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The Wisconsin

Engineer

April, 1949

In This Issue:

Tokens of Spring

15¢

Summer Opportunities

with

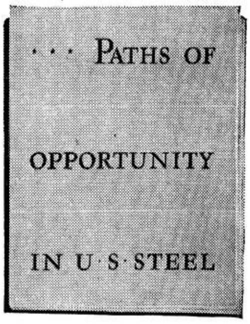
UNITED STATES STEEL

and how they can affect your future

UNITED STATES STEEL CORPORATION SUBSIDIARIES are now selecting a limited number of outstanding engineering students for summer employment. This temporary work has been designed to provide students with practical experience that will supplement their regular college curriculum. This work may also prove a valuable guide to the student in choosing his life work following graduation.

The activities of U. S. Steel Subsidiary Companies are so diversified that they require qualified men in just about every branch of engineering. And every effort is made to place these students in permanent positions with U. S. Steel after graduation.

Your Placement Officer can give you additional information about summer employment with United States Steel. Why not discuss the matter with him and at the same time ask him for a copy of the book—"Paths of Opportunity in U. S. Steel."



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UNITED STATES STEEL

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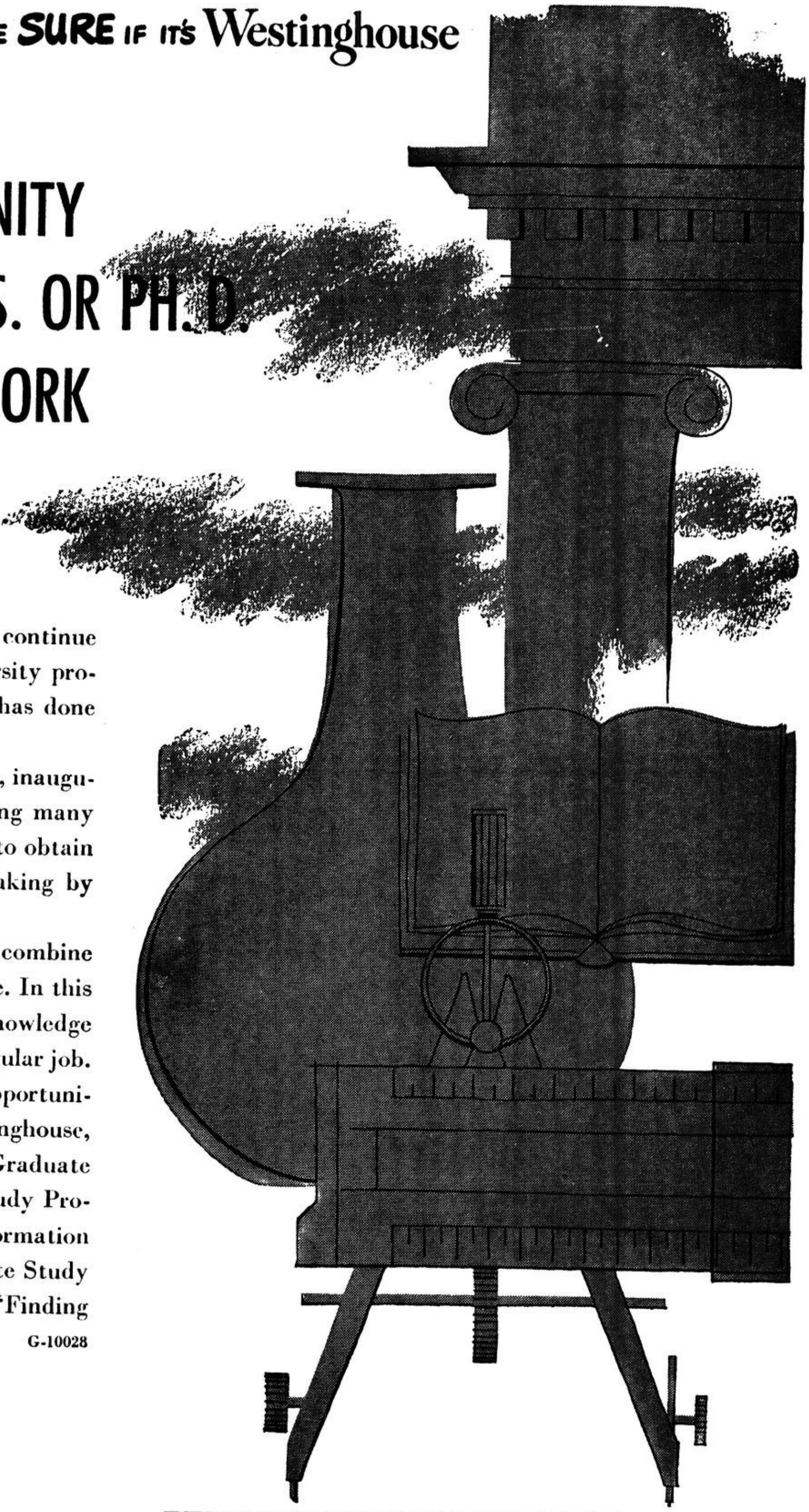
AN OPPORTUNITY TO OBTAIN YOUR M. S. OR PH. D. WHILE YOU WORK



Not all men qualified for graduate work can continue their advanced study under a full-time university program. Westinghouse recognizes this fact and has done something about it.

The Westinghouse Graduate Study Program, inaugurated in 1927, has been instrumental in helping many Westinghouse employes realize their ambition to obtain an M.S. or Ph.D. degree. It is a joint undertaking by Westinghouse and several leading universities.

The Graduate Study Program enables you to combine advanced study with your job at Westinghouse. In this way, you can apply advanced fundamental knowledge to solve the problems you encounter on your regular job.

Get complete information about the many opportunities offered engineering graduates at Westinghouse, including the advantages offered through the Graduate Student Training Course and the Graduate Study Program leading to higher degrees. Complete information is given in the booklet, "Westinghouse Graduate Study Program". You may also want a copy of, "Finding Your Place in Industry". Use coupon at right. G-10028

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Scene from the Alcoa Technicolor Film, "Unfinished Rainbows", starring Alan Ladd as Charles Martin Hall with Janet Shaw as his sister Julia. Available on request for your church, school or organization. Address Gulf Building, Pittsburgh 19, Penna.

ALAN LADD now co-starring in "WHISPERING SMITH", a Paramount Picture. Color by Technicolor.

How a group of American pioneers has held the price of Aluminum down

Charles Martin Hall, founder of America's aluminum industry, had a special kind of gleam in his eye. Every one of us has it too.

He was bound and determined to find a way to make aluminum cheaply. The schoolbooks all tell how he did it, where the world's greatest scientists failed.

Bluntly speaking, Charles Martin Hall set out to cut the world price of aluminum.

He was the first of the men and women of Aluminum Company of America. He licked a process. We who followed him—engineers, chemists, metallurgists, physicists, production experts—have been at it ever since.

But the gleam is the same. It's bumping elbows in the research lab with men who, in fifty years, have accomplished most of the finding-out that took fifty centuries, with the age-old metals.

It's working in the mill and having it seem that every shining sheet racing over the rolls is your own.

It's typing a letter in answer to a simple query, and having the deep-down feeling that you may be in at the birth of a new business, taking root in aluminum.

We propose to keep on being pioneers in broadening the usefulness of aluminum. Alcoa Aluminum sold in 1939 for 20 cents a pound. It sells today for 16 cents.

We are pioneering with microscopes and calipers and rolling mills. We'll stack them against axes and squirrel rifles and spinning wheels, for a place of importance in the history of our America.

To know other stories of the Alcoa family and the growth of aluminum's usefulness to you, write for free copy of "Aluminum—Its Story", ALUMINUM COMPANY OF AMERICA, *Gulf Bldg., Pittsburgh 19, Pa.*

ALCOA FIRST IN **ALUMINUM**

Variety of Equipment used by

SUPERIOR METAL TREATERS, INC.

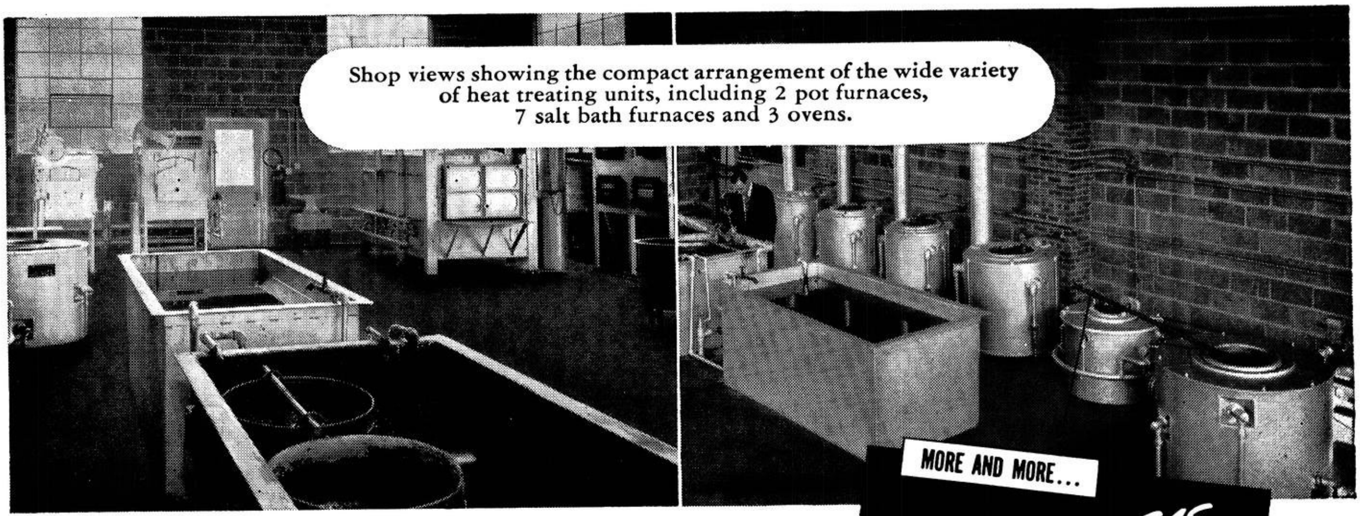
Emphasizes the Versatility of GAS

VARIETY is one of the most characteristic features of a commercial heat treating shop—variety of customer demands and variety of equipment required to fulfill them.

With a background of 22 years experience, Evan D. Ehmann, President of Superior Metal Treaters, Inc., knew just what to look for when he established his Newark, New Jersey, shop. This modern plant has the productive capacity to cope with the miscellaneous requirements of many customers.

Key feature of the installation is the versatility of the equipment. Each unit was chosen for its ability to perform under a number of different conditions. In selecting this equipment Mr. Ehmann determined to use GAS because, as he expresses it, **"During my years in this business I discovered that Gas Equipment provided the accurate control, economical operation, and versatility we needed. The precise temperatures and speed of heating we obtain with GAS mean a lot of extra production in our shop."**

Whether the heat treating process is a production-line application, or a commercial shop operation, the flexibility of GAS and the versatility of modern Gas Equipment are important economic factors. The characteristics of GAS make it stand out in any comparison with other available fuels for heat processing.



Shop views showing the compact arrangement of the wide variety of heat treating units, including 2 pot furnaces, 7 salt bath furnaces and 3 ovens.

MORE AND MORE...

THE TREND IS TO GAS

FOR ALL INDUSTRIAL HEATING

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Founded 1896

Volume 53 **APRIL, 1949** *Number 7*

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In This Issue . . .

Cover:

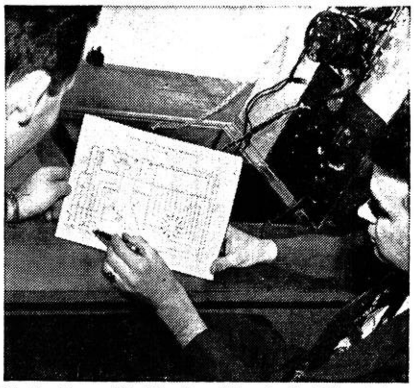
TOKENS OF SPRING—We don't really think that cover girl Phylis Pagel needs the king size slide rule to keep track of her tennis score. (An engineer probably would!) The lucky photographers who got this assignment are Robert O. Memmel and Robert Hull. The *luckier* slide rule came from Brown's Book Store.

Articles:

Departments:

DU PONT *Digest*

For Students of Science and Engineering



W. L. Foy, *Ph.D. in Physical Chemistry, Clark University, 1947, and A. C. Lapsley, Ph.D. in Physics, Virginia, 1947, discussing details of Color Densitometer Wiring Diagram used in connection with research on color photography.*

Chemists in Pictures

How Du Pont and studio scientists solved the problem of noisy film

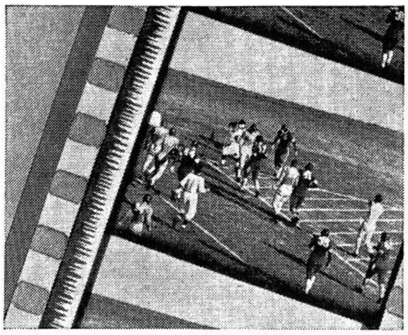
Who'd ever expect to find Du Pont chemists in Hollywood? When motion pictures suddenly started to talk, a whole new series of perplexing scientific problems was born, not the least of which was "noisy" film.

As you know, sound is usually recorded directly on film. If you hold a strip of motion picture film to the light, the sound track is seen as a narrow band of irregular lines. A light ray passing through the moving sound track falls on a photocell with rapid interruptions or changes in intensity. The photocell converts these interruptions into electrical impulses which, amplified, reach the theater audience as voice and music.

If the film has a coarse grain structure, it tends to give lines that are not sharp and uniform in density. Such irregularities interrupt the light ray—come out as distracting noise.

What could be done about it? Du Pont scientists of the Photo Products Department started a program of research, in cooperation with technical experts from the studios in Hollywood. They made and tested scores of film coatings. Finally there were developed films of exceedingly fine grain structures.

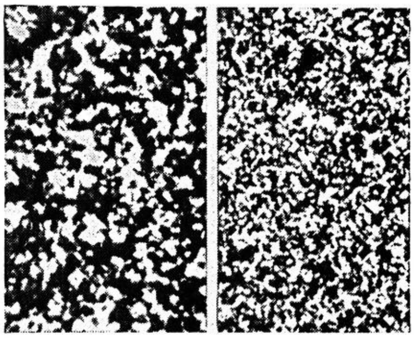
M-G-M and Paramount were among the first to use the new type Du Pont films. The development was heralded by the press as "another milestone in the technical progress of the industry," and in 1943 Du Pont received an Academy Award of Merit for its achievement. Now the use of fine grain films is practically universal in Hollywood. Actors, actresses speak their lines, with no technical restrictions to cramp their artistry.



Voice and music *appear as a continuous band of irregular lines on this movie sound track. Any irregularity means noise.*

You may have a place in Du Pont research

Had you been a member of a Du Pont Photo Products research team since 1931, you might have shared in many outstanding achievements, two of which have been recognized by "Oscars."



In coarse grain films, *the particles of silver are large and scattered. Compare with Du Pont fine grain film, right. (Magnified 1000 times.)*

Achievements *of Du Pont scientists over the years have won two "Oscars" from Academy of Motion Picture Arts and Sciences.*

The Photo Products Department, however, is just one of ten Du Pont manufacturing departments, all of which engage in continuous research. Operated much like separate companies, each holds challenging opportunities for young, college-trained chemists, engineers and physicists. Du Pont not only tries to select young men and women of promise, but makes a conscientious effort to help each one develop as rapidly as possible. Whatever your interests, you will find here the cooperation and friendly interest you need to do your best. As a member of a small, congenial working team, your ability can be seen, recognized and rewarded.

Don't miss reading this new booklet about Du Pont

Send for your copy of "The Du Pont Company and the College Graduate." This fully illustrated, 40-page booklet answers your questions, describes many fields which may be new to you. Tells about opportunities in research, production, sales, etc. Explains how recognition of ability is assured. For free copy, address: 2518 Nemours Bldg., Wilmington 98, Delaware.

WRITE TODAY *for "The Du Pont Company and the College Graduate"*

DU PONT

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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

More facts about Du Pont — Listen to "Cavalcade of America" Monday Nights, NBC Coast to Coast

(Photos by Wahlin and McKeon)

ST. PAT — 1949

Fritz Kohli, electrical engineer, breaks through a pile of buttons to claim the title of St. Pat for 1949.

