries could not convert over to supplying a back log of civilian demand and have therefore been forced to curtail their employment programs for the past few years. It has only been in the last year that the major aviation manufacturers have expressed any interest in taking on new technical personnel.

The young engineer will find that to get into this field he must usually meet one of two requirements; a high grade point average or a wealth of experience. At the present time a few of the major companies have openings for field service representatives. These positions require a general background of engineering principles plus a thorough knowledge of the company's product. A field service representative is nothing more than a trouble shooter and good will representative for the company and spends most of his time traveling around the country. One main prerequisite for this type of work is past experience with aircraft in both an operational and maintenance capacity. In this field the air force veterans will have the advantage over others that might be interested.

Certain specialized fields of research and development are pretty much wide open for the individual that is qualified to fill these positions. All types of engineers are required in these fields as there are problems in design, physics, electronics, metals and fuels. Most of the companies feel that an individual to be qualified for this type of work must have at least a master's degree in one of the branches of engineering.

AIRLINES

The airlines of the country have been expanding ever since 1940. This phase of aviation probably offers greater opportunities than any other. The expansion of routes and airplane fleets have made it necessary for the airlines to take on additional personnel.

Engineers seeking employment in this field though must realize that competition will be stronger here than in any other phase of aviation. Positions on flight crews such as pilot, co-pilot, flight engineer or navigator can almost be eliminated unless the graduate has had previous experience with the armed forces. Even with experience however, the openings for flight personnel will be few in number.

The major openings for engineers will be in mechanical overhaul and would be in a supervisory and inspection capacity. Some engineers are taken on as designers for the purpose of revising and improving equipment used by the lines. The administrative jobs would be mainly concerned with sales work. Air cargo and freight services are increasing and the airlines are looking for people to sell these services to manufacturers. Most of the airlines feel that a graduate engineer with the proper personality would best be able to sell air cargo and freight services.

THE PROSPECTS

The best way to seek a job in aviation may be somewhat confusing to anyone that is not familiar with the industry. However, there are some very clear cut avenues of approach. The Civil Aeronautics Administration can offer some information concerning statistics on the industry. The Air Transport Association of America is glad to give a list of addresses of all their members, which would include all the major airlines of the country.

Any civil service board can give information concerning positions that are open with the CAA or NACA. The individual that is interested in obtaining work in the manufacturing field can find the addresses of all aviation manufacturers in the Aviation Directory which can be found in any public library.

This article may sound a little discouraging for anyone thinking about getting into aviation, but for the individual who has a real desire to get into the field, this will be no great obstacle. There are jobs both good and bad, to be had in aviation and the engineer who is patient and willing to look around for them will probably find a position in the field of aeronautics.

This is the fourth and last of a series of biographical sketches concerning the four engineering professors who retired from active teaching last spring.

Emeritus Professor Ray Sprague Owen

(*Photo by Hone*)

by Charles Manske m'50

The retirement last summer of Professor Ray Owen brought to an end a teaching career of over forty years. His classes in surveying during that time brought to the students the benefit of instruction with a background of long and increasing experience in surveying work. Professor Owen has done surveying around Madison in his spare time all during his career as an instructor at the University. But he has not retired from performing surveys or from his many other activities. At the present time he does more land surveying than while he was engaged in teaching.

Ray Sprague Owen was born in Brodhead, Wisconsin, on October 29, 1878. He was the son of Frank W. Owen, Brodhead postmaster and merchant. He received his high school education at Brodhead High School, Beloit College Academy, and Janesville High School. Before attending college he worked for the railroad now known as the Burlington Route. In 1900 he enrolled in the topographic engineering department of the Engineering College of the University of Wisconsin. During the summer after his sophomore year he began his long career in surveying by doing leveling and plane table mapping for the U.S.G.S. After his junior year he was employed by the Bureau of Reclamation on a survey on the North Platte River in Wyoming. Following graduation in 1904 he worked for the reclamation service under Professor Schlicter in Kansas and Oklahoma, investigating the flow of ground water. The following year he worked on an irrigation survey on the lower Yellowstone.

In 1905 Professor Owen began teaching in the topographic engineering department of the University. In the summer of 1906 he married Theo Pickford of Madison. He

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(Photo by Bridwell)

Railroad Employment

by
Walter S. Lacher c'07

Mr. Lacher voluntarily offered to prepare this article in response to a request for information by Harry Bridwell of the ENGINEER staff. A Wisconsin graduate, civil engineering 1907, Mr. Lacher has served as engineering editor of Railway Age and managing editor of Railway Engineering and Maintenance. He has recently retired as secretary of the American Railway Engineering Association.

Do the railroads really want engineering graduates? Are they making any effort to recruit men of more than average ability? Do they have any plans that assures progressive advancement for men of proven merit? It is impossible to give any general answer to these questions, because the situation is a mixed one. Without question chief engineering officers as a whole are aware of the need for strengthening their organizations and of the advantages to accrue to the properties from the employment of college men who could be placed in line for promotion to administrative or executive positions. On the other hand top managements have not all been convinced of the importance of scouting for university men to the point where they are willing to do something about it.

For this reason and also because engineering officers take seriously the responsibility they assume in an aggressive recruiting of engineering school seniors, they are reluctant to make definite commitments unless they have the backing of their managements with respect to a thoroughly considered program that not only embraces employment but covers training and advancement as well. Therefore if a scout is on the campus in the interest of some railroad, students have reasonable assurance that a program for the employment of selected graduates has been worked out and that the number to be selected for special training will be small enough to afford promise of a reasonable rate of advancement for every man who measures up to the requiremments.

Unfortunately, the only data readily available on salaries is something more than two years old, but from these figures we find that the average of salaries paid to engineering graduates, that is, beginners, in railway service, were in line with or possibly somewhat higher than the average of the salaries paid by industry generally, and that the minimum salaries paid by railways were well bove the minimum reported for all graduates.

Conditions of employment on the railroads vary from department to department and also within individual departments. In the case of draftsmen and of other engineers doing other work in offices the conditions vary but little from those generally prevailing. Quite different, however, is the set up for the man employed "on line of road," who will often be required to spend a large part of his time away from home. However, as the result of the award to the non-operating employes in 1949, substantially all employes falling in this classification, and this includes engineers, are now employed on a 5-day, 40-hour week.

It is also true also that engineers employed in the field are subject to rather frequent shifting of headquarters, a matter of no small hardship to married men in these days, but it is not too much to say that the man who is required to make the greatest number of moves is deriving the benefits of a varied experience and is probably numbered among those who are "getting the works" while their superior officers are sizing them up as prospects for greater responsibilities.

Now let us look at the railroad industry as a whole, trace its development briefly, and examine the opportunities which are available to different classifications of engineers.

The railway industry has gone through some remarkable changes during the last half century. In 1900 it was generally believed that they were on the threshold of a vast program of electrification. Today we find only about a half dozen roads with any appreciable mileage of electrified lines, while three entirely unforseen developments in the industry are greatly augmenting the opportunities for the employment of electrical engineers.

In 1900 the extensive development of the railways was still in progress; railway magazines still carried items regarding new location projects in progress or in prospect. Today new line construction is rare indeed. Nevertheless field parties are now frequently engaged in location work of a high order, not for new lines, but to meet the needs of the ultra refinement in alinement for the operation of trains at extreme high speeds. In 1900 no power tools whatever were used in the maintenace of track with the possible exception of an occasional air hoist for the loading of old rail released from track. Today there is scarcely an operation of any consequence, from the tightening of bolts to the cleaning of ballast, for which some machine has not been perfected. In 1900 the design of the component parts of the track was virtually a matter of guesswork; the mechanics of the behavior of track under load was still a closed book. Today the validity of the scientific method as applied to the design of rails, for example, is generally recognized.

These examples spell progress in the application of engineering principles to railway problems, but they are not especially helpful to the engineering student who is trying to make up his mind as to the best field in which to look for a job. In spite of these examples, he will be inclined to ask if it is not a fact that the railroad industry is decadent, if not actually moribund. Is it not true, he will probably add, that promotions on the railways are slow and that many obstacles are thrown in the way of the ambitious young graduate who is trying to get ahead as rapidly as possible?

Yes, railroading is among the oldest of the great industries. It is true that they are no longer growing; the number of employes today is less thahn it was 20 years ago. Advancement certainly is slower than it is in newer and rapidly growing industries. However, it is necessary to bear in mind that, while the roads have had a head start in getting old, other industries are rapidly catching up. In point of rate of growth, or lack of it, there is far less contrast now than there was 20 years ago between the carriers and some of the other classes of "big business," for example, electric power, the telephone, automobile manufacture and steel production. In all of them promotions do not come as fast as in some new and rapidly growing undertakings. By the same token all of them present about the same picture with respect to domination by organized labor. There is little difference in the degree to which seniority rules and other provisions of working agreements interfere with the employment of trainees or special apprentices in subordinate supervisory positions.

The railway industry is unique in point of the variety of kinds of engineering involved in its operations. However, civil engineering still dominates the picture. There was a time when the railroads offered the one extensive field for the employment of civil engineers. Today, when fully 50 per cent of all "civils" are on public pay rolls, it is of interest to note that the railways comprise one form of private enterprise that still provides work for a great many of them.

Chemical engineers as well as chemists are employed in water treatment and in wood preservation. They, as well as metallurgists, occupy important places in the laboratories of the engineer of tests. However, it is only fair to point out that these men are essentially specialists, more or less segregated from the main business of railroading. Promotions are infrequent unless they involve transfers to a different line of work.

That mechanical engineering occupies an important place in the maintenance of cars and locomotives goes without saying; and it is of interest to note here that the general superintendent of the car and locomotive department of the Chicago, Milwaukee, St. Paul & Pacific Railroad is a Wisconsin graduate in mechanical engineering. However, it is well to keep in mind that the opportunities are confined more than would seem desirable to drawing room and other office positions. Labor agreements covering the filling of supervisory positions and the influence

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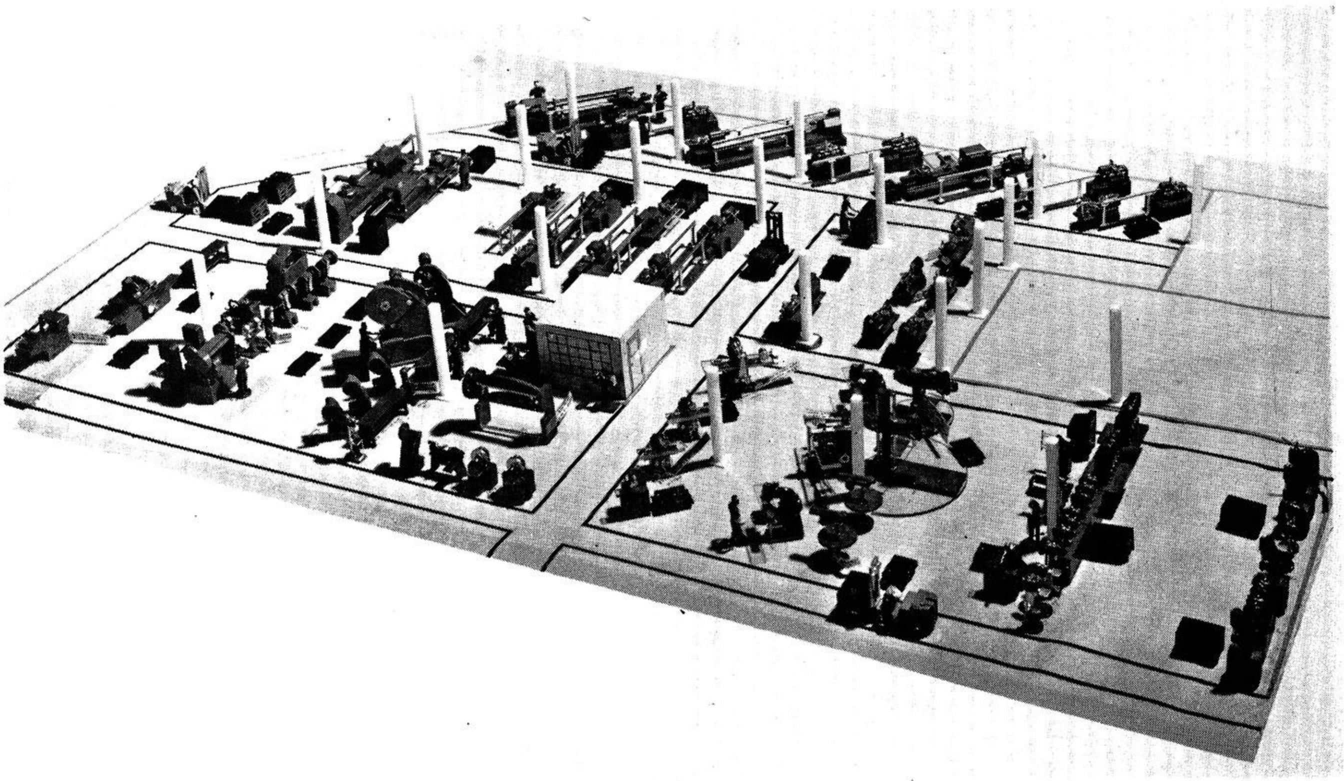

A layout illustrating the use of 3-dimensional models. *(Photo courtesy R. L. Doggett)*

PLANT LAYOUT

by Donald Stenske m'50

The basic secret to successful layout planning is common sense, first, last, and always. To point this out is the purpose of this article, but before going any farther let's take a look at the "who, what, when, where, and why" of it.