HC ENGINES

Inside the new Oldsmobile "Rocket"

by Russell Pipkorn m'49

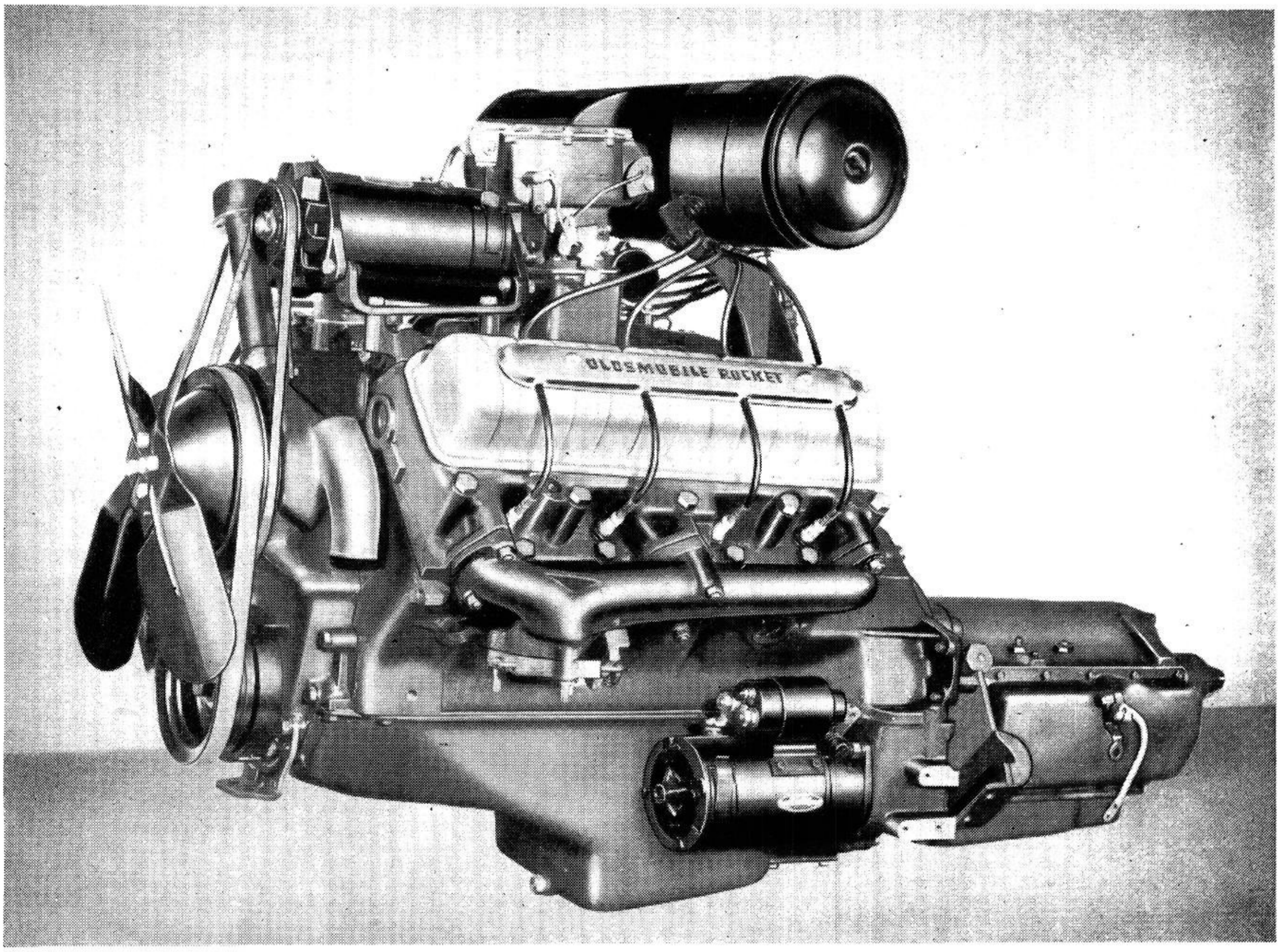
RESEARCH has again triumphed. Two new internal combustion engines have been developed, one by Dr. Charles F. Kettering, head of General Motors Research, and the other by the engineers of Cadillac. Both engines are strangely similar in design, having been developed independently. "Boss Ket," as Dr. Kettering is known to his associates, has always been an advocate of basic research, and again it has "paid off."

The high compression ratios, as high as 12 to 1, must wait for the advent of high octane gasoline, with an octane rating of about 100. In the meantime, with the available fuels, the maximum ratio used will be 7.5 to 1. Cadillac will use this ratio, while the Kettering engine will use a ratio of 7.25 to 1. This increased ratio (today's engines use ratios just under 7 to 1) means increased power with smaller, lighter engines.

Changes in the Design of Cylinders

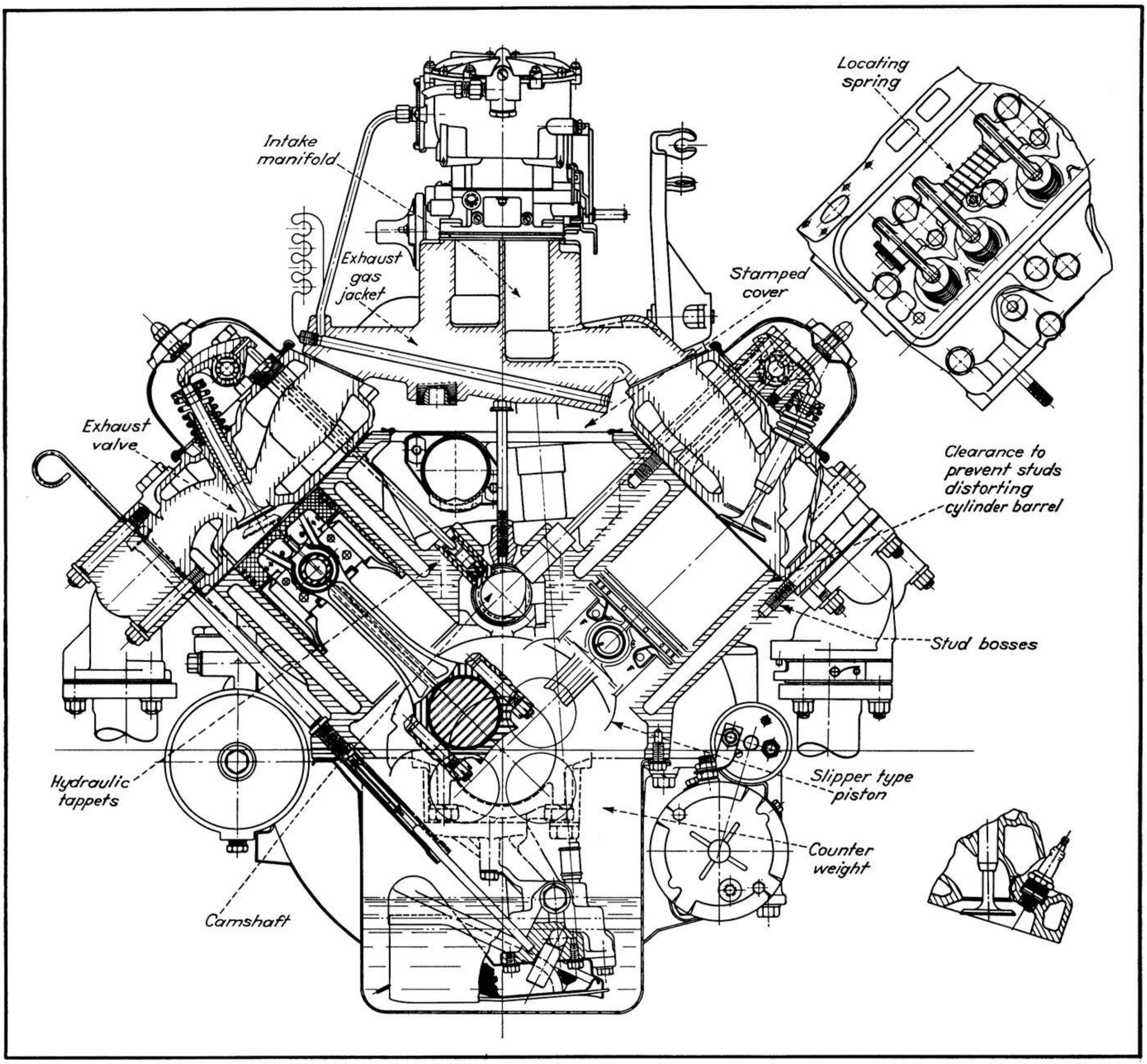
Numerous design changes were found to be the most successful by both groups. For the purpose of description, the Kettering engine is a good example. This engine is to be used on the new Oldsmobile.

The old eight cylinder in-line engine has been replaced by the V-type engine having four cylinders in each bank of the V. This has been responsible for the greatest decrease in the length of the engine. The crankcase has thus been shortened and made more rugged. The crankshaft has also been simplified, since now it requires only four throws instead of the original eight. In this design two connecting rods operate from one throw. The crankshaft—now only 26 7/16 inches long, 12 3/4 inches shorter than the old design—is stiffer and is less affected by the bending action produced by the piston force. Five main



(*Cut courtesy of Product Engineering Magazine*)

View of the new Kettering engine as being used in the new Oldsmobiles.



(Cut courtesy of Product Engineering Magazine)

A cross-sectional drawing taken through the cylinder of the Kettering engine. Note the V-type construction and the cutaway skirt on the piston. The cross hatched section around the cylinder heads outline the exhaust gas jacket.

bearings are used instead of the conventional three, helping to increase the rigidity of the crankshaft.

The diameter of the pistons has been enlarged to 3 3/4 inches and the stroke has been shortened to only 3 7/16 inches. This is a ratio of stroke to piston diameter of 0.917 as compared to the old ratio of 1.191. This decrease in the stroke length has made possible a decrease in the length of the connecting rods. This, along with a heavier I-section, has provided connecting rods more resistant to bending stresses. They have also been provided with a balancing pad on each end. In manufacture these pads are automatically machined to size to give accurate weights on each end and consequently perfect balance.

The piston has also been improved in design. Instead of the conventional full skirt on the piston, a portion on each side, in line with the wrist pin, has been cut out to allow clearance for the crankshaft. Slots between the head and skirt of the piston lessen the heat transfer to the skirt and consequently lessen the skirt distortion, always maintaining the proper fit of piston to cylinder. Steel struts, integrally cast in the aluminum piston give additional support to the wrist pin bushings. Four piston rings have replaced the conventional five with no loss in the proper sealing. Pads for balancing have also been included, cast as part of the wrist pin bosses. The weight of each piston is made identical by the proper machining of the pads. The wrist pin diameter has been increased to one inch.

Redesign of the Valve Arrangement

The conventional engine used an L-head. This allowed the valves to be actuated directly from the cam shaft. In this design, because of a restricted passage from the

(please turn to page 36)

At the . . .
BUREAU OF STANDARDS

by John Misey e'49

Located on 68 acres of wooded land in Washington's northwest section and resembling an institution of higher learning, is the National Bureau of Standards. To many it is just another government agency whose sole purpose is to be the custodian for the nation's basic scientific standards, but this represents only a small fraction of its functions. It is the principal agency of the Federal Government for research in physics, mathematics, chemistry, and engineering. Besides being the custodian of the Nation's basic scientifiic standards it conducts research leading to improved measurement methods, determines physical constants and properties of materials, undertakes major research and development programs, develops specifications for federal supplies, and serves government and industry in an advisory capacity on many scientific and technical matters in the physical sciences.

The Bureau of Standards was set up originally in 1901 although it had a forerunner in government service that was known as the Office of Weights and Measures in the Treasury department. The basic responsibility was the establishment of standards of physical measurements, however, as technology became more advanced the improvement of methods of measurement and the necessary associated research resulted in the expansion of the Bureau to a point where the staff totals 2500 persons, of which over 1000 are professional scientists, engineers, and research associates.

To carry its diversified activities to the fullest extent for the improvement of standards and for serving the government the Bureau is divided into 14 divisions. Each of these divisions contain a number of sections devoted to particular phases of the broader division. To discuss all these projects would require a volume in itself, but a cursory glance will show the extent of its work in order to fulfill its responsibility to the government.

Electricity and Optics

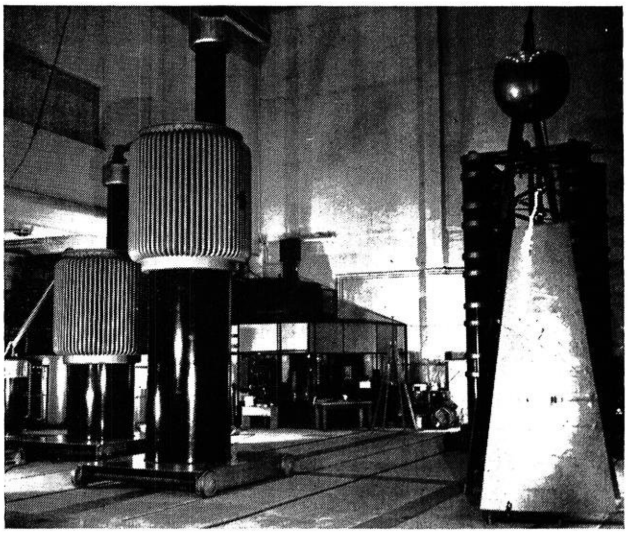
In optics this division is concerned with spectroscopy, interferometry, radiometry, photometry, colorimetry, optical instruments, polarimetry, and photographic technology. In electricity the Bureau tests standard instruments of the electrical industry. The devices usually tested include resistors, precision resistance apparatus, standard wire samples, capacitors, ammeters, voltmeters, wattmeters, current and voltage transformers, watt-hour meters, tape, wire, insulating materials, electrocardiographs, magnetic materials, standard cells, and batteries.

Metrology

The science of systems and weights is of primary importance in this division. It tests line standards, scales, meter invar base-line tapes, steel tapes, spring balances, level rods, saccharimeter scales, precision circles, standard weights, balances, watches, stop watches, marine chronometers, burettes, flasks, hydrometers, capacity and density standards, dental materials, railway track scales, gas meters, and gages of various types. It further determines the thermal expansivity of various solids and calibrates standards of extreme accuracy.

Heat and Power

Tests are made on optical pyrometers, thermocouples, and thermocouple materials, platinum resistance thermometers, clinical thermometers, compressors, ice refrigerators, oil burners, chimney furnaces, heat characteristics of precast concrete buildings, thermal conductivity, heats of combustion of fuels, ice cream freezers, baseboard heating systems, warm air furnaces, and electric hot-water heaters. It further determines the fire-resistance qualities of walls, partitions, deck coverings, oils, paints, and textiles.



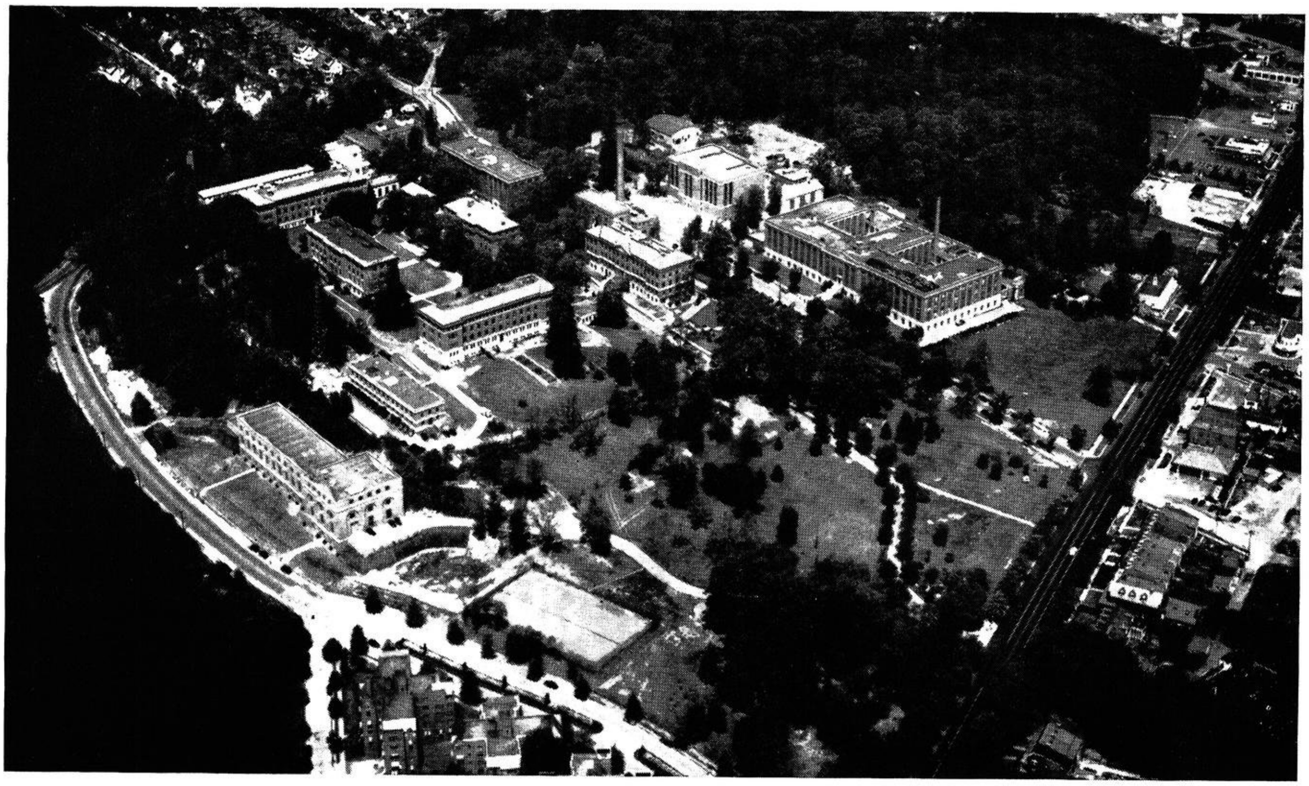
(Photos courtesy Bureau of Standards)
A test in High Voltage Lab on guided lightning.

Atomic Physics

This is one of the newer divisions in the Bureau but some of the work done in this division has been carried out for a number of years. The atomic bomb project had its origin here in 1939 but was later transferred to the War Department. For the research in atomic physics it has a million and one-half volt X-ray unit and a 50-million volt betatron. To this division the study of spectroscopy, mass spectrometry, radioactivity, and electronics has been transferred so that all these closely associated studies can be carried on without duplication.

Chemistry

A wide range of work in organic, analytical, and physical chemistry is investigated by this division, with special units devoted to gas chemistry; thermochemistry; hydro-



An aerial view of the National Bureau of Standards campus.

carbons; uranium and related materials; electro-deposition; reagents and platinum metals; paints, varnishes, and lacquers; and bituminous, detergent, and miscellaneous materials. Especially noteworthy is the expansion of the work of standard samples for the purpose of determining the composition of industrial materials.

Mechanics

This division tests and calibrates a variety of mechanical instruments from postage meters, phonograph needles, and microphones to aircraft, engineering, and laboratory instruments. It conducts research in sound aerodynamics, and hydraulics In engineering mechanics it conducts tensile-strength tests as well as compression, bending, and torsion tests on a variety of materials.

Organic and Fibrous Materials

The main activity in this division is the study in the field of rubber research of synthetic and natural rubbers. It makes several thousands of tests yearly on rubber, plastics, textiles, paper, and leather. A large part of these tests are for other government agencies for determining compliance of government purchases with specifications and to aid in the development or improvement of the specifications.

Metallurgy

The division is broken down into several sections which correspond to the specialized branches of metallurgy, namely; optical, thermal, mechanical, and chemical metallurgy. An experimental foundry complete with new rolling mills, precision casting units, and associated equipment is maintained to assist the scientists in studying various properties of metals. Some of the projects compromise exposure tests in atmosphere and tidewater immersion, and tests of working, welding, riveting, and casting of both ferrous and non-ferrous metals.