Anybody in the plant can get the idea that something should be done to improve efficiency. It may be a lathe operator who is disgusted with having to walk the length of the shop to the tool crib every day (if he hasn't long ago decided to hide his tools in a corner near his work place.) It may be the engineering department. It may be a fellow whose machine location forces him to stand in an aisle, and who must stop working and leap out of the way to prevent being knocked down by an electric fork truck.

Plant layout has been defined by Westinghouse as "placing the right equipment, coupled with the right method, in the right place, to permit the processing of a product unit in the most effective manner, through the shortest possible distance, and in the shortest possible time."

There are many circumstances under which a plant layout study may be made: before erection of a new building; addition of another product in an existing plant; where gradual expansion has taken place; a desire to increase sales by performing this service for customers (as in the sale of bakery equipment); to shorten the change-over and re-tooling time (as in the automobile industry.) These are only very general circumstances and by no means represents a complete list.

The work is done in the engineering department by industrial engineers, process or project engineers, or the executives of the company who are in charge of the production, depending on the size of the organization and the type and variety of engineers employed.

(Photo courtesy R. L. Doggett)
ME 180 class looking over a layout using 2-dimensional templates.

Why a plant layout study is made and how it is made is probably best illustrated by examining the problems confronting an actual company, how these problems were attacked, and some of the suggested solutions.

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Part Four

Lay That Sliderule Down!

by Paul Grogan, me instr.

π: The ratio of the circumference of a circle to its diameter, π, is clearly defined in mathematics as being a **transcendental number.** By transcendental it is meant the number is strictly out of this world, for such numbers cannot be expressed in terms of common integers short of an infinite series.

In our earliest encounters with π, we were taught to express it as simply 22/7, but in our present state of enlightenment we generally prefer 3.1416. The latter approximation probably adds unreasonably to the labor involved in a great many simple problems. The difference between 22/7 (3·1429) and 3.1416 is less than 13 parts in 31,400, or is less than 1 part in 2,400. An analgous situation is that of flattering a girl who weighs one hundred fifty pounds and one ounce by judging her weight to be a mere one hundred fifty pounds.

Further, we should not reach for a slide rule every time 3.1416 is used as a numerical substitution for π. That particular sequence of five digits contains no less than five distinct prime factors, $(2 \times 2 \times 2) \times 3 \times 7 \times 11 \times 17 = 31{,}416$, and they in turn lead to an imposing array of over 60 integer divisors with zero remainder. Some of those divisors appear below:

2	3	4	6	7	88	11	12
14	17	21	22	24	28	33	34
42	46	51	56	66	68	77	84
88	102	119	132	136	154	168	187

The product of the last two divisors, 168 x 187 = 31,416. Other divisors, 30 in all, may be found by dividing 31,416 by each of the remaining values reported above.

Trigonometric Functions: We would like to recall the statement of a fundamental proof that $\sin \theta = \theta = \tan \theta$ as θ approaches zero, providing θ is expressed in radian measure. We may interpret this information into the more conventional form of angular measurement in degrees by noting:

$$180 \text{ degrees} = \pi \text{ radians, or}$$

$$1 \text{ degree} = \frac{3.1416}{180} \text{ radians} = 0.01745 \text{ radians.}$$

The decimal value of one degree expressed in radians agrees very closely with both the sine and the tangent of 1^0 as reported in five-place tables. Within certain limits, therefore, we may determine either the sine or tangent of x, where x is a small angle measured in degrees, by finding the product

$$\sin x \cong 0.01745\, x, \text{ or } \qquad \tan x \cong 0.01745\, x$$

The method is hardly more than 1% in error if used for either the sine or the tangent of 10^0—the method being more applicable for expressing the sine function than it is for the tangent. Uniquely, however, it serves closely for either by yielding an intermediate value which represents both the sine and the tangent sufficiently well through the recommended range of 10^0. In fact, there is less than 5% error if sin 30^0 is determined as follows:

$$\sin 30 = \frac{30(3.1416)}{180} = \frac{3.1416}{6} = 0.5236$$

We know better of course, sin 30^0 being exactly 0.5000, although it is not bad for a "stranded in the middle of the Sahara sans slide rule, sans Sokolnikoff and Sokolnikoff" type of answer. There is no denying its utility in expressing closely:

$\sin 10^0 \cong 10(0.01745) \cong 0.1745$ vs. 0.1736, or 0.52% error
$\sin 6^0 \cong 3.1416/30 \cong 0.1047$ **vs.** 0.1045, or 0.19% error
$\sin 30' \cong \frac{1}{2}(0.01745) \cong 0.00873$
$\sin 30'' \cong \frac{1}{2}(0.01745) \cong 0.000145$

Applying the method to the tangent of the angles above leads to the same approximate solutions with respective errors of 1.03% and 0.38% in the first two instances. There is no apparent error in the three significant figures of the next two examples.

The approximation method is strongly recommended for expressing values of the sine and tangent for angles smaller than 6^0, where the functions range from 0.0000 through approximately 0.1000. Although the sine and tangent of small angles are generally expressed simultaneously by the ST scale on slide rules, they remain a hazard if not a mystery to the average slide rule mechanic. Furthermore, there is no provision on the ST scale for reading angles below arcsin 0.0100, or below 34.4 minutes.

We may draw upon any of the hundreds of trigonometric identities to speed us along our path of least resistance. It would appear we work most often with cosine components which are but slightly skew with respect to our reference plane or line of motion. We may approximate the cosine of small angles by application of the above correspondence between trigonometric functions and radian measure through use of a familiar identity:

$$\cos 2x = 1 - 2\sin^2 x$$

$$\cos x = 1 - 2\sin^2 \frac{x}{2}$$

If the angle x is small, we may substitute the actual radian measure of the angle for its sine function:

$$\cos x \cong 1 - 2x^2(0.01745)^2$$

$$\cos x \cong 1 - 0.00015x^2$$

This simple approximation serves admirably for cos x through $x = 40^0$.

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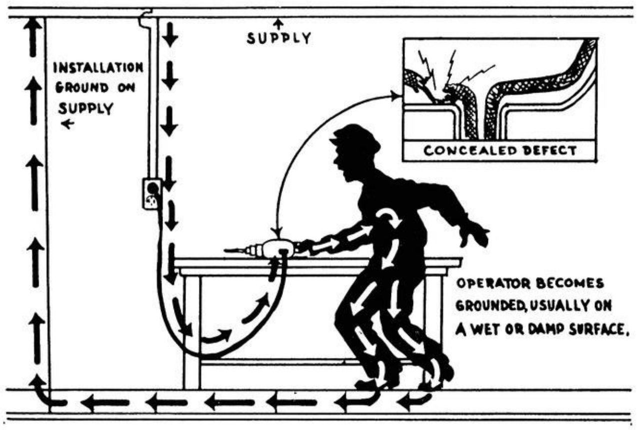
Shock!

by
Robert Whitson e'52

Low voltage shocks kill more people than lightning! Every person is familiar with the dangers surrounding high voltages, but all too few realize the dangers inherent in 110, 220, and 440 volts. A false security is present because of the wide spread use of low voltages both in the home and in industry, yet every year over 700 persons are electrocuted in accidents involving voltages less than 750 volts.

The belief that voltage kills is only half true. The essential elements of dosage are the actual quantity of current flowing through the body, the path of this current through the body, and the time the current flows through the body. That these factors are highly variable account for the wide range of voltages by which one man is killed and the other only slightly shocked.



The time of contact is highly important in the severity of the shock. If a man cannot let go from a charged part severe muscular spasms may occur. Men have had to be pried from charged wires long after death due to these spasms. Reasonably safe let-go currents for 60-cycle AC are nine and six milliamperes for men and women respectively.

If path of the current is through the region of the heart ventricular fibrillation, a periodic or irregular flutter of the heart muscles may occur. The heart will cease to supply blood to the brain cells and lungs, stopping breathing. If breathing and effective heart action are not started again within a few minutes, death will result. In contrast, current flowing between two fingers of the same hand would only cause a burn, depending of course upon the amount of current flowing. A partial nerve paralysis is produced by a current of several milliamperes. This nerve block prevents the signal of the brain from reaching the lungs and natural breathing ceases. Death will result unless methods of resuscitation are applied.

The amount of current which flows through the body is a factor which depends upon the conditions at that instant. Moist hands and a damp skin offer little resistance to the current. On the other hand dry, calloused skin would usually be highly resistive. The size or area of contact is also a major factor of resistance. A closed palm offers little resistance and may carry a large current whereas the tip of the finger would only carry a small current. A grounded person gripping the metal handle of a tool touching a charged body would offer little resistance to the current flow. The determination of the amount of current flowing through the body may be made from Ohm's Law.

$$\text{Current through body} = \frac{\text{Voltage applied to body}}{\text{Resistance of body and contacts}}$$

It has been found experimentally that a threshold of perception of current shock for 60 cycle alternating current is 1 milliampere. Further industrial experiment has shown that if the current it limited to .3 milliampere the possibility of receiving the sensation of shock is small. The necessity of eliminating the sensation of shock is important. Associated accidents such as injurious falls and dropped objects often occur because the person had been shocked slightly.

Electrical accidents are not limited to those that kill. Severe burns and flashed eyes are found too often. Burns may result from contact with over heated conductors and also from current flowing through the body. Burns severe enough to destroy bone and nerve tissue have been recorded. Deep penetrating burns such as these are painful and difficult to heal, and may be further complicated by infection. Exposure to high volume electric arcs results in extensive third-degree burns that are likely to prove fatal. Flashed eyes is an injury to the eye due to the inflamation of the retina caused by intense light. The intense light may be produced by arc welding or high voltage arc-overs.

From the above discussion it can be seen that the type of electrical accident varies from that of a fatal nature to one of slight irritation. All are dangerous and can be prevented. Big industries appoint safety experts who specialize in determining the cause of accidents and develop methods to promote safety throughout the plant and in the field. It remains for the little shop and small industries to look after electrical apparatus in a method both economical and efficient without incuring the cost of maintaining a full time electrician.

Safety

All too often a new machine is brought into the shop and just plugged into the electrical outlet. For this reason the designing of electrical equipment and electrically op-

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ON *the Campus*

by Fritz Kohli e'50

REGISTRATION FOR PROFESSIONAL ENGINEERING STATUS

A qualifying examination for the June engineering graduates who wish to obtain Wisconsin "Engineer in Training" status will be given on June 14.

The new Wisconsin law requiring a written exam for professional registration conforms with the laws of most other states, and "Engineer in Training' and "Professional" registration will be recognized by most other states.

A comprehensive article explaining the details and advantages of "Professional" registration can be found on page 12 of the January 1950 issue of THE WISCONSIN ENGINEER.

ASME

"The Engineer's Role in Labor Management" was the title of a talk presented to ASME by Prof. D. D. Lescohier, PhD. on April 26.

The new officers of ASME for the 1950-51 year are: Robert Wilson, Chairman; John Losse, Vice-chairman; Jim Forsyth, Corresponding Secretary; Gerald Axel, Recording Secretary; William Gallagher, Treasurer; and John Apple, Polygon Board Representative.

Bob Bergman was awarded the first prize of twenty-five dollars in the Student Paper Contest. Bob Prien was awarded the second prize of ten dollars. The Student Paper Contest is sponsored by the Rock River Section of ASME.

KAPPA ETA KAPPA

Delta Chapter of Kappa Eta Kappa sent a delegation of sixteen members to attend a meeting of The Milwaukee Alumni of Kappa Eta Kappa on May 5. A dinner and business meeting was held in the Allis Chalmers Club House. The evening program included an inspection and short discussion of the new powdered coal-electric locomotive, developed and now being tested by the Allis Chalmers Company.

A spring semiformal dance was held in conjunction with Theta Tau at the K. C. Hall on April 22. Music was furnished by Dave Spots and his orchestra.

TRIANGLE

Warren Racine was elected president of Triangle fraternity at an election held April 24. Other officers elected at the same time are: Rodney Johnson, Vice - president; Ned Breuer, Secretary; and Richard McKeon, Treasurer.

The newly elected officers were installed on April 29 at an initiation banquet held at the Kennedy Manor. They will hold office during the 1950-51 school year.

Seven pledges were initiated into the fraternity on April 29. The new members are: Robert Graumol, Ken Wright, William Filby, Robert Spaude, Jim Collins, Richard Davies, and Robert Sommerfeld.

Triangle's annual spring formal will be held May 20 at the Capitol Hotel, with music furnished by Wally Stebbin's band. Triangle alumni are cordially invited to attend.

MINING CLUB

The April meeting of the Mining Club featured a roast beef dinner followed by a talk on "Submarine Warfare" by Commander Metcalf.

A special election meeting will be held on May 4 to elect officers for the 1950-51 school year. On the following day a group of metallurgists will visit the Nash Motors plant.

Another dinner meeting is planned for the evening of May 18.

SPRING DANCE

An informal spring dance was held by Tau Beta Pi, Eta Kappa Nu, Chi Epsilon and Pi Tau Sigma on March 25 at the American Legion Hall. Members and their dates danced to the music of Dave Spots and his orchestra. Intermission entertainment featured the "Sandpaper Four" quartette.

CHI EPSILON

Civil engineers being initiated into Chi Epsilon this spring are: Donald Derber, Franklin Gerschke, William Kerttula, Richard Kolf, Donald Krchma, Herbert Kronholm, Kenneth Nelson, and Allen Porter.

SAE

Mr. Earl Monson, a development engineer with Nash Motor Corp. will talk to SAE on May 3. The election of the 1950-51 officers will be held at this same meeting. The candidates are: Chairman, Richard Smith and Bill Throndson; Vice-chairman, Doug Gordon and Will Gallagher; Recording Secretary, Allan Rose and Eugene Friedrich; Corresponding Secretary; George Simonds and Keith Kruel; Treasurer, Francis Manci and Jim Zirbes; and Polygon Board Representative, Walter Haese and Robert Ray.

The last meeting was held on April 5, at which time Mr. C. M.

(please turn to page 26)

Science Highlights

by Donald Miller m'50 and Donald Smithana e'50

OMNIBAC

A computing machine being developed by engineers of the General Electric Company is said to be at least 5000 times as fast as the human being in solving complex mathematical problems. The machine will be used to help solve complex engineering and scientific problems.

The name omnibac refers to "Ordinal Memory Inspecting Binary Automatic Calculator". It is a digital computer that deals directly with the digits of the original problem, as contrasted with the other broad type—the analog computer—which translates the problem into analogous terms such as length, speed or voltage. It employes the binary system of counting, a simplified method which utilizes only two digits—1 and 0—rather than the 10 characters of the familiar decimal system. The binary system is well adapted to computers because the two digits can be represented by a flow of current in one direction or the other, or an on and off of a switch.

The GE calculator does its work by means of 3300 electron tubes and associated electrical circuits. It has two memory cylinders which store information in the form of magnetic recordings. One cylinder contains the instructions to determine what the machine does and when. The other contains all the numbers the machine will be called upon to use in the solution to the particular problem.

The Omnibac will be most efficient in working on problems that might take days or weeks for programming alone. Programming is the sequence set up in advance by the mathematicians for the solution of the problem. Once the program has been set up, instructions and numbers will be fed into the machine by an operator at a key board similar to that of a standard typewriter. The typewriter translates the information into the binary system and punches this into a tape such as is used for teletype. From this tape the instructions are recorded on the machine's memory cylinder.

If a problem is complex the machine may then operate for hours or days, automatically, before producing the final result.

(Cut courtesy GE)

Omnibac computer.

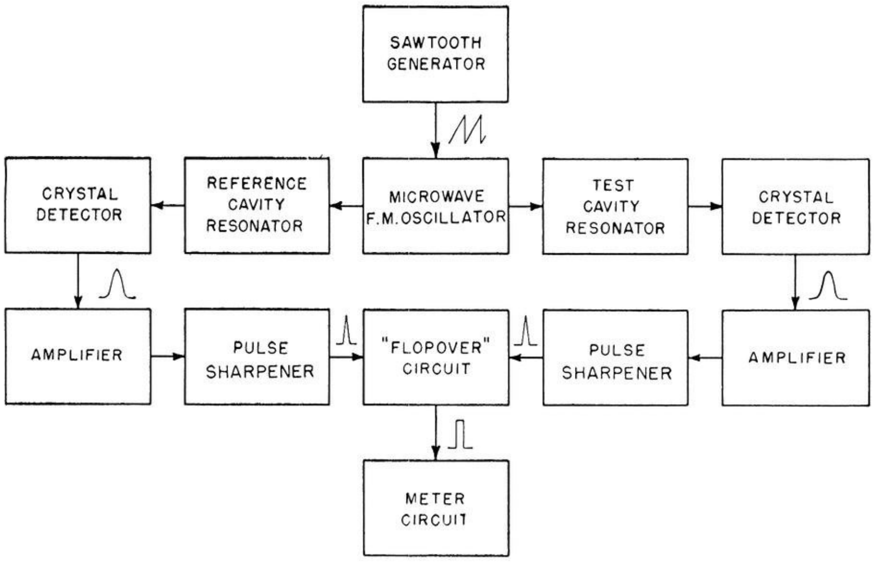
UNDERGROUND METALS CORROSION

Results of field tests that have been going on for many years on the underground corrosion of ferrous and nonferrous metals and alloys are now being analyzed at the National Bureau of Standards.

Specimens of representative pipe materials have been exposed to soil corrosion for periods of up to 14 years. The corrosion was measured as the loss in weight and the depth of pitting. The tests were made at 15 different locations in this country due to the differing soil conditions.

Failure of metals underground has, in the past, been attributed to the discharge of stray electric currents or high acidity. Where such conditions were not present it was assumed that iron and steel pipe might be expected to last indefinitely.

The results of the field tests indicate that the corrosion is more general and is a natural consequence of normal physical, chemical, and biochemical action of soils on metal surfaces.



BLOCK DIAGRAM OF MICROWAVE REFRACTOMETER

(Photo courtesy Bureau of Standards)

Schematic diagram of Refractometer.

Tests on the copper and its alloys with silicon, zinc, and nickel showed high resistance to soil corrosion in soils normally corrosive to iron and steel. Certain specimens of steels containing high percentages of chromium and nickel were very resistant to corrosion. Wrought iron specimens containing small amounts of chromium, nickel, and modybdenum, which produce high resistance to atmospheric corrosion in modern high strength steels, did not show appreciable difference in corrosion resistance. It is believed that conditions in soils do not favor the formation of tight, adherent rust deposits on which corrosion resistance in the atmosphere depends.

MONEL PLASTIC DEFORMATION

Polorized light has been used to show plastic deformation in Monel metal. When Monel is polished and etched by most etches it reflects light equally well in all directions. When it is polished and etched with an aqueous solution of chromic and nitric acids in ammonium chloride, the surface of the metal becomes optically active and polarized light can then be used to detect the differences in grain orientation. Although the method has been applied only to Monel metal, it has been found that it is possible to make other metals optically active. These are other cubic metals such as copper, aluminum, nickel, and alpha iron.

From this study it was found that with plastic deformation the directions of flow varied within small areas and the deformation in individual crystals was not uniform. The deformation was not confined to areas near the grain boundaries nor to the center of the grains but depended upon the orientation of adjacent crystals and direction of the stresses they imposed. In cases of severe plastic deformation it is believed that there was a bending of the crystal lattice.

STRONG ZINC ALLOY

Zinc, which has in the past been considered relatively weak, has been made as strong as brass by means of alloying elements.

The alloy composed principally of zinc with small quantities of copper and beryllium added has almost the same characteristics as brass. The alloy is, however, much cheaper than brass. The alloy has about eight times the useful strength of any zinc alloy now in use.

BRUSH WEAR

Electrical contacts or brushes made of graphite used to transfer current in electrical equipment used in high-altitude aircraft have shown very high rates of wear. In some tests brushes wore out in an hour, while on the ground these same brushes would last many times as long.

It has always been thought that graphite was inherently slippery and was in itself a good lubricant. It has been shown, however, that an invisibly thin film of moisture on graphite was required for its lubrication. By testing the wear of graphite brushes in a vacuum it was found that some wore as fast as an inch in an hour. When a small amount of water vapor was added to the chamber the wear was reduced to one thousandth as much.

The explanation for the high rate of wear of brushes at high-altitudes has therefore been found. At high-altitudes in the rarefied air at low temperatures the water vapor is almost completely absent. By shielding the parts and supplying water vapor to them it will be possible to increase the wear many times. It has also been found that certain organic vapors are about 1000 times as effective as a water vapor.

RECORDING MICROWAVE REFRACTOMETER

An instrument which measures and records small difference in frequency between two resonant cavities has been developed by a National Bureau of Standards scientist. In its present form, the new instrument can be adjusted over a wide band of microwave frequencies for measurement of dielectric constants of lossless gases and changes in the dielectric constant of such gases and very low-loss liquids and solids. Its extremely high sensitivity permits operation with small test samples.

The key operating principle of the refractometer is the comparison of two cavity resonators (microwave equivalent to a tuned circuit). A test sample (gas, liquid, or solid) is introduced into one of two otherwise identical cavities. The resultant difference in resonant frequency between the two cavities is then a measure of the dielectric constant of the test sample. Sensitivity of the

(please turn to page 20)

Alumni Notes

by Hank Williams e'50

Manuel Cutler, ('09), was named Engineer of the Month by Milwaukee Engineering in March. Mr. Cutler retired last July after 33 years of service as Superintendent of the Bureau of Bridges and Public Building in Milwaukee. In advising young engineers Mr. Cutler is quoted in the magazine as saying: "Always continue to study, investigate and learn about new advancements being made, seeking to improve yourself in means of expression, that is, either in writing or speaking. In this way, advancement will naturally come with a corresponding return in remuneration."