Mineral Products

In mineral products the division does test work involving porcelain, pottery, glass, glass refractories, cement (both chemical and physical tests), concrete and concrete materials, structural materials, lime and gypsum, soils, waterproofings, and enameled metals. In the field it tests cement making apparatus and inspects cement-testing laboratories and their various testing apparatus. It conducts research in the constitution, microstructure, and chemistry of mineral products.

Building Technology

In recent years the building profession has been looking more and more to the results of scientific research to guide its practices and has been relying less and less on tradition. For this reason the Bureau has taken projects related to this field and placed them in one division. It develops methods for determining the relative merits of materials, types of construction, and equipment used in buildings. It does work on safety problems, particularly fire resistance, and from this principles are developed which will guide the development of new types of construction. It investigates the field of structural engineering for better types of structural forms. It probes the subject of heating and air conditioning, works on exterior and exterior coverings, and finally writes codes and specifications.

Applied Mathematics

The division is divided into three sections. The first one is the study of new statistical methods for testing or similar procedures to be sure of drawing correct conclusions from results of laboratory methods. The second part is the performance of numerical computation and the development of mathematical tables. The last phase involves the development of computing machines for the Navy and the Census Bureau. It involves the development of very high speed calculating devices that work on electrical principles.

Commodity Standards

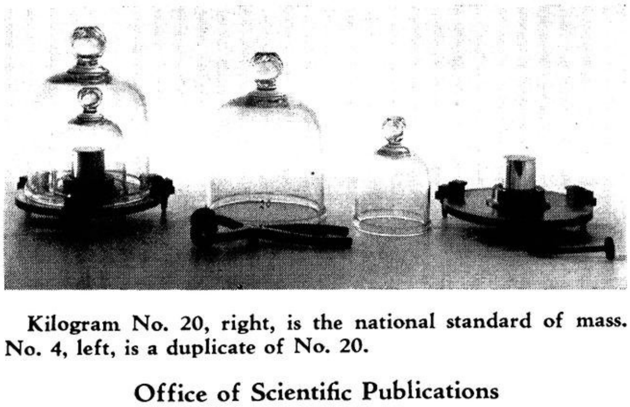
Since the government is one of the biggest businesses, the division develops commodity standards by which all government purchasing agencies can be guided. Upon requests from any group it sets up trade standards, simplified practice procedures, codes, and specifications which are voluntary in nature. These activities have been especially useful in the meal, cermaic products, textile, apparel, and chemical products industries. The recommendations cover numberless items such as: men's pajama sizes, manner of packing goods, vitreous china plumbing fixtures, standard doors, hardware cloth, asphalt tiles, and mechanical equipment.

Ordnance Developments

The Ordnance Department depends almost entirely on the Bureau for technical improvements and new developments of its equipment. This involves special research, tests, and evaluations of interest only to the Ordnance Department. Under its auspices the development of guided missiles, proximity fuses, and fire-control instruments are promoted.

Radio Propagation

This division carries on the country's share of the world-wide ionosphere research and measurement program; applies itself to basic microwave research; and conducts research in frequency utilization. It is engaged in predictions—3 months in advance—of the maximum and best usable frequencies for communication between any two points on the surface of the globe. Radio station WWV is operated by this division for broadcasting technical services such as standard frequencies and standard time intervals. It assists the F.C.C. in allocating frequency channels for non-government uses and coordinates its work with other government agencies requiring communications.

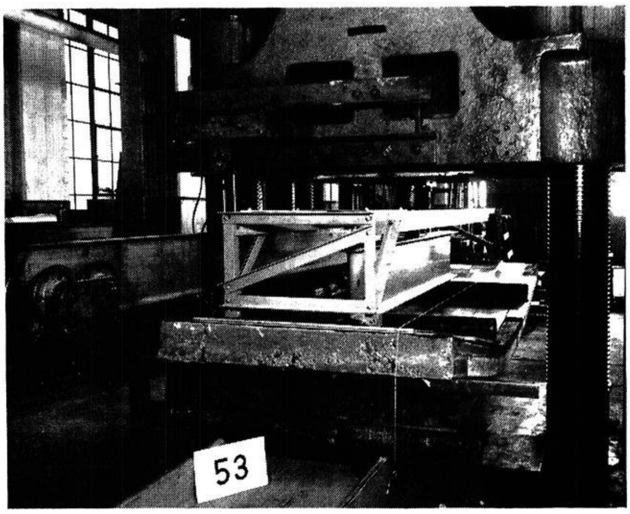


Kilogram No. 20, right, is the national standard of mass. No. 4, left, is a duplicate of No. 20.

Office of Scientific Publications

Research is fruitless unless the information can be passed on to others and applied to solving technical problems. For this reason the Office of Scientific Publication plays an important part in the Bureau's function. Through it go the results of many hours' research which are published for the dissemination of interested government agencies and for private industries and laboratories who may find this information useful. It publishes a technical news bulletin, periodicals, research papers, and reports which can be obtained through the government printing office.

Many have been the achievements of the Bureau throughout its lifetime, all of them being very important but some gaining prominence through situations under which they were made public. Among these are the war developments of the famous guided missile BAT which automatically seeks and follows the target to the point of collision; the



A 10 million pound testing machine subjecting a floor to a transverse load test to determine its deflection under maximum loading conditions.

development of the proximity or VT fuse for bombs, rockets, and mortar shells; the development of microwave radar; and all of the work for the Atomic Energy Commission from which has come the atomic bomb and related developments. More recently has been the development of the atomic clock which gives a basically new, primary standard of frequency and time, invariant with age.

To carry on the many functions, personnel becomes a very important problem. The Bureau's key research positions are filled by men of known competence in their fields of science, and every effort is made to secure top-ranking younger scientists and engineers from universities throughout the country. The employment of personnel is conducted by the Federal Civil Service Commission. It qualifies engineers, chemists, mathematicians, metallurgists, physicists, meteorologists, and geologists through examinations and certifications made by the Bureau. College sophomores and juniors can also participate in learning and developing professionally through practical experience by working at the Bureau during the summer months as a student trainee. The theoretical experience training does not cease with employment but is further advanced through graduate courses conducted out-of-hours for members of the Bureau staff. In addition there are in-hours training courses of graduate and undergraduate grade, designed specifically to improve the qualifications of Bureau staff members for the performance of their official duties. Colloquia or informal discussions of topics of interest in highly specialized fields are presented by various divisions of the Bureau at one or more times each year.

ALUMINUM *vs.* STEEL ALLOYS

by Walter Mueller m'50

The choice between aluminum alloys and steel alloys in many instances requires considerable deliberation. The application of aluminum alloys, however, does not overlap the field of application of steel alloys to a very great extent. There are enough major applications where either one could be used that a practical engineer should know the advantages and disadvantages of the use of these materials.

The uses of these materials overlap in three general fields of application. These are namely: structural work, sheet metal work, and castings. The criteria are lightness and strength. The actual applications are largely in industries manufacturing home appliances, aircraft, passenger coaches and railroad locomotives, automobiles, steamships, and architectural and ornamental supplies.

The number of alloys of steel and aluminum has grown to such an extent in recent years that the engineer is sometimes at a loss to know which one to choose. No two of the alloys have identical properties, and for each application some one alloy is best suited. It is also necessary to know the forms in which these materials are available and the sizes that are in commercial production.

Aluminum Alloys Approaching Strength of Steel

The recent war transformed aluminum from a metal of scarcity and limited utility to a metal of abundance and great usefulness. By simple alloying, it is possible to increase the strength of commercial aluminum by more than 50 per cent.

Many of these alloys have excellent casting characteristics, in contrast with pure aluminum which is rather difficult to cast. Alloys containing percentages of added metal may be worked by rolling and drawing. By the combination of alloying and strain hardening, a tensile strength equal to three-fourths that of steel may often be obtained, but in these hard tempers only a limited amount of forming can be done.

The discovery of alloys which respond to heat treatment processes marked the real entry of aluminum into the structural field. Several alloys have been developed which, in the wrought condition, will develop a tensile strength equal to that of structural steel. Their ductility is somewhat lower, but it is still sufficiently high to permit a considerable amount of forming. Casting alloys which respond to heat treatment are also available and permit the production of castings having superior mechanical properties compared with the alloys which have been more commonly used.

Probably the outstanding property of aluminum is its low specific gravity; for equal volumes, it is about one-third as heavy as the other structural metals in common use. This advantage is not lost in its commercial alloys because the increase in density resulting from the addition of the hardening elements does not exceed 3 per cent in the case of wrought alloys and the high strength casting alloys. Even in common casting alloys, the increase is not more than four or five per cent. The alloys in which magnesium or silicon is used as the chief alloying constituent are even lighter than pure aluminum.

Aluminum Is Resistant to Atmospheric Corrosion

In addition to lightness, aluminum offers excellent resistance to atmospheric corrosion. The metal is also not attacked by a considerable variety of chemical compounds, and for this reason it is extensively used in the manufacture and transportation of a number of commercial chemicals. The resistance of aluminum to the action of gaseous compounds of sulphur accounts for its use in railway passenger car roofs, equipment for use in oil fields, conduit and smoke ducts in round houses, and for rubber molds.

The fact that the compounds of aluminum are colorless is frequently an advantage. The use of the metals in utensils for the preparation of food depends upon the fact that aluminum compounds are not injurious to health as well as the fact that aluminum has a high coefficient of heat transfer.

The low specific gravity of aluminum enters into cost considerations even in those cases where the lightness of the metal is of no advantage. Comparisons should be made not on the price per pound but on the cost of the finished part. For rough estimates, the per pound price of the light alloy may be divided by three to give the proper relation to that of other commonly used metals.

Lightness of Aluminum Offsets Strength

When the replacement of common steel alloys with aluminum is considered, the inherent advantages of the lighter metal must be taken into account, since the first cost is practically always in favor of steel. The advantage of resistance to corrosion may alone be sufficient to justify the greater material cost. In the case of moving parts, lightness may be the deciding factor. The longer life and improved performance of the assembly resulting from the use of light reciprocating parts, with the consequent decrease in vibration and wear, may far more than compensate for any higher material cost.

In the transportation field, the savings in operating costs resulting from a decrease in power consumption are sufficient to offset the higher cost of light alloy construction in a short time relative to the life of the equipment. In railways cars, the time required to pay off the extra costs has been estimated to be three or four years from data obtained with experimental cars in which a considerable substitution of aluminum alloy was made.

In the case of trucks, where the maximum wheel load is limited by state highway laws, the returns from the greater pay load made possible by the use of aluminum, in addition to the power savings, have been sufficient to return the additional cost of the light metal in a period of three months.

Aluminum Produces Better Castings

Examples of the advantages of applications of aluminum alloy in railroading are instances such as the reduction in dead weight of a tank car by 8,388 pounds, and the preservation of the quality of chemicals in transit when containers of aluminum alloy were used. Aluminum in the roof structure slashes 4,000 pounds of dead weight from a railroad coach, and aluminum conduit saved 3,347 pounds from the weight in the same car. Forged aluminum locomotive connecting rods and cast heat treated cross head assemblies reduce inertia and centrifugal force and are durable in service. Aluminum sand castings are used for ornamental purposes because of their resistance to corrosion and the fine detail and attractive finishes that are possible.

Aluminum alloys are replacing steel alloys to a great extent because it is possible to make castings that are light in weight and economical and which eliminate many finishing operations. The details are accurately reproduced and dimensions are permanent.

Aluminum alloys are available in practically all the forms in which metal is available, including flat and coiled sheets, plate, bar, rod, wire, standard structural shapes, moldings and special rolled and extended shapes, seamless drawn tubing in round, square, rectangular, streamlined, and special shapes, rivets, nails, screws, bolts, nuts, bus bars, tanks, and drums.

Heat Treatment Improves Aluminum Alloys

Aluminum alloys may be classified in two groups: namely, non-heat-treatable and heat-treatable. The harder tempers are produced in the non-heat-treatable alloys by cold working, and the properties of the heat-treatable alloys are improved by thermal treatments.

For many uses, such as in airplanes, buses, railroad cars, ships, and truck bodies, the higher strength of the heat-treatable alloys, known as 14S, 24S, 61S and 75S, is required. Alloy 24S is heat-treated by heating to 920° F. to obtain solid solution of the alloying constituents. It is then quenched in cold water. Full properties are attained after the material ages at room temperature for four days. Alclad 24S consists of a core of 24S with a thin coating of pure aluminum on each side. This coating protects the 24S from corrosion, not only because it covers the alloy, but also because it provides electrolytic protection on any cut surface.

Alclad 24S is one in a series of alclads. They have considerably better resistance to corrosion than the bare alloys and have slightly better forming characteristics. A typical application now replacing steel alloy is the covering of the hull on a flying boat.

Aluminum alloys have a distinct advantage over steel alloys because of the fact that they can be used for die casting. This use accounts for a large percentage of the products made of aluminum alloys. Parts for such things as home appliances are easily fabricated in this manner. Small pumps and similar appartus usually use aluminum in this way. The major use of aluminum in the automotive industry is in the form of die castings. In such instances the decision is whether to use aluminum alloys or zinc alloys.

High Tensile, Low Alloy Steel

The answer of the steel industry to the challenge of aluminum alloys is a new type of steel called "high tensile, low alloy" steel. (The composition of this steel alloy is not disclosed.) It was introduced to the American scene in the early 1930's. Because the steel has greater strength, it allows lighter sections and lighter sections allow a wider latitude in new weight-saving designs.

This fact has been utilized to a great degree in the transportation industry. Whereas aluminum alloys are used in railroad cars where great strength is not important and on passenger coaches and locomotives to form the sides and other similar functions, this low-alloy steel is used for construction of freight cars, hopper cars, and flat cars where strength is required.

Experimental tests and nearly 15 years of rugged performance, both commercial and in combat, have yielded adequate information about this steel. It has high yield points, 60,000 psi. compared to 33,000 psi. for mild carbon steels. It has four to six times the atmospheric corrosion resistance of carbon steel, and from two to three times that of copper steel. These steels are unusually ductile and formable. They are also readily weldable. They are receptive to the gas, arc, and electric resistance welding methods practiced in modern shop work. This allows for weight reduction in another direction—the elimination of rivets.

Advantages of New Alloy Steel

This is a distinct advantage over aluminum alloys. Although aluminum alloys can be welded, the process is not very practical and not always satisfactory. Low alloy steel again, can not be die cast; consequently, each material cannot compete with the other in these respects. There is an advantage in using low alloy steels over carbon steels so far as welding goes because welding low alloy steel assures uniform metal with no brittle areas.

Low alloy steels have a shock resistance of several times that of carbon steel, and an abrasion resistance of at least twice that of ordinary steels. Their fatigue resistance is 60 per cent higher than carbon steel. These advantages were soon recognized and mobile equipment is constantly being redesigned to use lighter sections, cut down dead

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ON *the Campus*

by Robert Gesteland e'52

CHI EPSILON

Plaque night for the actives and pledges of Chi Epsilon, honorary civil engineering fraternity, took place Wednesday, March 30.

Formal initiation was held at the Union April 12, followed by a banquet at the Hoffman House. Newly initiated are: Robert Craig, Leonard Guth, Wilbur Holley, Charles Manske, Herbert Goetsch, and Floyd Whitmore. Toastmaster at the ceremonies was Prof. Eldon C. Wagner of the Civil Engineering department. Prof. Edwin R. Shorey of the Mining and Metallurgy department was the speaker.

Officers of the fraternity this semester are: Ralph Michael, president; Ralph Schlintz, vice-president; Ray Hahn, secretary; and Bill Haas, treasurer.

HKN

Prof. Jim Watson, retiring electrical engineering professor, was honored by the members of Eta Kappa Nu at an informal gathering in the Union on March 31.

The program consisted of an informal talk by Professor Watson followed by a bull session between the alumni and active chapter members. The large delegation of faculty members and alumni present enjoyed the program and helped down the refreshments.

ASCE

Mr. Willard Warzyn of the class of 1942 was the featured speaker at the March 8th meeting of the student chapter of the American Society of Civil Engineers. He told the group about his experiences as an engineer for the Dravo Corporation. His work included the supervision of construction of waterfront structures for a synthetic rubber plant near Pittsburgh, Pa.

At present Mr. Warzyn is associated with the consulting engineering firm of Mead and Hunt of Madison, and is in charge of planning a hydroelectric development in Upper Michigan. While a student at the University of Wisconsin, he was an officer of the student chapter of ASCE.

Future plans of ASCE include speeches by Mr. James Law, chairman of the Wisconsin Highway Commission and former mayor of Madison, and Mr. Wilmer Piper, secretary of the Wisconsin Board of Registration for Architects and Engineers.

TRIANGLE

In the manner of true engineers the men of Triangle fraternity celebrated the feast of their patron saint at a dinner at the chapter house on St. Patrick's Day, March 17. Guests of the group for the dinner were Triangle Alumnus William Grott of Madison and Prof. Patrick H. Hyland. Professor Hyland gave a short talk on St. Patrick and engineers in general, and after the group had adjourned to the living room, a thorough and lengthy bull session followed.

Triangle was host to ten engineers at a smoker at the chapter house on the first of March. Following what is developing into a tradition, all were entertained by Duey Glaubitz and his magic—same tricks and same jokes, but just as entertaining. Coffee, cokes, and cookies rounded out the evening.

Making his first appearance in Madison since his return from Florida, where he had spent the worst of the winter, Oscar, the Iron Man, spent the week before the St. Pat's dance being admired by the comely co-eds. From his place of vantage in the window of Wagner's Dress Shop, Oscar surveyed the doings on State Street and defied the Shysters to try something.

As usual, he made his appearance at the Engineers' Dance on the evening of March 19. It wouldn't be a St. Pat's dance without Oscar on hand to oversee the evening. He has notified Triangle that he has safely returned to Florida, as he can't take this changeable Wisconsin weather.

The hobo was king for the evening at a house party held by Triangle on Saturday evening, March 26. Old clothes were strictly the order. The front door was boarded up and the guests entered by the rear door. In keeping with the informality of the life of the "Knight of the Road," beer was served in tin cans. It was a party where everyone could relax and be himself.

Chaperons were Mr. and Mrs. Richard Woroch. Dick is a graduate instructor in the Mechanical Engineering department.