Adolph J. Ackerman, ('26, ce'32), is Vice President of the Hydroelectric Construction Department, **F. T. Matthias,** (c'31, ms'33, ce'40), is Construction Manager for a group of Brazilian engineering companies with headquarters in Rio de Janeiro. Matthias wrote recently as follows: "We have a very interesting program of construction at present involving tunnels, concrete dams, earth dams, canals and pump houses all designed to handle an ultimate flow of 5600 second feet. This is the principal project under construction and eventually we will divert this volume of water from its present drainage area and dump it 1100 feet down through a power house that now exists. We shall also have to install additional generating capacity in the existing power house. Our construction budget for this year is about 23 million dollars which represents a sizeable amount of work." Mr. Ackerman, in addition, has been elected director and vice-president in charge of engineering of Canadian-Brazilian Services Limited, of Toronto, Ont.

Alvin E. Pierce, ('49) is Assistant Engineer with the Public Utilities Commission in Honolulu.

The following 1949 graduates are employed with the City of Milwaukee:

Herbert A. Goetsch; John Guy Hahn; Floyd M. Whitmore; are with the Bureau of streets. **Martin L. Bachhuber; Glenn A. Goldsmith;** and **Kazuo Kubota** are with the Bureau of Sewers.

Paul Lillard, ('15), died in a Chicago hospital on December 30, 1949. He was unmarried. Following graduation, he worked in Madison for five years, part of the time with the Wisconsin Highway Commission and part of the time with Mead and Seastone. Most of his active career was spent in Chicago as a structural designer. He had been in poor health for a number of years preceding his death.

Walter S. Lacher, ('07), has recently retired as secretary of the American Railway Engineering Association, a position that he had held since the death of the former secretary, **Elmer T. Howson,** ('06). Mr. Lacher was on the staff of the Wisconsin Engineer when he was a student.

E.E.

The A. C. Nielsen Company, headed by **Arthur C. Nielsen ('18)**, announced on March 4 the taking over of the Hooper Rating Service. Nielsen has developed "an electronic audience research service of unmatched accuracy, reliability and usefulness". Which is now the sole source of network audience research. The Nielsen-reatings are now being made available to all former Hooper ratings clients.

Arthur Gennrich, Joseph Beischel, Richard A. Gall, John F. McCoy, John Stark, Harold A. Cork, and Richard Mendelsohn, all EE's, 50' are on a training program at R. C. A. in Camden, New Jersey.

Harry Wright, ('50), and **John Ashenbrucker,** ('50), are now working in the sales division of the Wisconsin Power and Light Company. They are stationed in Beaver Dam, Wisconsin, at the present time.

LaVerne Stelter, ('50), is employed with the Wisconsin Power and Light Company and at present is working in Fond du Lac, Wisconsin.

Ralph L. Woods, ('49), is with the Bell System. He is in the long lines department.

M.E.

Jay S· Plymesser, ('47), is at present working at the Des Moines plant of the Firestone Tire and Rubber Company.

Ch.E.

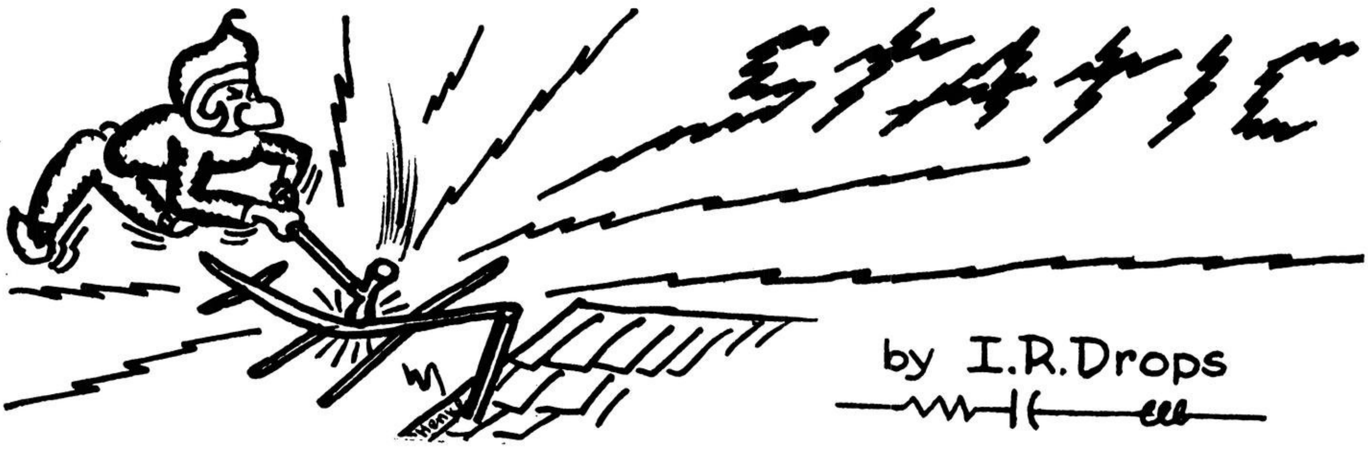
Robert U. Haslanger, ('), assistant general manager of the Western Division of Monsanto Chemical Company, has been put in charge of sales development activities of the company's Texas Division here.

Mr. Haslanger came to Monsanto in 1939, serving five years in the company's Plastics Division research department at Springfield, Mass., and subsequently as an engineer in the General Development Department in St. Louis. In 1947 he became assistant to the president at the company's general offices in St. Louis.

He was transferred to the Western Division in September, 1948, as assistant to the general manager. He became assistant general manager of the Western Division in February, 1949.

Prior to his association with Monsanto, he was employed by the Marathon Chemical Company and the Burgess Cellulose Company.

A native of Marinette, Wisconsin, Mr. Haslanger is married and has three children.



When women go wrong, men go right - - after them.

* * *

Mother: "Daughter, didn't I tell you not to let strange men come to your apartment. You know how it makes me worry."

Daughter: "It's all right, mother, I went to his apartment now let **his** mother worry."

* * *

First Indian: "Ugh."
Second Indian: "Ugh."
F. I.: "Ugh."
S. I.: "Ugh, Ugh."
F. I.: "Don't change the subject."

* * *

"Must you drive with one hand?" the pretty young thing inquired.

"Well, the car won't steer itself," answered her lawyer friend.

* * *

"Pardon me," said the stranger, "are you a native here?"

"Yes," was the answer, 'I've been here a goin' on seventy years now. What can I do for you?"

'I am looking for a criminal lawyer. Do you have any here?"

"Well, we're pretty sure we have, but we can't prove it."

* * *

Bank teller to customer: "sorry, Mr. Jones, but your wife beat you to the draw."

* * *

What's the matter with your finger?

Oh, I was downtown getting some cigarettes yesterday and a clumsy fool stepped on my hand.

* * *

Son: "Pop, what's an optimist?"

Pop: "It's a man who thinks his wife has stopped smoking cigarettes when he finds cigar stubs in the ash trays."

* * *

"Roger! Roger!"

"Yes, Ma!"

"How many times must I tell you that a cuspidor is to spit in."

Love is like a fried egg. Looks pretty at first, but the moment you take a stab at it, it becomes a big mess.

* * *

It was a C. O. D.—Come Over Drunk.

* * *

I call my girl Baseball, because she won't play without a diamond.

* * *

"That's quite some strapless evening gown you've got on. What keeps it up?"

"A city ordinance."

* * *

Her hand touched mine: Sensation.
Her hair was close: Contemplation.
Her lips brushed mine: Temptation.
Footsteps in the hall: **Damnation!**

* * *

It doesn't take a young wolf long to find out that a gal is a lot like a typewriter. Touch the wrong spot and all you get is bad words.

* * *

What is an extreme optimist?

A man who sits in the back row of a burlesque house and winks at the chorus.

* * *

A gentleman in the optical business was instructing his son in the technique of chiseling a fair and honest price out of a customer. He said, "Son, after you have fitted the glasses to the customer, and he asks, 'what is the charge?' " you should say:

"The charge is ten dollars.

"Then pause and wait for the flinch.

"If the customer does no flinch, you say: "That's for the frames; the lenses will be another ten dollars.

"Then you pause again—but this time only slightly—and again you watch for the flinch.

"If the customer doesn't flinch, you say: Each."

* * *

The old fashioned girl used to stay home when she had nothing to wear.

Science . . .

(continued from page 17)

present instrument under laboratory conditions is 200 cycles per second at an operating frequency of 9000 megacycles.

A klystron oscillator is used as a microwave signal source and is frequency-modulated with a sawtooth wave. The radio-frequency output from the klystron is fed to a T-junction which sends equal parts of the signal to the cavity resonators, one functioning as a test cavity, the other as a frequency reference. The cavity outputs are then fed through identical crystal detectors, amplifiers, and pulse sharpeners. The pulse pairs, repeated at a rate determined by the sawtooth frequency, then go to a trigger circuit. The first pulse turns it on and the second turns it off. The output of the trigger circuit is a rectangular wave with constant amplitude but variable width. The average value of this wave as measured in a meter circuit is then directly proportional to the frequency difference between the two cavities. In calibrating the microwave refractometer, it is desirable to use rare gases such as argon or helium whose dielectric constants have been measured very precisely at optical frequencies.

With solids and liquids very high sensitivity to small changes in dielectric constant could be obtained by filling the entire test cavity with the material. But, except in the case of practically lossless substances, this would seriously decrease the Q of the cavity. The restriction to low-loss materials is necessary because the present equipment is sensitive to changes in the Q of the test cavity.

It is believed that information yielded by this instrument on the refraction of the atmosphere at high frequencies will help to explain long-range "freak" reception which has long been a phenomenon of radio propagation.

THE OMEGATRON

The omegatron, a recent development at the Bureau of Standards in the realm of atomic instrumentation, is basically a miniature cyclotron. The omegatron has already made significant contributions in two fields: First, it makes possible for the first time the high precision measurement of the faraday directly by physical means rather than by electro-chemical methods as used previously. Second, the value of the nuclear magneton can now be determined, from which determinations of the ratio of electron mass to proton mass can be made with greater precision than ever before.

Since the faraday was defined as a quantity of electicity, many attempts have been made over a period of 100 years to determine its precise value. There is even a discrepancy between the two best previous determinations using iodine and silver solutions. This inconsistency has proved distressing in the revision of tables of atomic constants, since the faraday is a key component of these tables.

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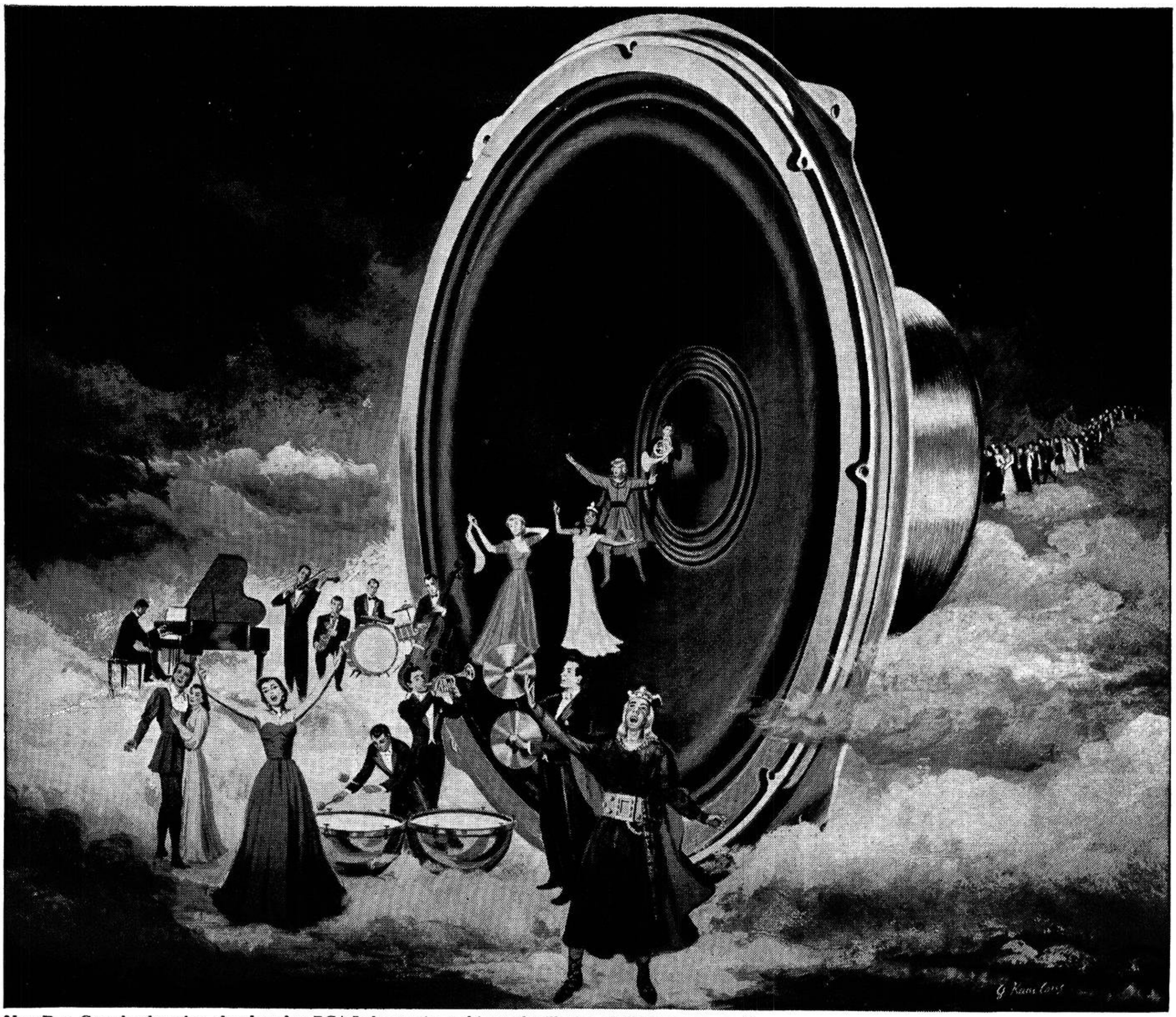

New Duo-Cone loudspeaker, developed at RCA Laboratories, achieves the illusion of "living presence."

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In addition, the RCA Duo-Cone loudspeaker's wide angle of sound pervades every corner of a room without sharply directed blast or blare. Its response to tones of every frequency is smooth, flowing, and even.

* * *

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Railroads . . .

(continued from page 11)

of top flight officers who came up the "hard way," have imposed severe limitations on the opportunities for engineering graduates to get a start in the shop or the roundhouse. However, every railroad has its mechanical engineer and an engineer of tests, each of whom heads up a staff that is engaged in engineering work of a high of electrifications of the so-called "steam" railroads is exorder.

While the likelihood of further important extensions of the so-called "steam" railroads is exceedingly remote, the electrical engineer is assuming a place of continually increasing importance on the roads. In the first place, the diesel locomotive, which is really diesel-electric, with emphasis on the "electric," demands the attention of electrical men. Another influence to this same end is the marked growth in the application of air conditioning, a field in which the railways were pioneers. The addition of the power requirements for air conditioning to those imposed by car lighting has completely changed the status of the passenger coach as a power plant and is demanding a complete redesign of the service and standby facilities in passenger stations and coach yards. Moreover, as railway managements have become aware of the new significance of lighting, the illumination engineer is finding a place in the picture.

Railway signaling will be founded in the future, as in the past, on the track circuit, but it is being greatly expanded as more and more examples of the economies of CTC (centralized traffic control) are brought to light. Electronics, on the other hand, is being applied for an entirely different purpose—primarily for communication between members of a train crew separated from each other by the length of a mile-long train, or between members of different trains, or between trains and stations. This trend has gone far enough on some roads to give rise to the creation of the position of electronics engineer.

The electrical engineer in railway employ occupies a somewhat anomalous position. Only on the half dozen roads with important mileages of electrified lines are the electrical engineers segregated in a subdepartment under the supervision of a chief electrical engineer. Normally, each separate group is attached to some department the head of which is not usually an electrical engineer. Thus, the signal engineer usually reports to the chief engineer, who is almost invariably a civil engineer. Other electrical engineers are divided between the engineering and mechanical departments, while the superintendent of communication, usually an electrical engineer, is generally attached to the transportation department. It is generally recognized that the place of the electrical engineer is taking on a greater importance, and it may be that this trend will eventually bring about the the creation of an electrical department.

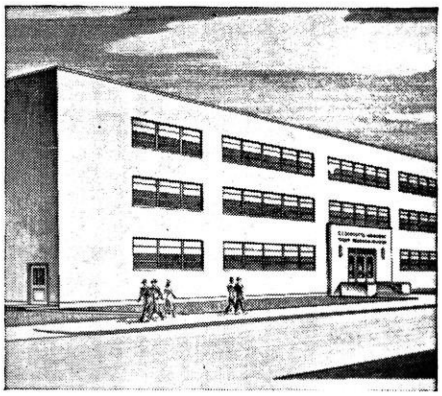
By far the largest single group of engineers in the employ of the carriers are the "civils." In the early days, in fact, even up to the beginning of the present century, the activities of the civil engineers were confined to the location and construction of new lines and the relocation and reconstruction of existing lines, as well as the design and construction of bridges. The maintenance of both tracks and structures was termed a practical matter in which "practical" men were deemed more proficient. But that point of view has disappeared in all but a few remote situations.

Units costs are now so much higher than they were 5 years ago that "rough and ready" methods can quickly result in enormous economic losses. In no industry has there been a greater increase in unit labor costs; track men earn as much in an hour today as they were paid for an entire 10-hour day at the beginning of the century. Consequently, any plan for improved supervision or for the replacement of men by machinery will receive a respectful hearing. Roadbeds that fail under today's loads and speeds after having carried the traffic of earlier years with no signs of distress, will be subjected to scientific study before resort to remedial measures, whereas such problems were formerly dealt with on the basis of "practical experience" but often with rather inconclusive results.

Thus, changing times have brought about a remarkable expansion in the utilization of civil engineers. Whereas they were employed initially in engineering per se, there is now a large outlook for them in an administrative positions, such as division engineer, district engineer and engineer maintenance of way. The extraordinary growth in the application of power equipment in construction and maintenance has led to the creation of a new field of usefulness for the technically trained man in such positions as superintendent (or engineer) of work equipment, which call for both engineering knowledge and administrative ability. From the standpoint of the technical knowledge called for, it would appear that training in mechanical, or even electrical, engineering would prove most useful, but because the men occupying these positions are drawn from the official ranks of the maintenance of way department, nearly all of them possess a background in civil engineering.

Railway engineering departments have always been dominated by college trained men, and other conditions being equal, the engineering graduate invariably receives the preference when positions are being filled. There is some difference of opinion among maintenance officers as to the adaptability of engineering graduates for positions as track supervisor or roadmaster, and working agreements with organized labor have imposed virtually prohibitive obstacles to the assignment of trainees to positions as section foreman and carpenter foreman. Moreover there are good reasons why the managements should hold such positions open for the recognition of ability in men who have not had the benefit of a college education. However, the fact remains that substantially all promotions of assistant division engineer and above go to men who were graduates of engineering courses.

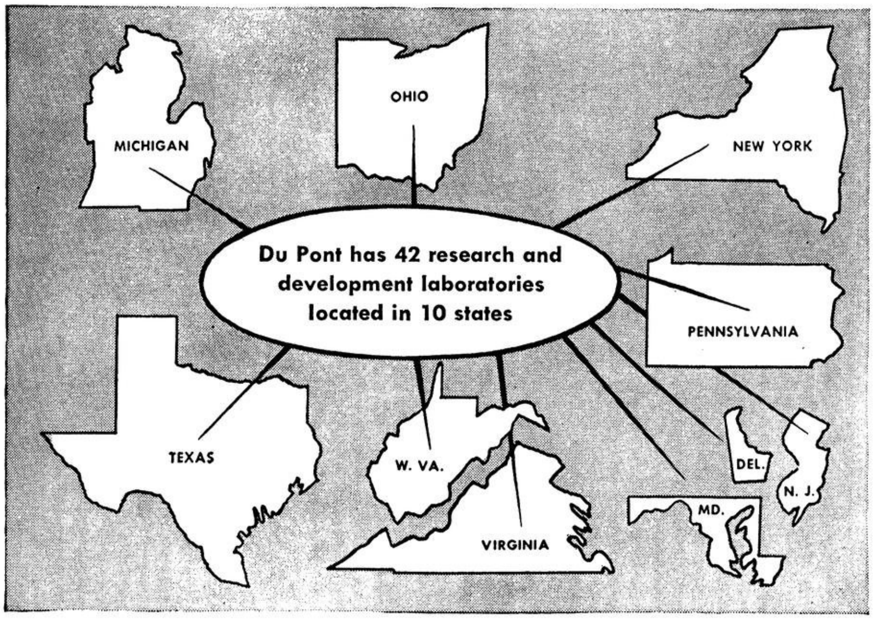
THE DU PONT DIGEST



Artist's drawing of the Marshall Laboratory, new Du Pont laboratory for research on finishes. Under construction at Philadelphia, it should be ready for occupancy by late 1950.

RESEARCH DECENTRALIZED

Du Pont scientists pursue their studies from Buffalo, N. Y., to Orange, Texas



THE DU PONT COMPANY is a large company. Its many manufacturing plants are now located from Maine to California. Likewise, the Company's research activities are spread over a wide area. From the Founder's informal scientific experiments on the Brandywine have sprung 42 research and development laboratories in ten states.

Each manufacturing department* has its own research director and maintains facilities for studies in its specialized fields. Thus, research having to do with dyes, neoprene and fine chemicals is centered at Deepwater, N. J.; research on cellophane and other transparent wrapping films at Buffalo, N. Y.; research on viscose rayon at Richmond, Va.; and research on coated and impregnated fabrics at Newburgh, N. Y. These are only a few of the places where Du Pont scientists are now at work. Each manufacturing department does fundamental research as well as applied research on new processes and products.

Many types of training

At any one time, many hundreds of different projects are under way in these laboratories. Though a relatively large number of Du Pont technical people are chemists and chemical engineers, other fields of training are strongly represented.

Among the scientists working with Du Pont are mechanical, electrical, civil, industrial, mining, petroleum, textile, architectural and safety engineers, physicists, metallurgists, biologists and mathematicians. About 30% of these men and women who are engaged in technical activities at Du Pont hold doctor's degrees.

Interchange of thinking

All manufacturing departments may draw on the services of the chemical, engineering and toxicological laboratories of the company in Wilmington. In addition, the Chemical Department's library at the Wilmington Experimental Station circulates reference material, conducts literature and patent searches and issues a weekly abstract of pertinent articles found in the important chemical journals of the world. This supplements normal work of this kind done by the various manufacturing departments.

No matter where a Du Pont research man may work, he has every opportunity to use his best talents, to advance as his abilities develop, and to profit by interchange of thinking with scientists whose minds complement his own.

There are ten Du Pont manufacturing departments —each conducting research: Electrochemicals; Explosives; Fabrics & Finishes; Film; Grasselli Chemicals; Organic Chemicals; Photo Products; Pigments; Polychemicals; Rayon.