KHK

Kappa Eta Kappa, electrical engineering fraternity, recently announced the initiation of 21 new members. They include: D. C. Rideout, E. Sheibe, J. Hafstrom, Glenn Peterson, Floyd Peronto, Allan Nemetz, William Maier, Rollin Chap-

*(please turn to page **30**)*

The SLIDE RULE

Why and How

by Russell Henke m'49

PART I

The slide rule is to the engineer what the drill is to the dentist, and the scalpel to the surgeon. It is his mark of distinction; and, not to be overlooked, it is the time saver which takes much of the drudgery out of the calculations which are part and parcel of the engineering profession. (Incidentally, it is also a handy whipping boy for those idiotic exam errors which crop up now and then.)

Since the slide rule is so much of the fiber of the engineer it seems that the majority of us are woefully lacking in understanding of the fundamental principles upon which this instrument is based and upon its development. This article has been written to rectify this oversight in our education.

The slide rule is not, as many may be prone to believe, a modern idea, nor even a modern development. The first slide rules date back to the late 1500's or early 1600's. It had its origin in the invention of logarithms by John Napier, Baron of Merchiston, Scotland, the first written evidence of this discovery being contained in a letter to a Danish astronomer in 1594. Since this astronomer didn't seem to do anything in particular with his knowledge we won't mention his name, and thus he loses his chance of going down in scientific history. According to the definition offered by John Napier, the logarithm of a number, N, was expressed by the relation:

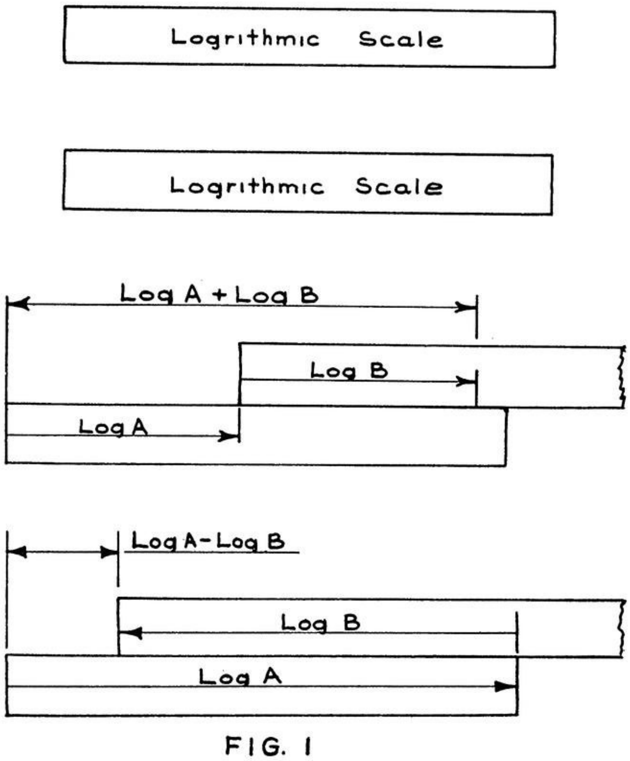

FIG. I

$\log N = 10^7 \log e \left(\frac{10^7}{N}\right)$, where $e = 2.71828$, according to modern parlance and definition. We won't endeavor to turn back the wheels of progress to Napier's original expression, the modern idea being perfectly sufficient in this case.

As we all know, when multiplying two numbers together the log of the product is equal to the sum of the logs of the two (or more) factors in the multiplication; and, conversely, in dividing two numbers, the log of the quotient is the difference between the logs of the factors involved; i.e.:

$$x = A \times B \qquad \log x = \log A + \log B$$

$$x = \frac{A}{B} \qquad \log x = \log A - \log B$$

This leads to the supposition that the first slide rule was probably one in which a logarithm scale was marked off on each of two sticks of wood and the two placed next to each other in such a manner that sums or differences of the logarithms of two numbers could be directly read, thus eliminating the necessity for calculation other than that of the anti log. It can easily be seen that this was not too satisfactory in view of the labor involved in calculating the anti log.

Figure 1 shows how this neat trick for multiplying and dividing might work. As a matter of fact, a gentleman named the Rev. William Oughtred devised just such an arrangement as we have just described in the vicinity of 1630. William Oughtred also was the first to develop and use the circular slide rule, the logarithm scales being marked out on the perimeters of two concentrically pivoted disks of cardboard. Thus the addition or subtraction of the logs was accomplished by merely revolving the disks in relation to each other. An innovation on Oughtred's circular slide rules was the inclusion of the logarithms of trigonometric numbers in addition to natural numbers.

As you can well imagine the process of holding two strips of wood together in order to add or subtract logs was soon frowned upon as old fashioned, and in 1657 a fellow named Seth Partridge brought out a neat trick. He held the movable slide between two stationary strips of wood, thus making the slide rule an integral unit. This rule had both number and trigonometric scales on both faces, making it—of all things—a complete duplex slide rule. That was 292 years ago.

These crude slide rules were not called by that name until, in 1683, a mechanic named Thomas Everard first designated his rules by the name "sliding-rule." The con-

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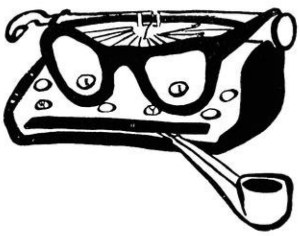


The Way We See It

LIBERALIZED ENGINEERING

An engineering education is probably one of the best preparations for anyone in modern times. Perhaps to a greater extent than any other type of college training does the engineering curricula teach the student to think clearly, accurately, and conclusively. On top of this the student engineer is taught to integrate theory and practice—and produce results.

Despite this training, there is very often raised the complaint against student engineers that they are "uncultured", "crude", "too practical", or "anti-social". They just have a lot of work to do. Many of these engineers actually want to get into personnel, sales, production, or managerial jobs which sometimes offer more rapid promotions with higher pay and less direct competition than found in technical fields.

These jobs require a lot of poise, "culture", and a background in social and fine arts. These men will also require a good fundamental knowledge of economics, psychology, and finance if they are to succeed in their enterprises. And more and more business concerns of all types are tapping the vast reservoir of talent held by engineers for this type of work.

Why then do most of our engineering curricula limit so many of their electives to technical subjects? An industrial or management option, or course, is not offered to engineers as such. Would it not seem wise to offer these men the training they desire and need?

Perhaps one solution to the problem would be two or three years of a pre-engineering course. Engineering is still striving to attain professional status. What better way to get there than by actually giving the engineers a truly professional background upon which to rely? Since there is such a terrific amount of technical material to be covered in any one engineering field, it would perhaps seem more practical to separate the cultural and technical subjects into different years.

There may still be other suggestions possible which would fill the needs of these men who desire a broader training. Perhaps work on a master's degree is the answer, but a definite need is felt among the engineering undergraduates for a more liberal engineering curricula. This could be through course options, more and better electives in engineering economics, commerce, English, and psychology, or perhaps an entirely new course.

POLYGON'S NEXT PROJECT?

A few weeks ago we spent an enjoyable evening in Great Hall of the nion. The occasion? The 1949 St. Pat's Dance, of course!

This festival was by far the most outstanding all-engineer function that has ever taken place on this campus. For once, the music was danceable, and the change from informal to semi-formal imparted a real party atmosphere. For many of us it was the big social event of the year, and for some, it was the last important campus affair.

Polygon Board and all who cooperated to make this dance such a success are to be congratulated on a job well done. Without a doubt, the events of the season took a great deal of careful planning, and an even more careful execution of the plans. Again, well done.

Another recent event on the engineering campus was Engineer's Day. Many old grads returned to the campus to see what this new generation of engineers was doing. And they found that quite a bit was doing!

But Engineer's Day, laudable activity as it was, nevertheless was a faculty affair. There is nothing wrong with this, but we feel that the student body at large should have a chance to exhibit the work they are doing, and that which they aspire to do.

Back in 1941, the students did just that! The Engineering Exposition was the highlight of that spring as far as the engineer was concerned. Student groups worked up impressive demonstrations not only for engineers, but to show the general public what engineering meant to them. Each department had several good exhibits, and it would hardly be fair to single any out. Various industrial concerns had exhibits, too, that demonstrated some of the outstanding engineering developments of the day.

Who came to see all of this?

People from every walk of life, from every part of the state, from all age groups, crowded through our M.E. building. High schools brought their students by the bus load to see what this engineering was all about. And they found out, too!

An exposition is a big job. It requires a great deal of planning, and close cooperation between several organizations. Now is the time to start planning. The new members of Polygon board have been selected. We are certain they will receive much aid and encouragement.

Will we have an exposition next year? **W.M.H.**

Science Highlights

by Howard Traeder m'48 and Donald Miller m'50

METAL FRACTURE THEORY

Investigations by the General Electric Research Laboratory have recently shown that the fracture of metals is due to the formation of small cracks between the grains or crystals of a metal. These minute cracks or nuclei are caused by the movement of the atoms of the metal across the grain boundaries. These nuclei are constantly forming and disappearing again, but they can be made to grow to a super-critical size when the metal is subjected to tension. A crack will then form and grow rapidly along the grain boundaries until the metal breaks. This theory can account mathematically for the many discrepancies between previous theories and actual metalurgical experience. If ways can be found to prevent crack formation along the boundaries and make the only possible break occur through much stronger grains, it will be possible to greatly increase a metal's strength at high temperatures.

TAGGED ATOMS

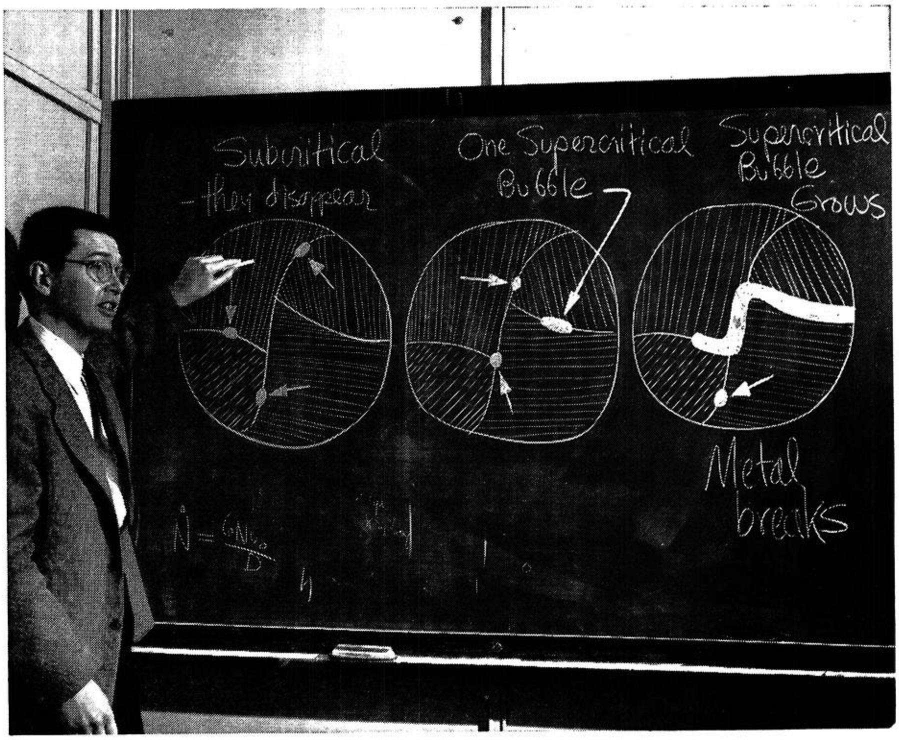
In the investigation of fracture theory, scientists have been using a radioactive isotope of silver, called "silver-110." The metal was electroplated on the surface of an ordinary silver block and after several hours at 500° C., the specimen was cooled and paper thin layers were shaved from the block. Each layer was checked for radioactivity with a Geiger counter, to determine how far into the block the "tagged atoms" had gone. It was found that the atoms may move between the grains as fast as one-tenth of an inch per week at 500°C. However, atoms passing through rather than around the grains take about 10,000 years to move an inch. The radioactive material used in these tests was greatly diluted to the point where it is not harmful if touched.

PISTON-JET POWER PLANT

The U. S. Air Force has announced the development of an aircraft power plant which delivers more than 4,000 horsepower to a propeller, as well as several hundred pounds of jet thrust. This power plant is a combination of a 28 cylinder Pratt & Whitney Wasp Major engine and a two-stage General Electric variable discharge turbosupercharger. The excellence of the Wasp Major-VDT lies in the effective use of the energy in the engine's exhaust gases, heretofore largely wasted, and in the after cooling of the supercharged combustion air. The exhaust gases are utilized in two ways. First, combustion air is supercharged and secondly, the gases are discharged to the rear through an orifice, the size of which is varied to obtain the best division of exhaust energy between supercharging and jet thrust. The conventional throttle is used only for low power operation. The power and speed, for the most part, are regulated automatically by the variable discharge nozzle. This determines the amount of exhaust energy extracted for supercharging, which in turn, fixes the power thrust of the engine. The elimination of throttling in the air intake reduces combustion air entrance losses. The power plant has all the elements of a turbojet engine, the difference being that the fuel is burned in the 28 cylinder Wasp Major instead of in the conventional jet burners.

LOW COST PHENOLICS

A new group of general purpose phenolic powders will lower costs with little sacrifice in properties of high-quality molded parts. These



(Cut courtesy General Electric)

Blackboard diagram illustrating metal fracture theory. In the first circle the metal is under tension, but no nuclei are large enough to grow into major cracks. In the second, chance atomic activity has caused a supercritical bubble. The third circle shows the crack rapidly growing as tension enlarges the supercritical bubble.

new wood flour filled materials are priced on an average of one cent below other general purpose molding powders. They are said to have good flow characteristics, cure time, and water resistance. Although they do not have a high gloss on long draw molds and are slightly less rigid, they are highly satisfactory for most thermosetting plastic applications.

ELECTRONIC READER

A laboratory model of an electronic device which converts reading matter into sounds of individual letters has been developed by the RCA Laboratories. In operation a line of type is scanned letter by letter with a scanning mechanism containing a miniature cathode ray tube and an optical system. Each printed letter is scanned vertically with a pin-point of light at a rate of 500 cycles per second. The scanning, however, is not continuous but is carried out so that the scanning spot pauses momentarily at several points along its path, thereby creating the effect of a series of scanned spots arranged in a vertical line. As the scanning mechanism is moved along the line of printed type, the light normally reflected is absorbed by the printed material and the beam is interrupted. These interruptions are converted into electrical impulses by means of a photo-tube and amplifier, the impulses operating selector circuits which recognize the letter and select the correct tape recording so the letter sounds may be reproduced by a loud speaker. The instrument will be a great help to the blind and also has possibilities as a recognition device for translation of coded patterns such as used by teletype machines.

ASKANIA CAMERAS

Special cameras are being used to measure the speed of new planes. The telescopic lenses of the camera give a clear image of an airplane at a height of 40,000 feet. By the use of these cameras it is possible to measure the absolute height of an airplane or missile with an accuracy of plus or minus 20 feet, while radar has an error of ten times this value. Ordinary level flight instruments are of little value in measuring the speed of a dive and it is this use which has proved the value of these cameras.

(Photo courtesy RCA)

Operation of the electronic reader.

VIBRATION METER

An instrument which can measure the amplitude, velocity, and acceleration of as many as 300 vibrations per second is enabling engineers to study vibrations of jet engines in flight. The detector is a cylinder three inches high and two inches in diameter, which converts vibrations of the engine into electrical impulses. In practice, several detectors are mounted on the engines being tested, at points where the vibration is most critical. The electrical impulses from the detectors are amplified and registered on an instrument mounted in the control panel. The meter has been developed to test new gas turbines now in production.

RAMJET RECORD

A Navy buzz bomb named Gorgon IV has lately been darting over the Pacific on stub wings in the longest flights ever made by pilotless aircraft with ramjet engines. Time: "more than ten minutes."

While this may not sound like much of a record, remember that ramjets, simplest of all engines and perhaps the best for supersonic flight, are still little beyond the Kitty Hawk stage of development.

The Gorgon IV's are built by Glenn Martin for the Navy. Launched in mid-air from a mother plane, they have been deliberately held down below the speed of sound for test purposes. Several, tracked by radar until they plunged into the drink, have been fished out so little damaged that minor repairs would put them in shape to fly again.

The flights were made from the Point Mugu, California, Naval Air Missile Testing Center to obtain performance data on the missile's ramjet engine developed at the University of Southern California and made by the Marquardt Aircraft Company. The engine has no moving parts except a fuel pump.—PSM

METALS TAKE A POWDER

Metals shortly may be "taking a powder" in the literal sense of the word. A new method of coating one metal on another has been developed, in which a layer of metal powder is applied on a surface to be coated. The surface and coating are then heated to a degree just below the melting point of the two metals for a few minutes, and finally cold rolled several times. The heating takes place in an atmosphere of pure hydrogen so that the powder cannot oxidize. Neither metal nor metal powder melts, it is claimed. Between cold rollings the surface is annealed. The thickness

(please turn to page 28)

TUNGSTEN

atomic sym: W

by John M. Warner m'50

Tungsten has a melting point of 3,400 degrees C., more than twice that of iron. Alloyed with carbon, its hardness is nearly that of the diamond. It has a tensile strength of 590,000 psi., five times that of medium carbon steel. It can be alloyed brittle, or with a ductility comparable to that of gold.

These characteristics plade tungsten at the top of the list of high-temperature, high-strength metals.

The first record of tungsten stems from the investigations of Scheele and Bergman, who, in 1781, detected its presence in a mineral aptly named scheelite, a calcium tungstate. Two years later in 1783, Juan, Jose and d'Elhuyar showed the same substance occurred in wolfram, an iron and manganese tungstate. They also obtained the metal.

For about a century, little was heard of tungsten, yet undoubtedly research was being carried on. Some time prior to 1900, an unknown German chemist heated tungsten powder and lampblack in an electric furnace and produced the first tungsten carbide. It was extremely hard and brittle. Natural diamonds were still harder and less brittle, so they were kept in general use.