★ ★ ★

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. . . THROUGH CHEMISTRY

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Slide Rule - - -

(*continued from page* 13)

$$\cos 40^{0} \cong 1 - 0.00015(40)^{2}$$
$$\cong 1 - 0.00015(1600)$$
$$\cong 1 - 0.2400$$
$$\cos 40^{0} \cong 0.7600$$

Four-place tables give the value, 0.7660. The error is 0.78%. At 30° and 20° we observe 0.115% and 0.032% errors, respectively.

The physical interpretation of the method of approximating cosine values is the substitution of the first quadrant segment of a parabola for the actual cosine curve. The parabola crosses the Y-axis y=1.000 and crosses the X-axis at X-81.1. The error, of course, being that the actual cosine curve does not intercept the X-axis until x = 90 in degree measure.

Strangely, these approximations are about the only practical tool for expressing the functions of extremely small angles such as are encountered in the most exacting of sciences, astronomy. Thus the sine (tangent) and cosine of one second of arc become

0.000004848137 and 0.999999999988, respectively.

The moon and the sun, almost barn-like in appearance in our heavens, subtend but approximately 30 minutes of arc. Whereas the apparent positions of even the closest stars as viewed from opposite sides of the earth's orbit change in the approximate magnitude of one second of arc.

By such substitutions as have been proposed above, it is possible to eliminate trigonometric functions from a great many calculations.

Line of Sight: In this age of flagpole sitters, balloon ascensions, rocket flights, and television, the line of sight problem needs refurbishing.

If a television transmitting antenna is **h** feet above the general surrounding terrain, reception will be possible at ground level **d** miles from the tower where the wave has become tangent to the earth's surface. The geometry of the situation reveals that the distance to the horizon along a line of sight is the approximate geometric mean between the height of the tower and the diameter of the earth, or,

$$d = \sqrt{\frac{7910 \times h}{5280}} = \sqrt{1.5h}$$

If a transmitting antenna is some 300 feet above the neighboring ground level, the range becomes,

$$d = \sqrt{450} = 21 + 9/43 = 21.2 \text{ miles}$$

A householder with a 50-foot receiving antenna may be a few miles beyond the arc of tangency and still have reception. We may apply the formula again and determine the reach on this form of shoestring catch:

$$d' = \sqrt{1.5h'} = \sqrt{75} = 8.7 \text{ miles}$$

Without interference reception is therefore limited by theory to a modest 20-30 miles, experiences of phenomena of reception with comparable antennas over distances of 80-90 miles notwithstanding. Sunspots, dust, other atmospheric and physical influences may be accountable.

Excellent congruence with existing navigational tables is found with a similar formula derived for expressing the distance to the horizon in nautical miles,

$$d'' = \frac{2\sqrt{h}}{3}$$

The latter formula being useful for ocean carp, who, if they can jump nine inches out of water, can spot flotsam a nautical mile away. River carp, of course, are expected to use $d = \sqrt{1.5h}$. Oddly enough, they need jump but eight inches to scan the first statute mile. The second mile is rougher, but that brings up a little economics on television towers.

The so-called "broadcast range" of a given tower is proportional to the square root of its height. There is in-area served is proportional to its height. There is incentive, at least, to go the limit on tower heights until some other factor outweighs the potential market which can be served.

Logarithms: Approximations in terms of logarithms are at times useful in obtaining a relative answer. The difficulty lies in finding a suitable "transition piece" to get from thinking in terms of real numbers to the logarithms of those numbers.

It remains very useful to recall that the base 10 logarithm of the integer 2 is very nearly 0.3, and then proceed to fix in our minds various other related logarithms. Our original error is approximately 0.3%. We are now prepared to state:

(*please turn to page* 32)

Campus . . .

(*continued from page* 15)

Bently, Vice-president of Deluxe Products Corp. spoke on the subject "The Relation of Lubrication and Filtration to Engine Life."

ASCE

The May meeting of ASCE featured a movie entitled "Prestressed Concrete" furnished by Preload Enterprizes.

The Sixth Annual Midwestern Conference of ASCE Student Chapters will be held at Purdue University on May 19-20. The Wisconsin Chapter will be represented at the conference by Richard Kolf, Robert Claypool, Gerald Riddiough and Thomas Wilson.

AIChE

A meeting will be held on May 11 for the purpose of electing officers for the following school year. Movies will also be shown at this meeting. Plans will be made to particiapte in Parents weekend which will be held on May 20-21. A picnic to be held at Olin Park is planned for May 27.

ETA KAPPA NU

The spring initiation of Eta Kappa Nu will be held in the Memorial Union on May 11. The initiation banquet, served in the Beefeaters Room will feature as guest speaker, Mr. George Steinmetz, Chief Engineer with the Wisconsin Public Service Commission. Mr. Bernie King, electrical engineering instructor, will act as toastmaster.

TAU BETA PI

Prof. Howard B. Gill of the University Sociology Department will be the guest speaker at the spring initiation banquet of Tau Beta Pi. Prof. Ben G. Elliot will serve as toastmaster at the banquet which will be held in the Roundtable Room of the Memorial Union.

IRE

Mr. John Biggs of Collins Aircraft presented a talk, with slides, on the subject of aircraft instruments at the May 4 meeting of IRE.

An election meeting is planned for May 11 to elect new officers for the coming year. Movies will be shown and refreshments served.

THETA TAU

Theta Tau fraternity plans a gala weekend on May 27-28. An initiation ceremony will be held during the afternoon of the 27th, followed by the election of officers for the coming year. These events will be followed by an initiation banquet to be held at the Capitol Hotel. The weekend will be topped off by a picnic for all members and alumni the following day.

AIEE

Nathan D. Pingel was elected Chairman of AIEE for a coming year at a meeting on April 26. Clifford D. Lau was elected Vice-chairman and John W. Armstron, Secretary-treasurer.

The speaker for the evening was Mr. Henry Worthman of the Dow Corning Corporation who presented a talk on the newly developed silicon electrical insulation.

Layout . . .

(*continued from page* 12)

THE PROBLEM

A Madison firm which is a leading manufacturer of specialized and complex equipment became vexed by gradually increasing "growing pains." The time came when it was necessary to make a definite move toward greater large-scale efficiency in order to meet competitors' prices.

Undoubtedly the biggest thorn in the company's side was the fact that as the company grew, new machines, assembly benches, employes, office space, stores, shipping room area and so on were added as they were needed. Quite naturally, little thought was given at the time to the rolling-snow-ball effect and new space was taken where it could be found. Another building was added.

A duplication of the first plant resulted from this; dual machine shops, offices, inventories shipping and receiving rooms now had to be kept.

No standard size tote box was used throughout the plant, and in many places discarded packing boxes served as tote pans.

Stores in both buildings held similar or identical items of raw stock, work in process, and finished goods. Inventories soared to over a million dollars.

Tracing W. I. P. showed that some parts originated in one building, were trucked to the other one and returned to the first building again, sometimes traveling the length of the plant several times in each building.

Other factors, either the cause or effect of the new proposed layout were: some of the present machines were going to be scrapped; new machines were on order; a new Ford truck is on order, which would conserve storage space, change aisle requirements, and have a marked effect everywhere in the shop.

Other problems, not directly concerned with the layout are irrelevant here and won't be mentioned.

THE SUGGESTED SOLUTIONS

Probably the most important single factor was to move all fabrication to one building and all assembly to the other. The very nature of the business demanded this step be taken, although it wouldn't have been necessary if only two distinctly different products were being manufactured.—As one of their engineers has said, they are a "job shop on a production basis."

Another important suggestion was to have the general flow of the products approximate a semi-circle: from receiving to machine shop to shipping, with the fabrication order synchronized with a physical loop of the plant.

THE METHOD OF SOLUTION

Now to leave the specific problem for a time and study the general method used. After the need or desire for a different plant layout has been realized, and the prelim-

(*please turn to page* 34)

R. S. Owen . . .

(continued from page 9)

continued as instructor until the fall of 1917, when he left the University to take a commission as a captain, and later major, in the army Corps of Engineers. On the trip over to France Mr. Owen, who always was fond of instruments and gadgets, took a sextant along with him on the boat. While everyone else was wondering where they were, he took daily observations on the sun, and knew their position all during the trip. In France he was assigned to General Pershing's intelligence section at Chaumont. He received the Order of the Purple Heart and the French Academic Palms.

He resumed teaching in the fall of 1919, and was made head of the topographic engineering department soon after that, when Professor Leonard Smith withdrew to take over as chairman of the structures department. In the summer of 1920 Professor Owen began organizing the summer survey camp at its present location at Devil's Lake, where it has been built up largely by student labor. He was always known for being very active at summer camp. The students really had to scramble over the boulders to keep up with him on surveys that he conducted.

While on the faculty, Mr. Owen served as assistant dean of men during the year 1921-22. He was also chairman of the discipline committee for a period of about five years. He stopped teaching after the summer session of 1948 to take a year's leave of absence, after which he retired.

In addition to being a member of the American Legion, Military Order of Foreign Wars, and the Society of American Military Engineers, Professor Owen was active for a long time as a colonel in the Wisconsin National Guard. During one of their frequent encampments at Camp McCoy, he was assigned to mix the chemicals to produce a smoke screen over a certain area of the camp for some maneuvers. Instead of being "too little and too late", his smoke screen was "too much and too soon", covering the whole camp and a good deal of the surrounding territory.

During his many years in Madison Mr. Owen has been connected with several land companies engaged in making subdivisions in and around Madison. He has also spent a great deal of time in making land surveys for private individuals, largely employing student help. He says that his surveys have covered enough territory so that he could walk completely around the city of Madison on land he has surveyed.

Professor and Mrs. Owen have three daughters: Mrs. Sally Marshall, Mrs. Merle Hamel, and Mrs. Betsy Steele. The latter two of the Owen girls are doctors. Mrs. Hamel has recently been appointed head of the new Madison Red Cross blood center. There are eleven grandchildren, between the ages of eight and fourteen.

The Owen home, "Bungal-Owen", is a large, rambling, Early-American house on a lake-front tract in Monona Village. It has received mention in most of the well-known home magazines in the country. The interior is decorated in authentic Early-American style, with immense fieldstone fireplaces, old furniture of that period, a grandfather clock, and a collection of old maps, ship's barometers, and many other instruments. Mr. Owen has always been interested in furthering social activities among the engineering students. His home was generously lent for functions and parties of the engineering societies, and for a long time the Owens put on a spring feed each year for the civil engineering students.

Although the long period of his service to the University as a professor has ended, Ray Owen has not retired from the other aspects of his active life. He will probably continue in his occupations and his many hobbies for years to come.

Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

BEAM STRENGTH — When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

CRUSHING STRENGTH — The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

SHOCK STRENGTH — The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH — In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

Without beam strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON

CAST IRON PIPE SERVES FOR CENTURIES

Science . . .

(continued from page 20)

In addition to absolute mass measurements, the omegatron's high resolution and extreme sensitivity make it ideal for analysis of gases and vapors, and for measurement of nuclear packing fractions (the excess of actual mass over mass number for any isotope) which are important in atomic engineering work.

The omegatron operates on the same fundamental principle as a large cyclotron, yet the heart of it is no larger than a package of cigarettes. The so-called cyclotron equation, $w = eB/M$, is applied to discriminate between particles of different mass. The ratio e/M is found easily by determining w with the aid of accurate frequency standards and measurements of B by means of nuclear resonance methods.

As in the cyclotron, the omegatron employs a radio-frequency electric field at right angles to the magnetic field. With this frequency equals that of the rotating ions (resonance) they will spiral out from the center and a collector placed at a fixed distance from the center of rotation of the ions will give maximum ion current.