It was not until well along in World War I, that the Fatherland began running low on diamonds. As these are a much needed industrial tool, a search for some substitute was inaugurated. The Osram Lamp Company put two researchers, Baumhauer and Schroeter, on the job. Finally, after many failures, they were rewarded for their diligence by the production of the first cemented tungsten carbide. They perhaps did not realize the importance of their discovery for it truly revolutionized machine shop practice. Cemented tungsten carbide scratches sapphire and when handled carefully is tough enough to draw into wire the toughest metal of them all—tungsten itself.

The extreme temperatures required to alloy tungsten were the main stumbling blocks in its path. A powder metallurgy process, now common, was the ultimate solution. Baumhauer and Schroeter pressed small particles of tungsten, graphite, and cobalt, the latter being the binder, into shape and sintered. This essentially produces a mixture somewhat different in structure than the conventional alloy.

The munitions maker Krupp took over where Osram left off, but too late for World War I. The post-war years evidenced remarkable strides in the perfection and application of the newly discovered alloy. Krupp amazed American manufacturers with the speeds and feeds used in machining cast iron. Cratering continued, however, even on the best carbide tools when machining steel.

In 1928 General Electric took a license from Krupp A. G. and adopted the trade name Carboloy. They set up a company by that name in Detroit to develop, manufacture and distribute cemented tungsten carbide to American manufacturers and to help train them in its use. Since then a number of other companies have entered the field of hard carbides. Hot press methods were developed which made possible fabrication of tungsten carbide rolls weighing several hundred pounds. These can be rolled in cold rolling mills to mirror-finish strip which is stamped into razor blades and shimstock, etc.

Carboloy's long list of achievements in the cemented carbide field includes tips for bits and scribers; oil well drills; diamonds in carbide core drills for mine samplings and grinding wheel dressers; tipped center for lathes and grinders; punching and forming dies; fishpole guides; and tools for machining porcelain, quartz, plastics, and glass.

A recent application of tungsten carbide occurred in the war, where it was used as a shell core inside an aluminum housing. The weight reduction permissible with the aluminum housing made possible greatly increased velocities over the conventional steel armor piercing shell. For example: The new 76 mm. shell weighs about nine pounds, while the old weighed 15 pounds. This decrease in weight allowed an increase in velocity from 2,800 fpm to 3,400 fpm. This was sufficient to penetrate the German Tiger and Panther tanks.

Present supplies of tungsten are obtained generally from wolfram which is found in China, Burma, Japan, Australia, Bolivia, and the U. S. Ore concentration is necessary, since the ore will usually assay only 0.5 to 2.0%. When associated with quartz, the concentration is easily accomplished by flotation due to the tungsten's high density.

Freedom from impurities is absolutely necessary when used for light bulbs and wireless work. For this the process used is reduction by hydrogen of the oxide, where the tungsten is obtained as a powder. A process developed by Coolidge enables tungsten to be drawn to a fine wire. Powdered tungsten is compressed into bars which are heated in an atmosphere of hydrogen. After heating to 1,500 degrees C. these bars ar converted to rods in special swaging machines operating at 10,000 blows per minute. Further reduction is accomplished through dies.

Along the line of special research, Prof. M. L. Holt of the University of Wisconsin has succeeded in alloying

(please turn to page 36)

St. Pats Dance Citations

BADGER

Fritz Kohli, or should we say "St. Pat", gets a prize of a much needed razor.

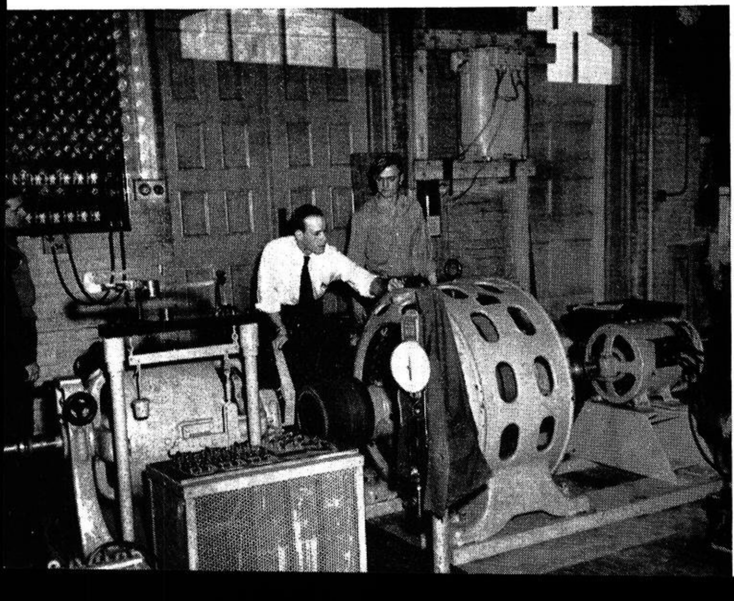
Story by Nemetz and Strasse

Engineer's Day and the St. Pat's celebration were the outstanding events of the past month, if not of the entire year, in the Engine school. Engineer's Day, new to the University, was held on March 15 while St. Pat, of course, reigned on the traditional March 17 and at the dance in his honor the following Saturday evening.

Engineer's Day was characterized by an open house in the College of Engineering, featuring special exhibits in all departments. Typical of these exhibits were the model and plans of the new engineering building on display in the M.E. building lobby, the casting operations in the metal casting lab., and various electronic devices shown in T-23. In the evening a banquet was held in the Union, with Prof. William H. Kiekhofer of the department of economics as the principal speaker. Following Prof. Kiekhofer's address a number of citations were awarded to distinguished alumni of the College of Engineering.

Recipients of these citations include Joseph Albert Cutler, president and general manager of the Johnson Service Company; Albert J. Goedjen, vice-president of the Wisconsin Public Service Corporation; William J. Grede, president of the Grede Foundries, Inc.; LeRoy Francis Harza, consulting engineer; Eugene C. Herthel, manager of the Research and Development Department, Sinclair Refining Company; Harvey V. Higley, chairman of the board of the Ansul Chemical Company; Louis Richard Howson, consulting engineer; Harry Karl Ihrig, vice-president and director of laboratories of the Globe Steel Tubes Company; William R. Kellett, general superintendent and director, Kimberly-Clark Corporation; Ernest A. Longnecker, president and general manager, LeRoi Company; Edwin F. Nelson, vice-president of the Universal Oil Products Company; J. F. Roberts, manager Hydraulic Department of Allis-Chalmers; Leon A. Smith, superintendent of the Madison Water Department; Halsten J. Thorkelson,

A familiar scene to all EE's is this shot of the dynamo lab.



A group of Engineers Day visitors watch a demonstration in the internal c bustion engine lab.

NGINEERS

Basketball Engineer's Day

Photos by Wahlin and McKeon

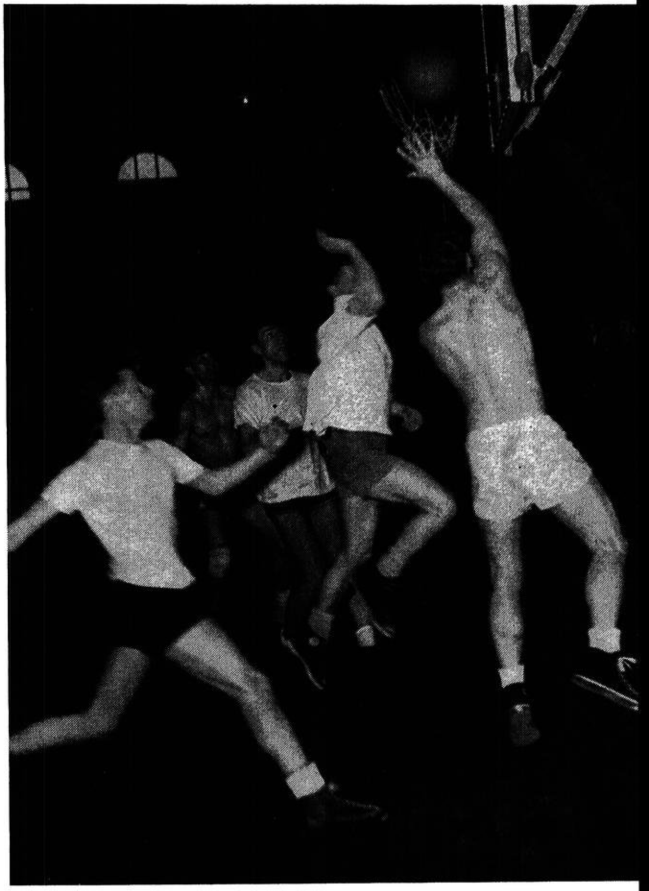
vice-president and director (retired) of the Kohler Company, and H. L. Woolhiser, city manager of Winnetka, Ill.

Not to be forgotten was the St. Pat's celebration!

March 17th the armory was the scene of a game usually called basketball. Actually it was more of a combination of boxing and football as two teams consisting of law students and engineering students respectively fought for the right to take shots at a basket with a ball. Not lacking in spirit, luck, or anything else it took to win the game, the lawyers came through on top by one point. It is, therefore, their right for the next year to say that St. Pat was a lawyer. The engineers did not give up the cause after the game, however, and several midnight forays were made to the law building in attempts to desecrate it in an appropriate manner. Even commando tactics had no effect because of the watchful eye of officer Glen Fisher. It seems that during the daytime, though, a few containers of evil smelling fluid made their presence known within the building.

On Saturday, March 19th, the slipstick was traded for the lipstick as the engineers and their formally-attired girl friends and wives danced to the music of Lou Rene in Great Hall of the Union. Chaperones for the evening were the chairmen of the five branches of the engineering school and their wives, namely the Petersons, the Van Hagans, the Elliotts, the Hougens, and the Barkers. Dean and Mrs. Withey were guests at the dance. The high point of the evening came during intermission when Fritz Kohli e'50 was installed as St. Pat. Intermission also saw the judging of beards by the Badger Beauties.

Flash! A recent report from Polygon Board gives the following points in the St. Pat's contest. EE's totaled 1,654 points, the ME's got 1,185, the M&ME's had 1,045, the CE's had 955, and the ChE's had 709. The EE's, as seen above, won and had their representative, Fritz Kohli, crowned St. Pat.



The Engineer-Lawyer basketball game. Something went wrong and the better team lost by one point.

Beard contest winners grin happily. No, the Badger Beauties on the right eren't entered.

If you attended the St. Pat's dance you should recognize this picture of the chaperones.

Alumni Notes

by Hank Williams e'50

C. E.

The recent elections of the Fox Valley chapter of the Wisconsin Society of Professional Engineers resulted in the election of the following Wisconsin graduates: **Harold C. Trester,** ('35), president; **Wayne G. Bryan,** ('33), secretary-treasurer; **James E. Bambery,** ('28), and **Francis J. Euclide,** ('31), directors.

Virgil L. Minear, ('23), is reported to be with the U. S. Engineer's Office, in Washington, D. C., in charge of foundation engineering. Since graduation, he has been associate engineer with the Bureau of Reclamation, and foundation engineer on the Panama Canal. More recently he has been with the Office of Inter-American Affairs at Washington.

George S. Salter, ('24), formerly Mid-West Representative of A.S.C.E., is design engineer in the Filtration Design Division of the City of Chicago.

James M. Whiteside ('26) is sales engineer with the Pittsburgh Corning Corporation in the Chicago Office.

Jay Everett Henry, ('36), recently resigned as director of public works at Wheeling, W. Va., and is now with Engstrom and Wynn, engineers and contractors of the same city.

Glenn H. Von Gunten, ('38), has been transferred from the Baltimore office to the Walla Walla office of the Corps of Engineers. He is at present head of the powerhouse design section of the Walla Walla District.

E. E.

David Alva Powell, ('07), died on December 19, 1948. At the time of his death, he was executive vice-president of the Iowa Power and Light Company, Des Moines. From 1907 to 1910, he served as a cadet engineer with the Madison (Wis.) Gas and Electric Company, and from 1910 until 1925 was with the Milwaukee Gas and Light Company. From 1926 until 1932, Powell was president of the Muskegon (Mich.) Traction Company. He became vice-president and general manager of the San Antonio (Tex.) Public Service Company in 1932 and remained there until 1942. In 1943, Powell became executive vice-president of the Iowa utility, the position he held until his death.

Edwin G. Fox, ('08), was present at Engineer's Day, and gave an address on Russia. Fox had spent considerable time in Russia. At present, he is vice-president of the Freyn Engineering Company of Chicago.

Paul V. Koos, ('27), has been shifted to the personnel department of the American Telephone and Telegraph Company of New York, New York.

Albert J. Goedjen, ('07), is manager and vice-president of the Wisconsin Public Service Corporation of Green Bay, Wisconsin.

Herbert L. Woolheiser, ('12), is the city manager of Winnetka, Illinois.

C. T. Schrage ('21) is at present employed with New York Telephone Company.

Fred E. Hartman, ('31), is chief engineer for the Dryden Harlan Electric Company of Appleton, Wisconsin.

J. K. Babbett, ('36), is assistant chief engineer for the Wisconsin-Michigan Power Company.

M & ME

Thomas O. Olsen ('49) is working in the mining engineering department of the Oliver Iron Mining Company of Hibbing, Minnesota.

Karl J. Klapka is an engineer in the diamond drilling department of the Wheel Trueing Tool Company in Detroit, Michigan.

George J. Barker, Chairman of the department of Mining and Metallurgy at the University of Wisconsin, is a member of the General Council of the American Society for Engineering Education. Their national convention will be held June 20-24 at Rensselear Polytechnic Institute, Troy, New York.

Walter R. Giese, ('41), is in the sales engineering department of the Milwaukee Wisconsin A-C Supply Company

Ch. E.

David N. Carlson ('18) is a sales engineer for the Stainless Foundry and Engineering Company of Milwaukee, Wisconsin.

P. G. Ellis, ('31), is an assistant to the president of the Wisconsin Public Service Corporation.

A. G. Brann, ('20), is an assistant engineer for the Wisconsin-Michigan Power Company.

John R. Williams, ('44), is employed as a process engineer for the Sinclair Refining Company of Harvey, Illinois.

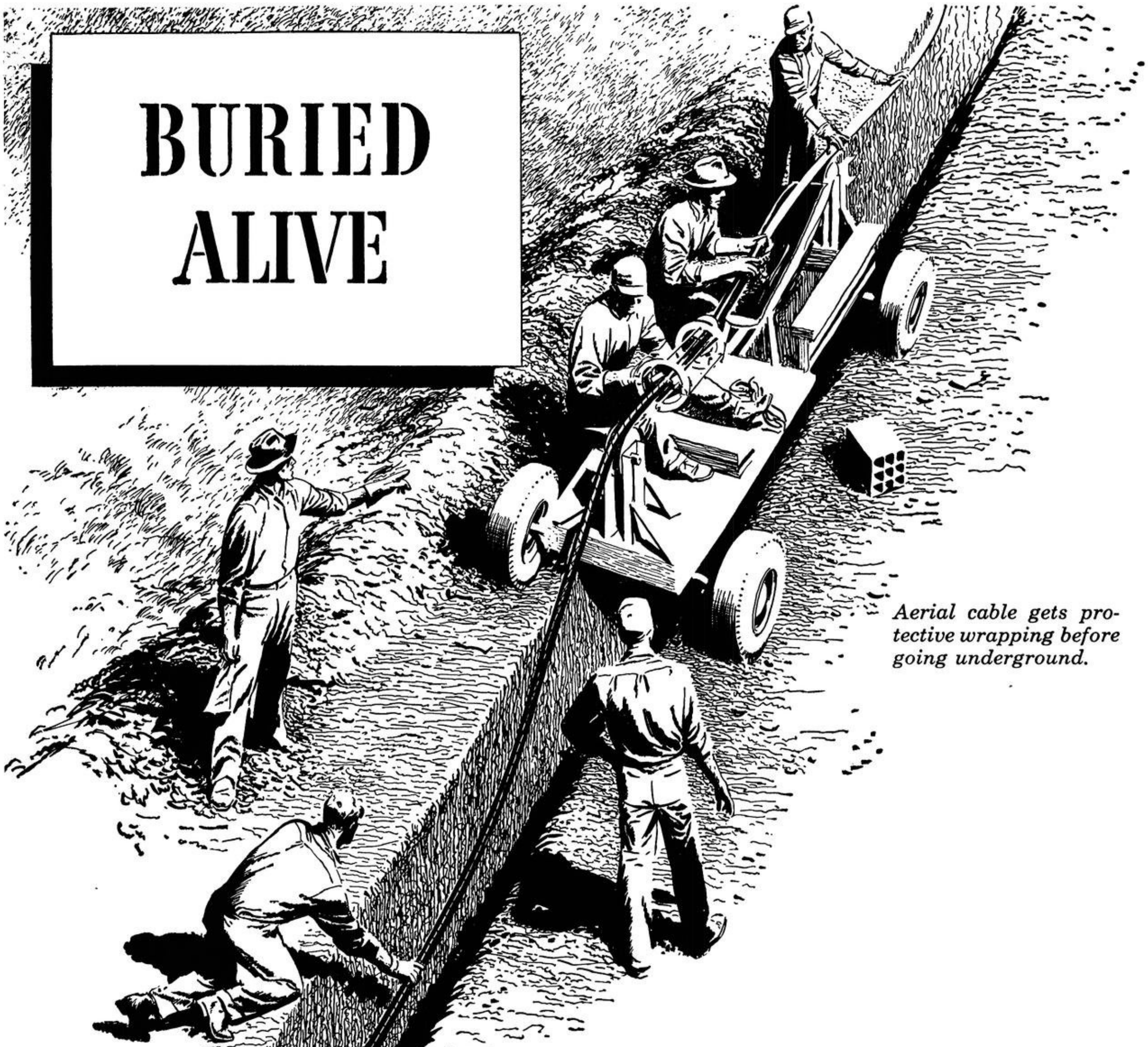
M. E.

A. E. Liebert, ('20), is president of the Logemann Brothers Company of Milwaukee. He was recently honored with an award at the Engineer's Centennial Banquet.

W. A. Pollock, ('35), is an engineer for the Wisconsin Electric Power Company of Milwaukee, Wisconsin.

H. P. Dahlstrard and wife attended Engineer's Day. Mr. Dahlstrard is director of the steam turbine engineering department of Allis-Chalmers of Milwaukee, Wisconsin.

BURIED ALIVE



Aerial cable gets protective wrapping before going underground.

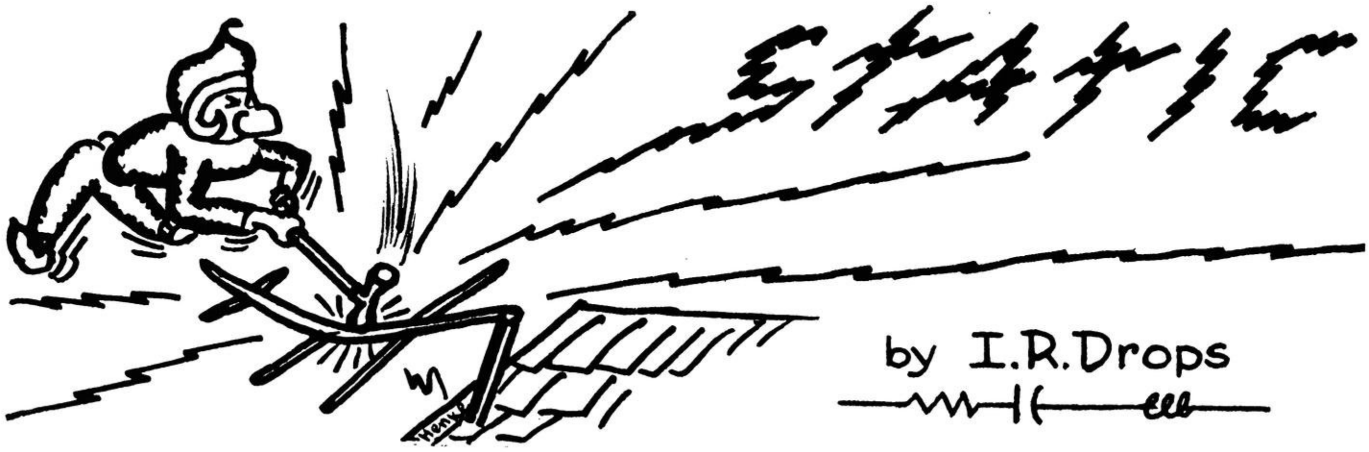
A highway near Ann Arbor, Michigan, was being widened. This meant that a telephone pole line had to come down. But the cables it carried were too busy and too important to be cut. They had to remain in constant use.

Telephone engineers got busy.

Within two months, cables along the five mile stretch were "buried alive"—with every circuit in service all the time. Every inch of cable was given a protective wrapping to make it suitable for underground use. Streets, highways and railroad tracks were crossed. Work was done at night to avoid busy-hour traffic. Yet not a single telephone call was interrupted.

The skill and initiative of the telephone engineer are important reasons why America has the finest telephone service in the world—at the lowest possible cost.

BELL TELEPHONE SYSTEM



There comes a time, every few years, in the life of a student publication when the writer of a humor column must turn it over to someone new for one cause or another. So it is, with a tear in my eye, that I turn this column over to a younger man with newer and fresher ideas. As a parting gesture, however, I offer the following joke (while the editor isn't looking), which has already been censored three times.

—C. F. S.

[redacted]

(Remember the faculty reads this too.—Ed.)

* * *

The EE determines the Saybolt Universal Viscosity—

An engineer walked up to the hotel desk, put down a dime, and asked for a can opener. The clerk gave him two nickels.

* * *

Inst.: "What are the names of the bones in your hand?"

I.L.S. Student: "Dice."

Inst.: "How many tons of coal were exported by the United States during any one year?"

Shyster: "1492, none."

* * *

After seeing these signs in a library recently we can't figure out whether the librarian who wrote them was broad-minded or plastered.

"No loose dogs allowed."

"Only low conversation permitted."

* * *

C. E. (tenderly): "Shall we go inside and listen to the radio?"

Bright Co-ed: "No, I'm too tired—let's play tennis."

* * *

SHYSTER'S SPECIAL

There is the story about a certain U. W. law student who stayed up all night trying to break a widow's will, but we can't print it here.

* * *

Two stuttering freshman M.E. students had finished heating a piece of steel and one placed it on the anvil.

"H-h-h-h-h-h-hit it," one of them said to the other.

"Wh-h-h-h-h-h-here?" asked the other.

"Aw h-h-h-h-h-hell, we'll have to heat it again now."

* * *

When wiping up that spilled glass of brew with this page, remember—

RUB, DON'T BLOT!

* * *

"You look like Helen Green!"

"I don't look so good in pink either."

* * *

We don't have a leopard but we sure have one spotted.

* * *

You don't have to go to Europe to marry abroad.

* * *

Co-ed voice over heard in Union theater: "Take your hand off my knee! No, not you! You!"

* * *

An engineer brought his baby to the preacher to have him baptized.

"Now," he said, "you baptize him right. Last time I wanted my son called Tom, you named him Thomas. This time I want my son named Jack and you do it right."

ENGINEERING GRADS

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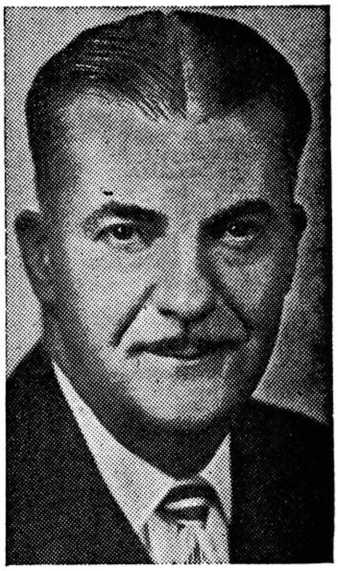

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Why I Never Joined a Sorority

1. I never joined women's organizations at home.
2. I don't want a lot of fraternity boys calling me up.
3. I never danced with a man in my life, and I don't want to start now.
4. I don't like the idea of rooming with one girl a whole semester.
5. I am a man.

Floral Arrangements
by
Floral Artist

Remember MOTHER with Flowers

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Notice:

ALL 1950 GRADUATES . . .

See important announcement on page 28!

—H. G. GOEHRING
PLACEMENT DIRECTOR
COLLEGE OF ENGINEERING

THIS SEASON PARTICULARLY,
SMARTNESS IS KEYNOTED BY

COLOR

and you'll find your most becoming

and exhilarating

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In the May ENGINEER . . .

Materials Handling

Shale Oil

Slide Rule — Part II

Rare Metals

Watch for these Features!

ALLOYS . . .

(continued from page 13)

weight without sacrificing strength, and thereby increasing capacity.

Alloys of aluminum are used in the redesign where strength is not essential to reduce weight still more. Pullman Standard Car. Co. reduced the weight of box cars about 10,000 pounds using this method. Low-bed trailers, such as those made by Rogers Brothers of Albion, Penna., are being constructed with sections of the same weight of low alloy steel as was used with ordinary steel, thus giving the trailers much greater strength. The Fruehauf Trailer Company reduced the average dead weight of its trailers by 1,600 pounds—each pound of reduced weight is worth one dollar per year to the operator.

New Alloy Steel More Corrosion Resistant

Low alloy, high tensile strength steel has been used in many applications with great saving in weight where aluminum alloy could not have been used because of the strength factor. The extraordinary corrosion resistance of this steel makes it usable in applications where ordinary steel would not stand up and aluminum alloys would not have the required strength.

The cost of this steel is such that it encourages its use against that of aluminum alloys. The automotive industry has already turned to these steels because its ductility allows it to be formed into the modern contours. Ordinary steel fails and tears in forming and aluminum alloys would not have the required strength or rigidity. The use of these steels results in a decrease in dead weight which is also desirable. As an example, the hood top of a popular car is 18 pounds lighter because of the use of these steels. The bumper, another severely contoured formation, formerly was made of spring steel. Now it has the advantage of being made from low alloy steel, and is made more economically.

Making the Choice — Aluminum or Steel?

As was stated before, the number of alloys of steel and aluminum has grown to such an extent in recent years that the engineer is sometimes at a loss to know which to choose. The context of the above material points out the majority of the advantages and disadvantages of each group; and in general, it can be said that aluminum alloys can be used to an advantage when lightness is necessary and high strength of secondary importance. Also, the corrosion resistance and workability of aluminum alloys makes it desirable where strength does not enter into the considerations.

Steel alloys are chosen when strength is the main characteristic desired. Every problem concerning a choice between the two materials will have peculiarities of its own and hence will demand individual consideration. Sometimes the two materials can be used to an equal advantage, at which time other factors such as plant facilities and availability of the material will be the deciding factors.

"—They perfect nature and are perfected by experience" —FRANCIS BACON

What these man-made gems mean to you

SYNTHETIC STAR SAPPHIRES like this one, which only the finest of nature's stones can equal, are now made by *man.*

Yes, Union Carbide—which since 1942 has made synthetic crystals for precision instruments and other industrial uses—today produces the loveliest of synthetic star sapphires *and* rubies for personal wear.

But far more important to all of us are the research and technical skills . . . the work with extremes of heat and cold, with vacuums and tremendous pressures . . . that lie behind these superb jewels. The research and skills that produce today's *better materials* . . . used by industry in turning out numberless products.

The same research that brings these man-made stars within our reach . . . brings us, too, man-made leather and rubber. It also gives us today's *better* food, clothing, and shelter. It helps us resist disease. It improves our heating and lighting. It's a part of our swifter, safer transportation systems . . . our communications . . . our progress in construction.

The people of Union Carbide work with a vast range of Alloys, Chemicals, Carbons, Gases, and Plastics. They are constantly perfecting new processes . . . and producing hundreds of materials . . . for the use of science and industry to benefit mankind.

FREE: *You are invited to send for the new illustrated booklet, "Products and Processes," which shows how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics.*

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1950 GRADUATES!

In order to render maximum assistance to students graduating in the Class of 1950, it will be necessary for the Engineering Placement Office to have complete personal data for every student not later than June 1, 1949. The information desired should be placed on a personal data sheet, which is required, and a personnel leaflet form. This will make it possible to have placement data available for use by prospective employers immediately after the opening of the fall semester.

Printed personnel leaflets in addition to the required personal data sheets are recommended for all members of the Class of 1950. These leaflets, which will be prepared by the Engineering Placement Office, are being used by many colleges at the suggestion of industry. Included will be your picture and basic information of interest to prospective employers. Each senior may purchase a lot of 100 leaflets for the actual printing cost of $6.00 plus an application-size glossy photo. The purchase of printed personnel leaflets is optional. However, past experience has proven their value for use during personal interviews both on and off the campus; with letters of application; by your department, the Placement Office, or friends recommending you. They furnish a businesslike and convenient method of supplying your basic qualification for employment. Since the personnel leaflets will materially assist both interviewers and prospective employers, students who provide complete data will be given preference on interviewing schedules.

Both forms will be available in the Engineering Placement Office, 356 Mechanical Engineering Building, and in each departmental office, after May 1, 1949. Each student who expects to graduate during 1950 is required to complete one copy of the personal data sheet in his own handwriting. Students desiring printed leaflets can secure a personnel leaflet form along with the personal data sheet. The leaflet form should be printed or typewritten. These two forms and one application size (1¾ x 2¼) glossy photo must be in the Engineering Placement Office by June 1, 1949. The material will be prepared during the summer and will be available for use immediately after the opening of the fall semester. Students purchasing printed leaflets may obtain them after presentation of a fee card showing payment has been made. Instructions for this fee card will be issued during fall registration. Students having printed leaflets will not be required to furnish additional photos for personal data sheets.

The Placement Office wishes to serve you in the best manner possible. Your cooperation in the procedure outlined will increase its effectiveness in helping you to secure employment.

—H. G. GOEHRING,
PLACEMENT DIRECTOR,
COLLEGE OF ENGINEERING

partners in creating

For 81 years, leaders of the engineering profession have made K & E products their partners in creating the technical achievements of our age. K & E instruments, drafting equipment and materials—such as the LEROY† Lettering equipment in the picture—have thus played a part in virtually every great engineering project in America.

K+E

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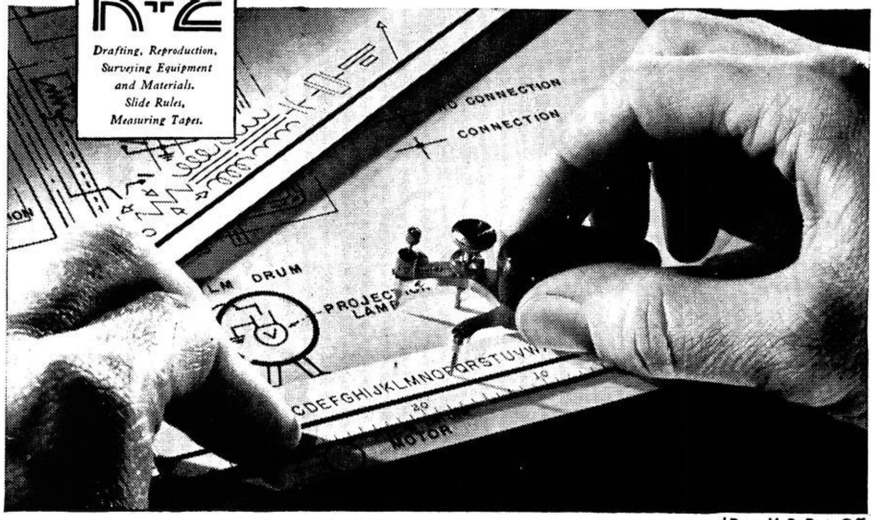

†Reg. U.S. Pat. Off.

KEUFFEL & ESSER CO.

EST. 1867

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Science . . .

(*continued from page* 18)

of the surface is controlled by depth of the powder layer used. The process is quite simple where small parts are involved, but the question of economics cannot be answered without some trials on a larger scale. A possible use of the process is in the manufacture of bi-metallic elements.

MERCURY VAPOR TURBINE

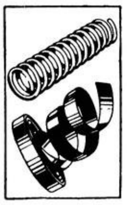
The first postwar mercury turbine-generator has been built by GE and put into service in Hartford, Connecticut. The unit is capable of producing 15,000 kilowatts of power. In addition to producing power, it will produce extra heat, which will be used to produce steam for other turbine-generators in the plant. It will produce some 20,000 pounds of steam per hour at a pressure of 400 pounds per square inch. A number of similar mercury power plants will be installed in various parts of the country during the coming year.

"You THINK you know what Roebling makes...

you stand there talking about Roebling wire cloth and screening. Well I tell you Roebling makes *electrical wire and cable*. I've bought them since before you were born!"

• • • •

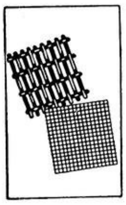
Of course both engineers are right. At its four big plants in and near Trenton, New Jersey, Roebling makes an extremely wide variety of wire and wire products . . . develops new types and achieves quality standards of highest efficiency and service economy to industry.



ROUND — FLAT — SHAPED WIRE. Every inch of Roebling high carbon wire is just like every other inch in gauge and temper, grain structure and finish. That means fewer rejects, fewer stoppages . . . production speed and lowered costs . . . It's available *now!*

WIRE ROPE. Roebling wire rope is a standard specification in many industrial fields. Among the large variety of types, Roebling Preformed "Blue Center" Steel Wire Rope is outstanding for easy handling, operating efficiency and economical service cost.

ELECTRICAL WIRE — CABLE — MAGNET WIRE. With 65 standard types to choose from, there's a Roebling Electrical Wire or Cable for all transmission, distribution and service requirements . . . For high-speed winding you'll find Roevar Magnet Wire is tops.



WOVEN WIRE FABRIC. Roebling industrial Screens range from finely woven Filter Cloths (including highly corrosion-resistant types) to largest Aggregate Screens. Roeflat Screen, a new development, has 75% more wearing surface . . . gives up to 90% more wear.

Whatever career you are studying for, when you get on the job you will find one or more types of Roebling products serving there, dependably and at low cost. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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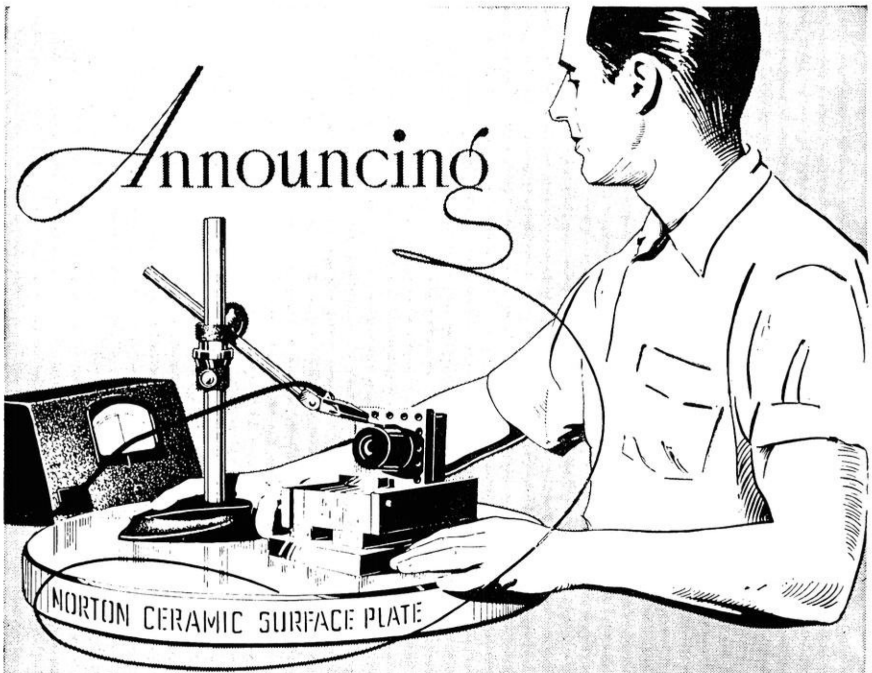

Another NORTON "FIRST"

THIS time it's a *ceramic* surface plate—an entirely new type of plate for toolmakers and inspectors to use in making their precise measurements. This Norton-developed ceramic plate has distinct advantages over previous types of surface plates including: (1) a longer-lived surface, (2) a smoother surface, (3) a flatter surface and one that *stays* flat. It will not warp nor deform, not sweat nor corrode, not deflect under load.