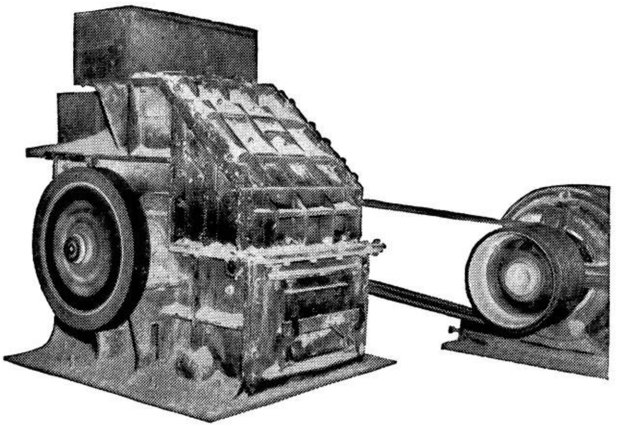
Resonance is quite sharp and can be determined very precisely. The degree of sharpness is called the "resolution" and is proportional to the number of revolutions an ion makes. For this reason, a set of guard rings at high positive potential set up a trapping field which holds the ions in the field for more than a millisecond, enabling thousands of revolutions to be made before being collected. This sensitivity permits very small samples to be used. A wide range of pressures may be used and excellent resonance peaks have been obtained at pressures around 10-7 millimeters of mercury.

Television images can be given a third dimension by techniques recently developed by RCA. Dr. V. K. Zworykin, Vice President of RCA Laboratories, explained that this would extend the usefulness of their industrial television system and could be accomplished with a minimum of additional equipment.

In order to produce the stereoscopic effect, two cameras side-by-side would view the object in the same way that the spacing of human eyes produces the effect of depth. The TV signals, corresponding to the two offset scenes, would then be transmitted to two kinescopes, either through the air or by suitable cables. The separate images would be combined and viewed through special filters to give the three-dimensional effect.

The entire industrial TV system operates on 110 volts, 60 cycle A. C. and consumes about one-third the power of an electric toaster. The equipment, including controls and power supply, weighs only 58 pounds and is enclosed in a single carrying case.

Another page for **YOUR BEARING NOTEBOOK**

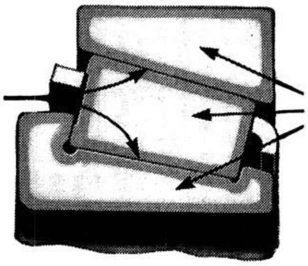


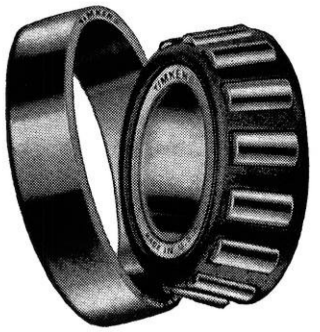
How to keep a rock crusher from minding the grind

In a hammermill rock crusher, every revolution of the rotor shaft puts a heavy shock load on its bearings. Engineers have solved this problem by using Timken® tapered roller bearings. Timken bearings take the heaviest loads—both radial and thrust. They require a minimum of maintenance and normally last the life of the crusher.

Why TIMKEN® bearings can take the tough loads

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





TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Learn more about bearings!

Some of the engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. For additional information 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

Shock . . .

(continued from page 14)

erated machines has taken on a note of caution, safety for the operator. Bus panels and control units for high voltages are built with inter-locking systems that require the high voltage to be disconnected before the lock will open. These locks are masterpieces that will thwart even the most foolhardy repair man or operator. Another example is the interlock safety switch used in connection with fuse boxes and switch boxes for equipment. A cam-like arrangement makes it impossible to close the switch while the door is open. The switch can be locked in the open position to prevent other than the one who locked it from closing it. These are only two of many items designed with the safety of both the operator and the repairman in mind. To be sure that the equipment purchased is safe electrically it should bear the seal of the Underwriter's Laboratories, Inc., which identifies the unit as complying with the National Electric Code.

The designing of safety features in electrical equipment must be followed by the proper installing and use of the equipment. Haphazard installation or lack of preventative maintainence can be just as dangerous as turning on a light while standing in a bath tub. The removal of equipment which is defective and beyond safe repair is only one means of preventing electrical accidents. In general the safety in the shop must be practiced and built into the shop.

By isolation, current carrying equipment should be enclosed in special rooms, as established for transformers and control panels, where ever possible. Where ever electrical equipment cannot be isolated, fire resistant enclosures should be established. Such an enclosure may be made of metal framing and heavy wire. The enclosing unit serves a two fold purpose. That of isolation and as a barrier against dropped tools or other short circuiting items. Thus the equipment such as a motor or switch box would have little chance of being jammed by such dropped items.

Barrier guards should be established where enclosures are not possible. This is especially true around test areas and experimental equipment present in many shops to prevent any of the temporary wiring from being tampered with by an unauthorized person. When several testing areas are in one location passages well marked and clear should be present for the passage of personnel from one area to another or through another. This is a common practice in large plants yet a neglected precaution in many of the smaller organizations.

By the proper grounding of dead metal and enclosures protection from the direct exposures to charged surfaces is increased. The reason for electrical grounding develops because of the method of power transmission in use today. Most electric circuits have one side of the circuit itself permanently connected to ground.

(please turn to page 36)

Sliderule . . .

(continued from page 24)

$\log 4 = 2\log 2 = 0.6$, $\log 8 = 3\log 2 = 0.9$
$\log 5 = 1 - \log 2 = 0.7$, $\log 9 = \frac{1}{2}(1+\log 8) = 0.95$
$\log 3 = \frac{1}{2}\log 9 = 0.48$ $\text{Log } 6 = \log 2 + \log 3 = 0.78$

These rough values for the logarithms of small numbers make it possible to obtain many other more difficult results. The cube root of 2 may be found approximately through these crude logs. $1/3 \log 2 = 0.1 = \log 5 - \log 4$. The cube root of 2 is closely 5/4, of 1.25.

2^{10} is found by logarithms: $10 \log 2 = 3.0$; $2^{10} = 10^3$. As a check upon our accuracy, $2^{10} = 1024$, whereas $10^3 = 1000$. Our original error was 0.33%. It has grown to 2.4%. It pays to keep in mind that approximations with logarithms will introduce error very rapidly as the powers used become higher. In other approximation methods, we have found it necessary to establish a certain range throughout which the approximation holds sufficiently well. In terms of logarithms, our range applies to the power of the exponent, but will remain undefined.

The above method still may be used to obtain a rational answer for the perennial poser of the investment that begins with a single penny on the first day of the month and then doubles each succeeding day for 29 additional days. We may write each day's investment down as $2^0, 2^1, 2^2, \ldots, 2^{28}$, and 2^{29}. First we should estabblish that the final day's investment is simply one penny over half of the gross investment. This may be shown to be true for any day leading up to the last day, and it can be shown to be true for the last day if a person sticks to the task. We simply state, two cents the second day **vs.** one already in deposit,, four cents the third day **vs.** three already accumulated, 8 cents the fourth day **vs.** 7 cents on hand, etc. The total investment, therefore, is very nearly $2 \times 2^{29} = 2^{30}$.

Changing over to logarithms, we express the logarithm of our unknown number as $30 \log 2 = 9$. The number of pennies, then, is 10^9 or one billion. The approximate solution is ten million dollars. The actual solution: $10,737,418.23.

We observe $\ln 20 = 3.0$. Then $\ln e 20^3 = 9$. In other words, $e^9 = 8000$, and $e^{10} = 2.718\ (8000) \cong 22{,}000$. Your slide rules generally limit calculations of e^x to e^{10} with the solution approximately that which is shown above.

We may express 20 as an exponentional value of either 10 or e: $20 = 2^3 = 10^{1.3}$

Taking logarithms to an undefined base,
$\log 20 = \log e = 1.3 \log 10$.

Selecting **e** as our base yields $33 = 1.3 \ln 10$, or the logarithm of 10 to the base **e** is approximately $3/1.3$, or 2.3. You may recall 2.3026 as a closer value.

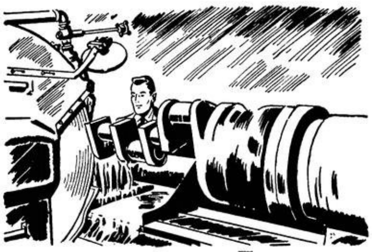
Selecting 10 as our base yields $1.3 = 3 \log e$, or the logarithm of e to the base 10 is nearly $1.3/3 = 0.433$. The recognized conversion factor is more nearly 0.4343.

The last two relationships having utility in changing from one logarithmic base to another.

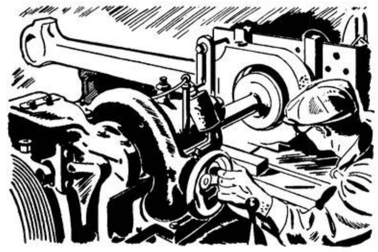
How Edwin Peterson might answer his 7-year-old son Paul. Edwin knows the answers. He's been around Norton for 30 years. In fact, ten percent of Norton employees have been on the job 25 years or more.

"Gee, Dad, WHY DOES IT HAVE AN UPSTAIRS?"

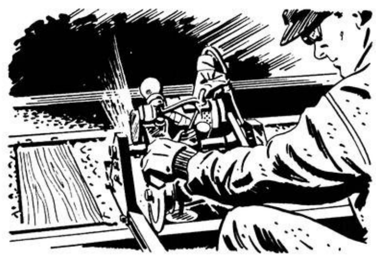
"To make traveling more fun. The idea is to give people more to see and do while riding faster and safer. That means more passengers for the railroads so that they can keep fares down and still add more comfort to long trips."



"Railroad comfort comes from many things, son. Smooth-fitting parts are important. Parts like Diesel engine crankshafts, pistons and wheels. That's why so many railroad shops use Norton grinders and Alundum grinding wheels to make parts smooth.



"Take those side rods on steam locomotives. They get farther over on the smooth side thanks to Norton internal grinding wheels. And parts are finished so accurately with Norton quality controlled wheels that they last for thousands of miles, Paul.



"Getting back to comfort . . . modern trains travel over 60 miles an hour. So, they need smooth rail joints. Those joints are welded for safety. Then, they're ground smooth and slotted with Norton grinding and cut-off wheels."

"Hundreds of other parts of modern railroad trains and tracks also get a lift from the sure touch of Norton Products. So does just about any other product you can name. That's why I'm not boasting when I say that Norton makes better products to make other products better."

NORTON

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

Making better products to make other products better

ABRASIVES — GRINDING WHEELS — OILSTONES — ABRASIVE PAPER & CLOTH — GRINDING AND LAPPING MACHINES — LABELING MACHINES — NON-SLIP FLOORING — REFRACTORIES, POROUS MEDIUMS & LABORATORY WARE — NORBIDE PRODUCTS

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

Layout . . .

(continued from page 27)

inary suggestions have been discussed and evaluated, the first tangible step is taken. This includes an accurate floor plan of the existing buildings, with columns, walls, stairs, offices, ventilating pipes for paint-spraying booths, and all more or less permament fixtures whose movement would involve an exorbitant expenditure of money.

Following this step is an area-usage study of the existing set-up. Calculation of aisle space, stores, machine shop departments, and so on is the basis on which the feasibility of the proposed plan is to be compared.

The most interesting and controversial phase of the layout planning is now ready to blossom the actual plot plan of the various departments. Measurements of the machines, benches, tote pans, and so on are taken and recorded on separate sheets, with important information such as the capacity, work station number, speeds, feeds, department, type, manufacturers number, overall length (or width) with overall depth, space requirements for servicing and any other pertinent comments. Also, a sketch of the top view is usually drawn to scale on this sheet, with the outline showing the farthest protruding points within seven feet of the floor.