The development of this unique surface plate is typical of the progressive research that has made Norton an acknowledged leader—not only in abrasives and grinding wheels but also in the development of grinding and lapping machines, high temperature refractories and a wide variety of wear-resistant materials.

In the Norton laboratories at Worcester, Chippawa and Troy, there are 195 scientists, engineers and technicians constantly at work on new or improved Norton products.

NORTON COMPANY, WORCESTER 6, MASS.

Behr-Manning, Troy, N. Y., is a Norton Division

The main Worcester plant of Norton Company—world's largest producer of abrasive products

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ABRASIVES — GRINDING WHEELS — GRINDING AND LAPPING MACHINES
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LABELING MACHINES (BEHR-MANNING DIVISION: COATED ABRASIVES AND SHARPENING STONES)

Campus . . .

(*continued from page* 14)

ple, Neal Jenewein, Norbert Rhinerson, and Gus Attewell.

R. C. Holland, R. F. Dickinson, Don Barber, Robert Karow, E. Hanson, William Beranek, Kurt Kasper, Henry Williams, Rolland Krohn, and Bill Conrad.

SAM

The campus now has a new organization that should be of interest to engineers. It is the Society for the Advancement of Management (SAM). On March 31, after a satisfying dinner in the Union, this organization received its charter from the president of the sponsoring Milwaukee chapter, Mr. Frank Kovich.

After the presentation Dean Withey and Dr. Witte briefly commented on the utility and possibilities of this organization to students, and of advanced management principles to society as a whole. The meeting was culminated with a very excellent talk by Mr. Roger Kelly who works in the industrial relations department of the Trackson Co. in Milwaukee. He was very informative as to effective methods of selling yourself into the right job, the job you want and fit.

This organization is well on its way to success with over 70 members at this early date in its history. How about it, engineers, let's bring this total up to the top in the nation's student chapters.

ASME

Mr. A. T. Lillegren, vice-president of the Madison Kipp Corporation, spoke to ASME on Thursday, Mar. 31.

Mr. Lillegren was a member of a board sent to Germany to review the progress the German die casting industry made during the war. His report, which has been substantiated by further investigation, indicated that German die castings were not superior to those made here. Mr. Lillegren said that although the German engineers had made significant advances, the quality of their work was not as high as originally supposed.

New RCA 16-inch direct-view television tube fills gap between popular 10-inch tubes and the projection-type receivers.

"Inside story" of a bigger, brighter picture on your television screen

The screen on which you are accustomed to seeing television is the face of an electron tube—on which electrons "paint" pictures in motion.

And the size of the picture, unless projected, is determined by the size of the tube.

Working to give you *bigger,* brighter pictures, RCA engineers and scientists developed a new way to make large, direct-view television tubes. They found a method of "welding" large areas of glass and metal . . . while keeping a vacuum-tight seal!

Using this development—ideally suited to mass production—RCA can now build television tubes of light, tough metal . . . using polished glass for the face, or "screen."

An achievement of research

Development of this new way of making television tubes is a continuation of *basic television research* which began at RCA Laboratories. Such leadership in science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

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- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

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SLIDE RULE . . .

(*continued from page* 15)

traction to "slide rule" was inevitable.

Another innovation of Everard's was gauge points—numbers used often in slide rule settings and involving standard measurement and unit conversion factors. These rules also had scales to be read for the calculating of square and cube roots of numbers.

It was up to a lad named John Warner to design the first scales for reading square and cube root directly—this occurred about 1722.

One William Hunt brought out a slide rule about 1697 which had scales for finding the area of a circle, given the diameter; a scale for finding the perimeter of ellipses of known axes; and one for finding the length or width of a rectangle of unit area when the length or width, respectively, was known. This latter scale actually boiled down to a scale of reciprocals, since the length of a rectangle of unit area is one over the width. A fellow named Wallostan was the first to make use of this principle in putting such a scale on a slide rule—it is the simple scale running in the reverse direction. This little gem came out about 1797 and in 1815 this same Wallostan brought out scales specially adapted for calculation in chemistry.

In case you are wondering where the hairline that is always so elusive came from, you can blame it on Sir Isaac Newton. He devised a scheme for solving cubic equations using three movable slide rule scales laid side by side and a separate straightedge laid across all three. The first one of these hairlines actually built right on the slip stick was put there by John Robertson, about 1775.

It might be interesting to note that these early slide rules were so crudely made that great inaccuracy often resulted. About 1775 our own James Watt had a slide rule made with great care and of great accuracy, thus setting the standard for the future and popularizing the device.

Shortly after this William Nicholson, who published a technical journal, began to devote some time to the slide rule and really boomed it in his magazine. In 1817 he announced the development of the folded scale by Sylvanus Bevan. That's the scale labeled "CF" and "DF" on our modern K&E's and Dietzgens.

After this time and Nicholson's death the slide rule was the subject of concerted neglect in England, and France took over the lead in slide rule development and manufacture.

About 1716 the circular slide rule of Oughtred was independently reinvented in France and gained great popularity. In 1815 the log-log scale was invented by Peter Roget. He called it the "logometric" scale and showed how it could be used for raising a number to any power or taking correspondence roots. The problems in which the log-log scale is really a life saver, those involving exponentials, compound interest, thermodynamics, hydraulics, etc., were not of practical interest in those days, so the scale was soon forgotten, only to be reinvented many times over, as the occasion demanded. Log-log scales for the solution of algebraic equations as high as the quintic were devised and a scale for use with complex numbers $a + b\sqrt{-1}$ was developed by Mehmke in Germany.

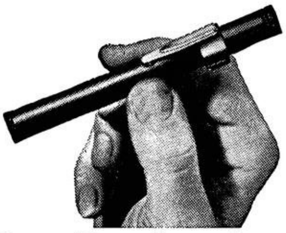
In 1815 Lenoir in France made a substantial contribution to the success of the slide rule by devising a dividing machine for marking off the scales of the rule. This led to great accuracy and increased production, for formerly the work was all done by hand.

The next great development of the rule was the Mannheim rule, which is the form of the slide rule as we know it today. It was developed by a French artillery officer named Amedee Mannheim. Since that time developments have been more along the mechanical line than in working out new types of rules. The magnifying runner, vernier runners, decimal indicators, and the like, are examples. The polyphase, duplex rules are all outgrowths from the Mannheim rule.

A later development in the United States is the cylindrical slide rule patented by Edwin Thacher. The chief advantage of the cylindrical rule is the accuracy which can be attained and the speed and variety of operations that can be performed.

With this brief historical sketch of the development of the slide rule as we know it today, we will draw this part of the article to a close. Next month, in part two, we will spend some time on the use of the rule and try to explain some of the lesser known procedures with which time and effort can be saved in working problems.

For Measuring RADIOACTIVE EMISSION



Pocket Gamma Ray Dosimeter

A personnel protection instrument to measure cumulative exposure to x- or gamma rays. The cylindrical case contains an ionization chamber and a quartz fiber electrometer. Optical system enables position of the fiber to be read easily upon a 40-division translucent scale. Standard range O-200 milliroentgens. Size 4¾" x ½" dia.

Other Cambridge Instruments

LINDEMANN-RYERSON ELECTROMETER has high sensitivity and good stability. Does not require leveling. When reading, the upper end of the needle is observed on a scale illuminated through a window in bottom of case. Size 8.3 x 6.5 x 3.5 cm.

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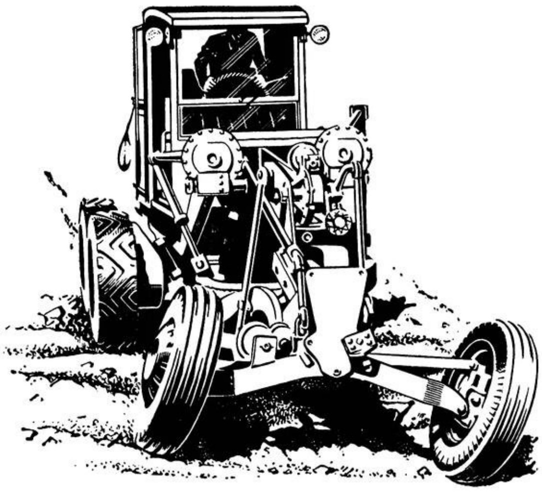

How to get a good steer from a grader

To make motor graders easy to steer, and to carry the weight of the front end, leading construction equipment manufacturers use Timken® tapered roller bearings in the king pin yokes. Timken bearings carry the heaviest radial and thrust loads in any combination, no matter how tough the going gets.

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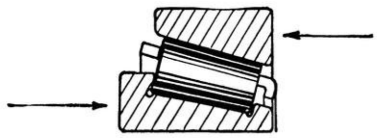

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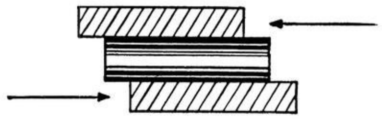

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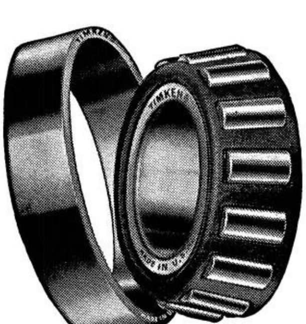

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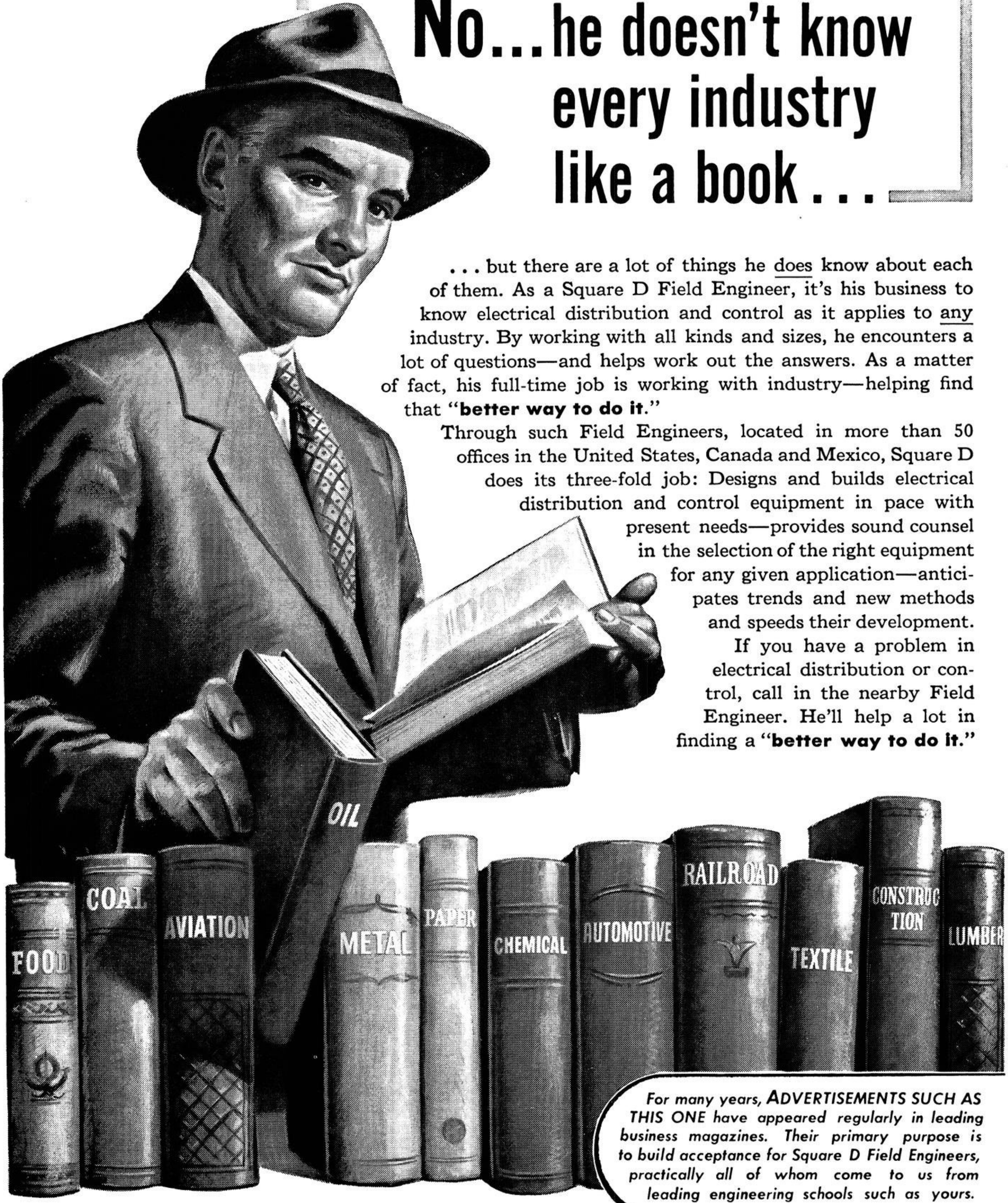
No... he doesn't know every industry like a book...



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

Through such Field Engineers, located in more than 50 offices in the United States, Canada and Mexico, Square D does its three-fold job: Designs and builds electrical distribution and control equipment in pace with present needs—provides sound counsel in the selection of the right equipment for any given application—anticipates trends and new methods and speeds their development.

If you have a problem in electrical distribution or control, call in the nearby Field Engineer. He'll help a lot in finding a "**better way to do it.**"

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TUNGSTEN . . .

(continued from page 19)

tungsten by electrodecomposition. Using an aqueous solution of sodium tungstate and, for example, nickel sulfate, tungsten and nickel are formed at the cathode. Different metals can be used in the solution, however the best results have been obtained with nickel, cobalt, and iron as the codepositing metals. Since most any metal can be used as the cathode, many very important applications of the process seem possible. The experimentation is still in the laboratory stage, however, and some time will be necessary before large production can be initiated.

As wire or sheet, tungsten is dull white. It is corrosion resistant, and as such, alloyed with chromium and cobalt and steel it makes excellent surgical tools. Permanent magnets annually absorb several thousand tons of steel containing 5 to 6% tungsten. In addition to its well known use as light bulb filament, it is used as an x-ray target, in thermionic tubes, galvonometer suspension, electrical contacts, and refractory crucibles. Tungstate of soda is the most important tungstate and is used as a mordant in dyeing and calico printing. It also helps make textiles noninflammable.

With the ever increasing demand for metals that will stand up under high temperatures, tungsten, either in its pure state or its alloyed state, is sure to be one of the leaders.

HC ENGINES

(continued from page 8)

valve cavity to the cylinder cavity, there is a loss in volumetric efficiency. To avoid this, the engineers turned to overhead valves. These valves, operating with stem upward, must be actuated through tappets and push rods, but these arrangements are extremely noisy, especially when the engine is cold. To overcome this clicking, a hydraulic valve lifter was developed.

This unit consists of a piston arrangement in the cam follower which is actuated by oil under pressure. This oil pressure, plus a spring, take up the slack when the valve is closed, but do not exert enough pressure to open the valve. When the push rod is actuated, a ball check valve prevents the oil from leaving the little piston, thus forming a nearly solid rod. Any variations are automatically taken care of by the opening and closing of the ball check valve to allow more oil to enter or a small amount to escape.

The valves are actuated by a single camshaft which is located above the crankshaft and between the two banks of pistons. The camshaft is driven by a silent chain drive and suitable sprockets from the crankshaft. The intake valve has been increased 3/16 inch in diameter to 1 3/4 inches and the exhaust valve has been decreased slightly to 1 7/16 inches in diameter.

The cylinders are supplied with the fuel-charged air through a single intake manifold located between and

(please turn to page 40)

Adaptable to many special applications such as sorting and quality control devices. Simple setting provides readings of .0001" to .00001". Intermediate settings can be made easily to match prescribed tolerance limits. Equipment includes: amplifier unit; external and internal comparators; gage head cartridge for jig or fixture mounting; signal light attachment. Write for catalog. Brown & Sharpe Mfg. Co.,

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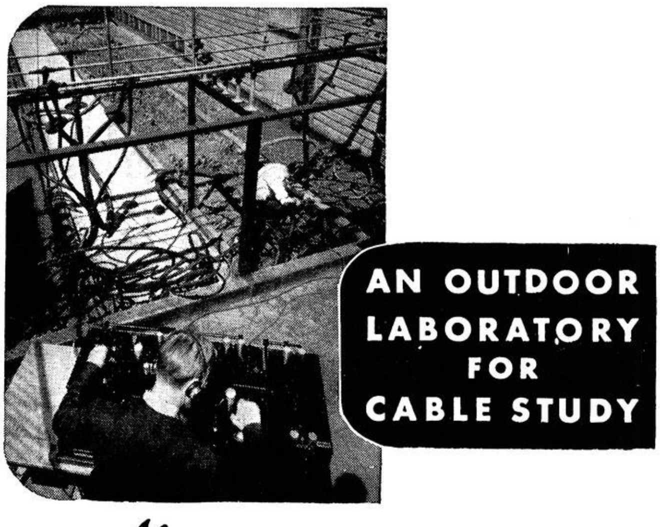

Nothing is guessed at, nothing is taken for granted by the engineers in charge of Okonite's cable proving ground. Buried in various types of chemically different and highly corrosive earth, pulled into conduit or installed overhead, electrical cables are tested under controlled conditions of temperature, voltage and loading conditions duplicating those of actual operation.