Now templates can be made of the machines or three-dimensional models may be purchased, both having their advantages under certain circumstances. Which system is used has little effect on the next stop: moving the models about on a layout background. This is the most time consuming phase of the layout and the climax of the study. There are innumerable combinations and many attempts are made before a satisfactory layout is decided upon. This point is reached when the plan cannot be picked apart for any justifiable reason.

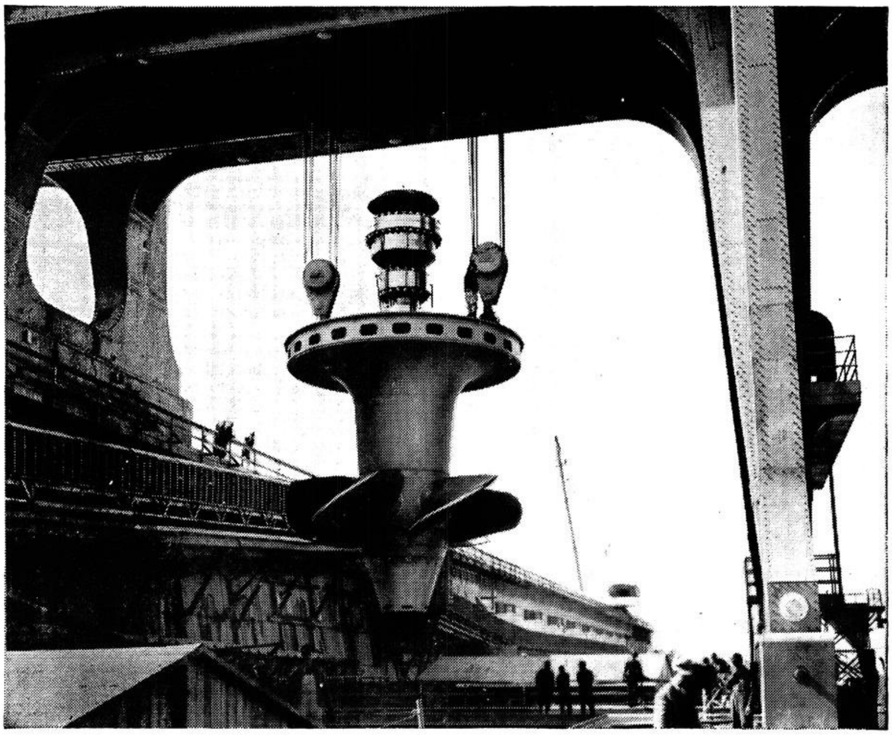
"Clean-up" consists of ironing out any final problems or differences preparatory to final "O. K." by management When this is completed the actual plant layout job is finished. However, in existing plants there is necessary a "checkerboarding" of moves to insure against excessive loss of time due to several machines standing idle at their new location before the old machines are moved away.

In the actual layout problem previously discussed, the University's M. E. 1880 class working on layout planning was split into two five-man teams.

The company's engineers, and the two groups of students under the supervision of Professor R. L. Daggett formed three distinct teams, each working more or less independently of the others. The purpose of making three parallel proposed layouts was to obtain three points of view and attempt to correlate the best ideas into one plan. There were some minor differences of opinion, but it was extremely interesting to note that in general the three groups each arrived at essentially the same conclusions and final plan.

SPRINGBOARD TO A CAREER IN ENGINEERING

by J. F. ROBERTS
Manager, Hydraulic Department
General Machinery Division
ALLIS-CHALMERS MANUFACTURING COMPANY
(Graduate Training Course 1919)



Kentucky Dam TVA **Field erection view of 250-ton gantry crane lowering hydraulic turbine assembly. One of five 44,000 hp, 48-ft. head, Kaplan type turbines.**

YOU HAVE to start somewhere—and as far as I know, flagpole painting is the only job where you start at the top. Next best thing is to get in where there are many opportunities, and many interesting, worthwhile paths to follow—particularly if you are not entirely sure just what type of work you want to do. You then have a chance to try more than one field, and eventually find the work that will give you the most in satisfaction and success.

J. F. ROBERTS

Growth of Hydraulics

The field I'm best qualified to discuss is hydraulic engineering. Crude waterwheels were man's first mechanical source of power. Today, in highly perfected modern form, they're still a major source of abundant, low-cost electric power. The field is constantly expanding and holds a world of opportunity. Hydraulic power becomes increasingly important to the nation as the need for low-cost power steadily increases. Moreover, a hydraulic plant once installed produces energy with a minimum of manpower. There's no fuel to mine, prepare, ship, unload and burn—small operating personnel is required.

Right now at Allis-Chalmers we're designing and building turbines for vast new hydro-power projects, not only for the U.S.A. and Canada, but also for Mexico, South America, Norway, New Zealand and the Philippine Islands. We're also restoring many veteran turbines to better-than-original efficiency and capacity after long years of faithful performance.

Hydraulics was a field that I hadn't seriously considered as an undergraduate at the University of Wisconsin. I graduated as a Mechanical Engineer in 1918, and entered the Allis-Chalmers Graduate Training Course in January 1919. It was there that I got interested in the big waterwheels.

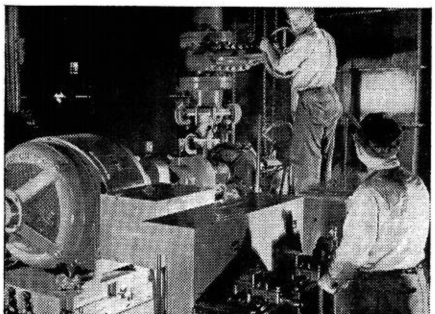
My first assignment was in steam turbine erection. Then I moved over on the hydraulic turbine test floor. In May 1919 I was sent to North Carolina on the acceptance tests of a big hydro-electric power installation. I continued with hydraulic field work such as tests and trouble shooting until 1925, when I went into the sales end of the work. Two years later I left the manufacturing side and became Hydraulic Engineer for the Power Corporation of Canada, supervising the design and installation of some 15 plants.

In 1936 I became Hydraulic Engineer for the U. S. Government TVA, involving 12 projects and 30 large units. I returned to Allis-Chalmers in 1942 as Manager of the Hydraulic Department—and had the unique experience of building some of the same turbines that I had purchased for TVA.

Vantage Point for All Industries

These personal notes serve to illustrate two interesting facts about the Allis-Chalmers Graduate Training Course. First, it's tailor-made for each student. Since 1904, graduate students here have been helping plan their own courses—making changes as they went along and new interests developed. They've had an opportunity to divide their time between shop and office—follow important projects through from drafting board to installation.

Second, the organization is in close contact with virtually all phases of industry: hydraulic or steam electric power plants and utilities; mining, smelting and rock products; public works; steel and metal working; textiles; food processing; flour milling. Allis-Chalmers builds basic machinery for ALL these industries and many more. Its engineers, executives, salesmen and production experts have a ringside seat for industry in action.



Graduate students conduct performance tests of centrifugal pump units.

ALLIS-CHALMERS A-C ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

Shock! . . .

(*continued from page* 32)

It is for this reason most fatal shocks pass through the feet and require the most complete equipment protection where the individual using it will be standing on a conducting surface.

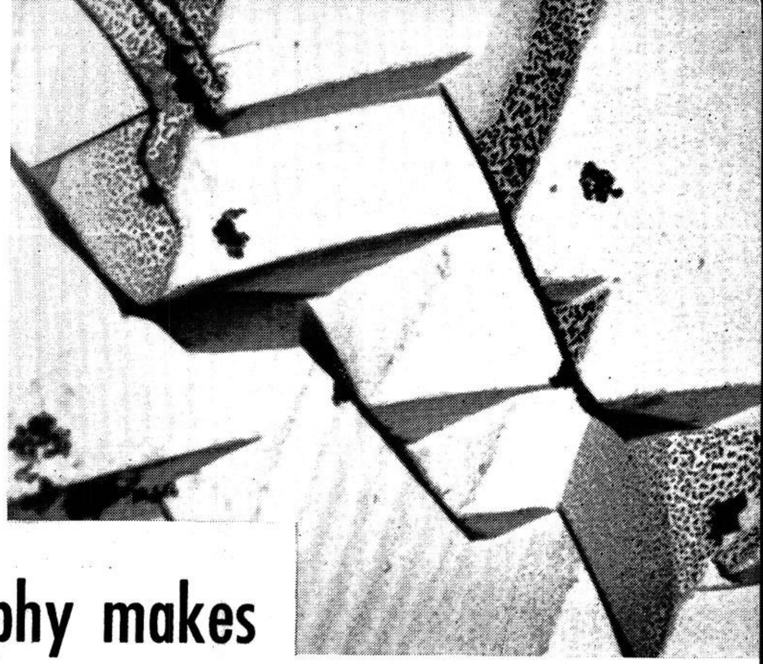
Since insulation within the enclosure may at some time fail and cause the shortening of a charged part to the dead metal the ground should be of high current capacity so the short will open the fuse of circuit breaker. The ground wire is usually attached to some water pipe or other permanent system which is continually connected to ground. A three wire system is now in use by which two wires carry the current and the third is the ground wire The arrangement is such that the ground wire is connected to a third prong of a three way plug. For 220 volt systems a fourth wire is added to serve as the ground. What ever method used for grounding, permanency should be assured by a periodic checkup. Deaths have occurred repeatedly that were directly due to accidental breakage of protective ground connections. In the absence of a water pipe a rod should be driven at least eight feet into the ground such that it is always in contact with moist earth. A strong mechanical connection as well as a good electric connection should be made. There are many modern grounding attachments on the market which will insure the above conditions.

Grounding protection should be afforded to all types of portable equipment, frames of generators, motors, switchboards, controls of motors, tracks and motors of cranes lightning arresters, electrical equipment of elevators, and other equipment which may build up static electricity.

When ever repairs are being made on any electrical equipment they should be made with the circuit dead. To assure that the circuit is not accidentally made alive the switch should be locked open and if the circuit is fused, the fuses removed. A warning tag signed by the repairman who opened the circuit should be attached to the locked switch. Only when the circuit is ready for use should the lock and tag be removed.

The National Electric Code as recommended by the National Fire Protection Association and the Underwriters Laboratories approved list of equipment may be used as authoritative guides and references. All installations should comply with any state or local laws or ordinances.

The field of electrical safety is so broad that no one article could cover all requirements. On newer and large installations formal state and city codes have never been written and it remains for the designer and manufacturer to write their own safety specifications. For any wiring or other electrical equipment specifications the National Electric Code as Recommended by the National Fire Protection Association and the Underwriter Laboratories approved list of equipment may be used as authoritative guides and references.



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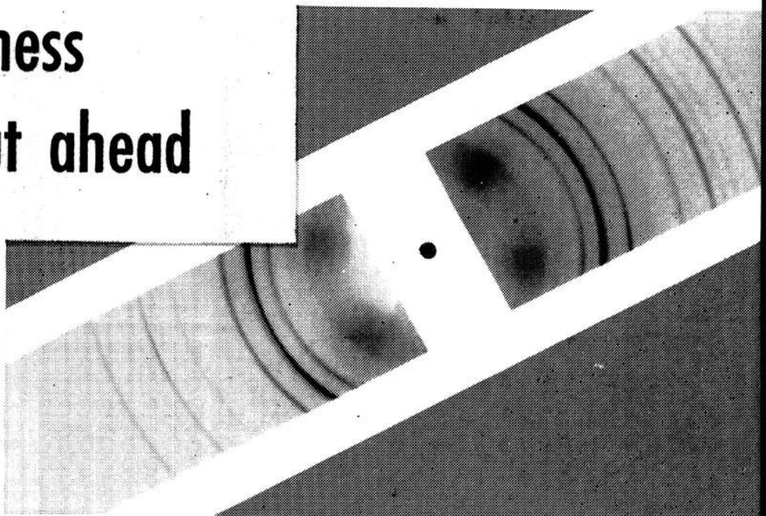

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