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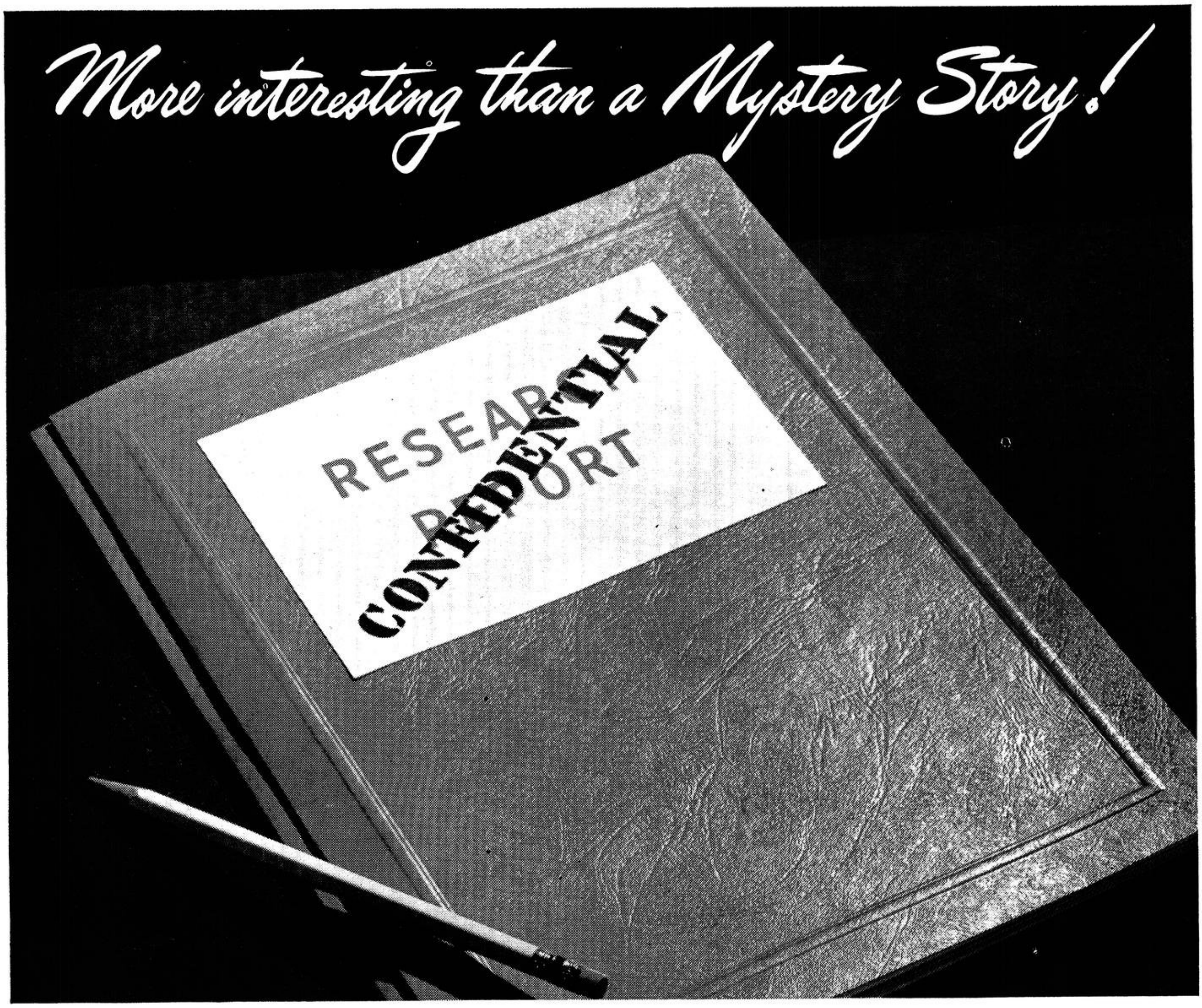
OKONITE
4289 insulated wires and cables



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What does that suggest to you? Condensation? Polymerization? Dehydration? Alkylation? Acylation? Esterification?

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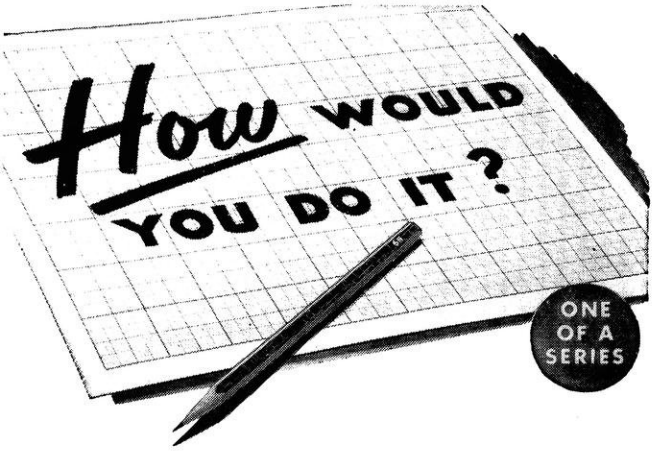

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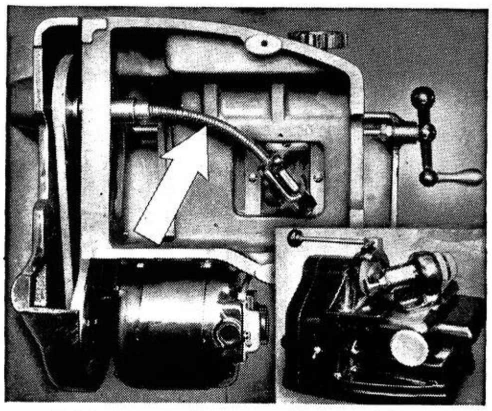

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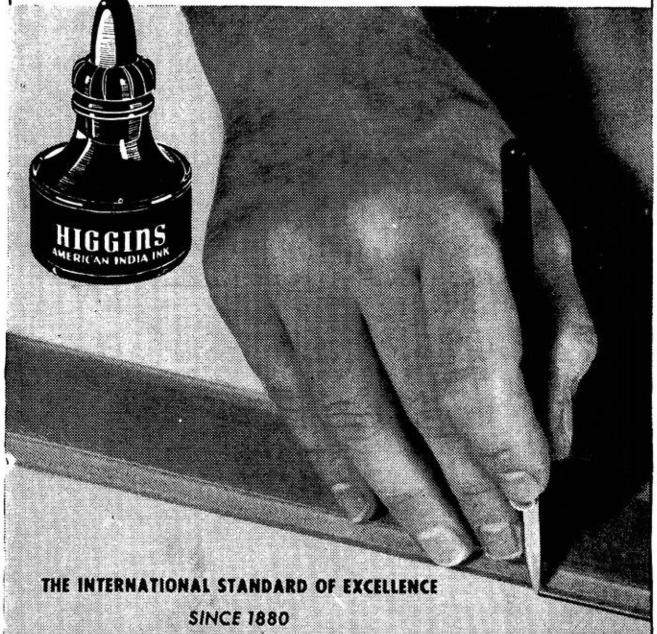

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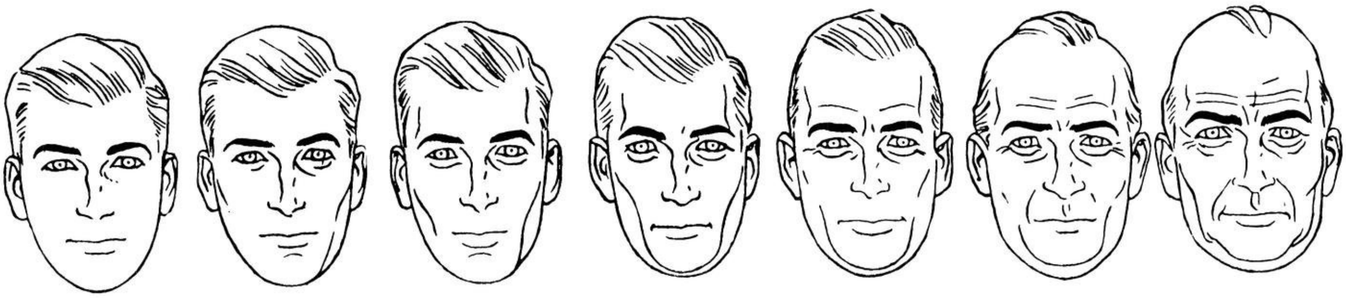

The answer, of course, is never—*not as long as he continues to be an engineer*. As an engineer, every problem put to you, in school and out, will always test your professional skill and ingenuity. The next step, then, is to *make sure you'll always pass.*

Today you're passing those exams with the information you're getting out of books, lectures and the laboratory. Tomorrow, when you are out on the job, the lectures and the laboratory will be gone. But your engineering books will always be there, and to them you will add the business and technical magazines devoted to your special branch of work.

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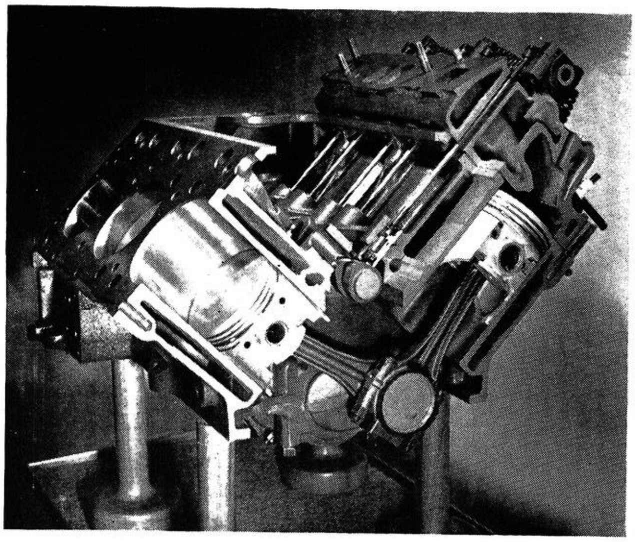
H C ENGINES . . .

(continued from page 36)

above the two banks of cylinders. The individual intake passages are surrounded by the exhaust gas jacket, making possible some use of the waste heat in heating the incoming charge. Removal of the exhaust gases is done through a manifold extending down each bank of cylinders along the outside.

New Combination Vacuum Pump and Fuel Pump

In addition to the design changes which are common to both engines, the Kettering engine now uses a newly developed combination vacuum pump and fuel pump. They are both driven through rocker arms riding on a



A cutaway model of the Kettering engine showing the pistons and camshaft. The new valve mechanism is also shown.
(Photograph courtesy Popular Science Magazine)

common eccentric on the camshaft. The double-acting vacuum pump serves as a booster between the manifold and the windshield wiper because the increased slope of the windshield requires more vacuum to drive the wipers. Both pumps operate on the principle of the diaphragm.

The dual carburetor has been simplified so that all operating parts are mounted inside the top cover, which means easier servicing. All of the working members are removed by simply removing the cover.

A new baffled crankcase breather is mounted at the rear of the engine between the banks of cylinders. The baffling removes the oil vapor in two steps and returns it to the crankcase.

Advantages of the New Design

This new engine design has numerous advantages. The power has been increased for a shorter, lighter unit. The power of the Cadillac engine has been increased to 160 hp., 10 hp. over the 1948 model V-type engine, with a decrease in weight of about 200 pounds. The Kettering engine, rated at 135 hp., has a power rating approximately 17 per cent greater than engines of the same displacement. The old engine had a rating of 115 hp.

Fuel economy is a good selling point. Cadillac reports a 15 to 20 per cent increase in fuel economy. The Kettering engine has an increase in fuel economy also. The old straight engine had a fuel consumption of 0.620 lb. per hp. hour while the new engine uses 0.533 lb. per hp. hour, a decrease of about 14 per cent. With this decrease in fuel rate for increased horsepower, the thermal efficiency has increased to about 26 per cent, an increase of 18 per cent over the old design.

The weight per horsepower is the measure of the weight improvement in any engine. The new engine weighs only 5.52 lb. per hp. as compared to a weight of 6.22 lb. per hp. in the old design.

The use of balance pads on a number of the moving parts has increased the balance of these parts, thus reducing the cause for much of the vibration which is detrimental to both the engine and the automobile.

Improvements and the Consumer

The average purchaser of such an engine in his automobile does not understand the technical facts about the improvements. Rather than these technicalities he thinks about the power available and the miles he can travel per gallon of gasoline. The power has been increased, that is true; but the engine rating is based on a maximum available rather than the power which is ordinarily delivered or needed by the automobile in ordinary circumstances. So far no drastic increases in mileage have been guaranteed; although no actual figures are available, some increase is predicted. Actually the compression ratio which will be used has been increased only very little over that which is used in present models.

New Designs and the Future

The 12 to 1 compression ratio for which the engine has originally been designed will undoubtedly be seen in use some time in the future. This still remains for the advent of 100 octane gasoline in quantities available to the general consumer. The future development, then, of the much improved designs with drastic increases in efficiencies and decreases in fuel rates lies in the hands of the gasoline industry, which must supply this high octane fuel in quantity and at reasonable prices. This may be in the near future since designs of the engine and those directly connected to the engine, such as the tooling and the engine mountings, have been made with this change in mind so that with only a minimum of retooling and changes the engine could be modified to change the compression ratio to up to 12 to 1. With this high compression ratio and high octane fuels, the Oldsmobile engineers have predicted up to and even exceeding 25 miles to the gallon of gasoline in ordinary city driving.

The new design has, however, set up a challenge to other engine manufacturers. Undoubtedly this will lead to further improvements or further changes in design. This fact is typical of our type of economy, where competition leads to improvement. Basic research, too, is important in the development of new and improved products.

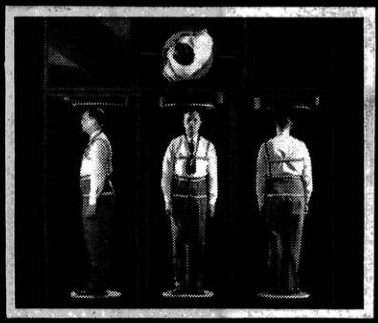
All size 42
—yet no two alike

Now, photography with its speed and accuracy measures a man for his clothes quickly and with precision in every dimension.

Recently a striking new idea hit the headlines—an idea aimed at fitting made-to-measure clothes more accurately than ever before. It was the idea of Henry Booth of Amalgamated Textiles, Ltd., and he named it "PhotoMetric."

In the PhotoMetric method, photography scans you with a wink of its precise eye from before, behind, above, and from the side. With the click of a shutter it gets all major measurements plus all the individual variations from a "perfect" size. It oversteps the limitations of the tape and records contours, proportions, shape, and posture as well.

Later, in the pattern room, the film is projected and, in effect, there you stand while the craftsman with special calibrated devices measures your image in three dimensions—getting some thirty highly accurate readings.



PhotoMetric installations are already going in from coast to coast. It is a fine example of how photography is serving business, science, and industry—speeding methods, refining technics, improving products. It may be well worth your while to look into what the photographic process can do for you.

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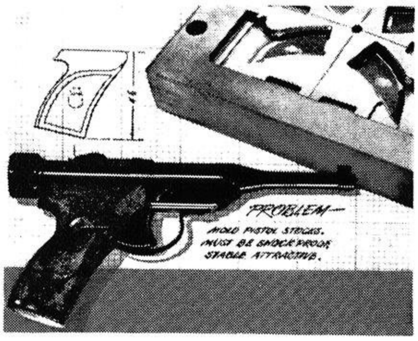
PLASTICS—A MULTIMILLION-DOLLAR INDUSTRY AND STILL GROWING

"Plastics" to most people connotes something modern—something new. And the plastics industry, as it now exists, is still an infant, but a lusty and vigorous one.

How fast it has grown in a short span of years is indicated by these figures, which show the number of plastics molding plants in the United States in the last thirty-nine years:

1910	8 plants
1920	63 plants
1930	172 plants
1940	575 plants
1949	1,160 plants (estimated)



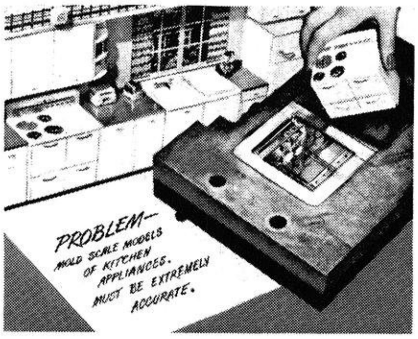
The Ancients Molded Plastics

But the art of casting "plastic" material in molds is an old one. As long ago as King Solomon's time, asphalts and mineral tars were being molded into useful shapes.

These natural molding materials were the only ones available for centuries—until the invention, in 1869, of the first modern synthetic plastic, celluloid. Today the plastics industry makes dozens of synthetic materials with a wide range of molding characteristics.

General Electric entered the plastics business more than fifty years ago by molding carbon rods for arc lamps from clay and lampblack. Later, G. E.'s plastics operations expanded rapidly, when plastics began to be used extensively in electrical insulation.

As General Electric's plastics operations grew, it became practical to offer plastics services to other companies.



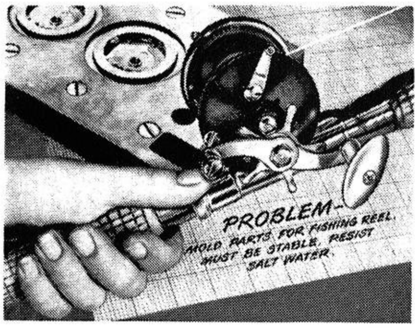
Now General Electric is unique in the industry, being both a manufacturer of plastics molding materials and one of the world's largest plastics molders.

G. E. provides a complete plastics service. It has facilities for producing special types of molding compounds and for designing, engineering, and molding any kind of plastics part or product.

You may breakfast at a dinette table with a surface of G-E Textolite* (a laminated sheet plastics); your toaster may have a base of plastics, molded by G. E.; the breakfast service may be G-E plastics plates and cups in beautiful pastel shades. Your automobile, your refrigerator, your radio, your camera—all are likely to incorporate plastics parts produced by General Electric.

The Scope of G-E Chemical Department's Operations

Molded plastics are just one part of General Electric's Chemical Department's operations. Other products made and sold by the Chemical Department include the amazing new materials of organic-silicon chemistry called silicones, Glyptal* alkyd resins, insulating varnishes, permanent magnets, and plastics



molding compounds. Every month new chemical developments are coming from the G-E research laboratories. And the variety and scope of G-E chemical operations promise to broaden tremendously as this research progresses.

For more information, write Chemical Department, General Electric Company, Pittsfield, Massachusetts.

A message to students of chemistry from

F. W. WARNER

Engineering Manager of the G-E Plastics Division

The rapid growth of the plastics industry in the last ten years offers us some idea of the progress we may expect in plastics within the next decade. For a young man who wants to "grow up" with a rapidly expanding business, the field of plastics seems to offer particularly attractive opportunities.

*REG. U. S. PAT. OFF.

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PLASTICS • SILICONES • INSULATING MATERIALS • GLYPTAL ALKYD RESINS • PERMANENT MAGNETS • MOLDING COMPOUNDS