ILLINOIS TECHNOGRAPH

December

1942

★

AIR TRANSPORTATION

MECHANISM OF MAGNETISM

PARACHUTES

SYNTHETIC RUBBER

A.S.C.E. CONFERENCE

OUR SOCIETIES

TECHNOCRACKED

★

...shed 1885 Member E.C.M.A.

20¢

For More Than a decade designers of aircraft have foreseen the day of freight-carrying planes flying the airways of America. Now, with Dow successfully extracting weight-saving magnesium from sea water, the era of commercial freight transport by air draws measurably closer. Vast quantities of this lightest of structural metals are being used in the construction of aircraft for our armed forces and will eventually be available for industry at large after Victory is won. Thus from the waters of the sea will come wings destined to transport many of the nation's products of peace by air.

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

New York, St. Louis, Chicago, San Francisco
Los Angeles, Seattle, Houston

MAGNESIUM

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND VICTORY

DECEMBER ★ 1942

This Issue . . .

THE TECHNOGRAPH

Staff . . .

L. Byron Welsh .... *Editor*

William G. Murphy .... Associate Editor
Paul Salerno .... Assistant Editor
Lee Sullivan .... Photographer

SENIOR EDITORIAL STAFF

Walter J. Gailus, Steven Yurenka, John L. Colp

EDITORIAL ASSISTANTS

William R. Schmitz, Byron M. Robinson, Don Hallberg, Jim Murray, Eugene Bixby, William Rychel, Charles E. Yale, Jack Steele, Herb Newmark

Dean E. Madden .... *Business Manager*

William Beich .... Circulation Manager
Alex Green .... Subscription Manager

BUSINESS STAFF

David Causey, Byron Krulevitch, Don Deno, John Henton, Bob Rouse, William Lurvey, James Lyle, James A. Chapman

MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Arkansas Engineer, Colorado Engineer, Cornell Engineer, Drexel Technical Journal, Illinois Technograph, Iowa Engineer, Iowa Transit, Kansas Engineer, Kansas State Engineer, Marquette Engineer, Michigan Technic, Minnesota Techno-Log, Missouri Shamrock, Nebraska Blue Print, New York University Quadrangle, North Dakota Engineer, North Dakota State Engineer, Ohio State Engineer, Oklahoma State Engineer, Oregon State Technical Record, Pennsylvania Triangle, Purdue Engineer, Rose Technic, Tech Engineering News, Villanova Engineer, Wayne Engineer, Wisconsin Engineer, and Cooperative Engineer.

Published Eight Times Yearly by the Students of the College of Engineering, University of Illinois

Published eight times during the year (October, November, December, January, February, March, April, and May) by The Illini Publishing Company. Entered as second class matter, October 30, 1921, at the post office of Urbana, Illinois. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions, $1.00 per year. Single copy 20 cents.

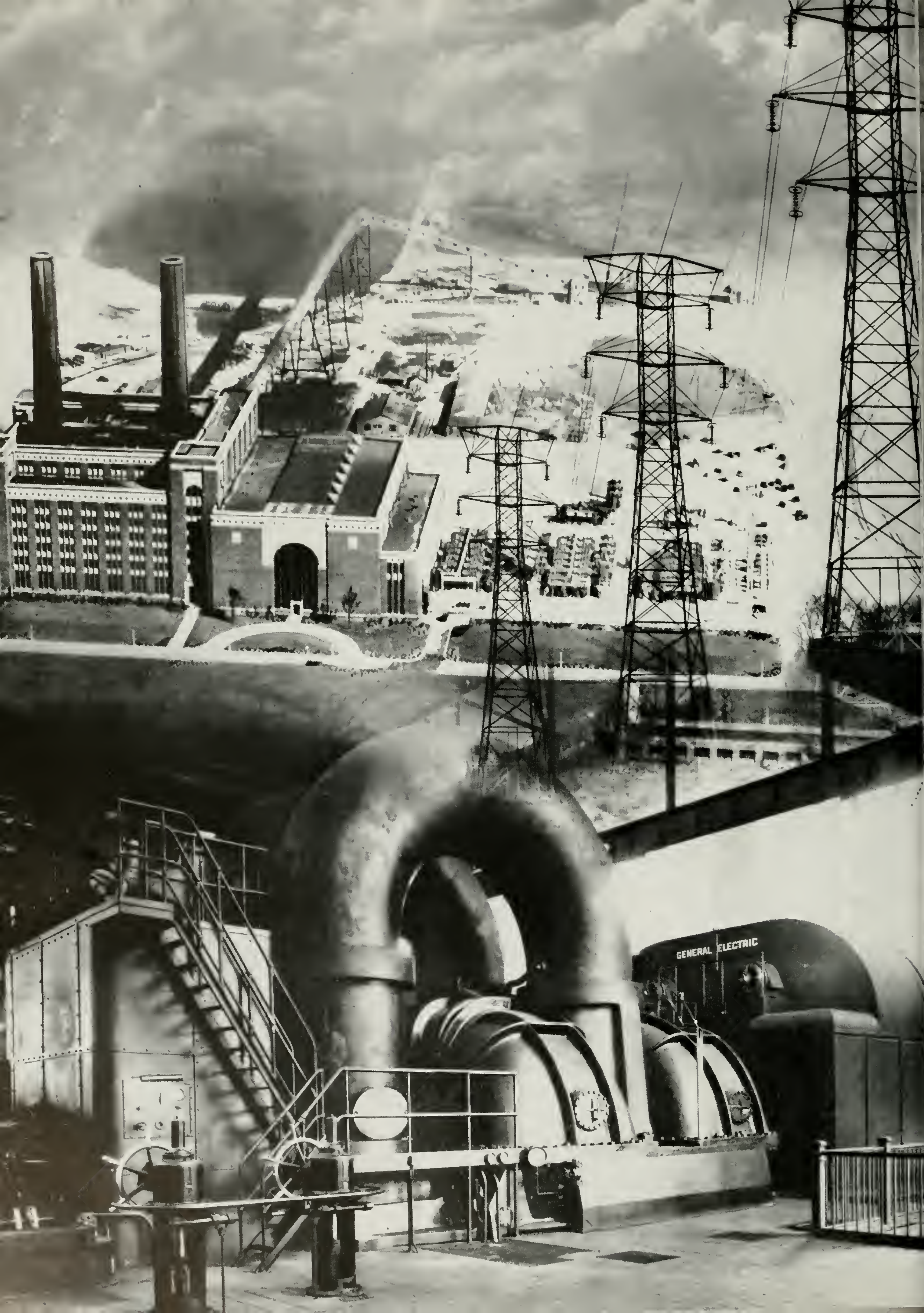
Frontispiece . . .

Electric power generation and transmission. *(Photomontage, Courtesy General Electric).*

★

Cover . . .

Three Aircobras in formation. *(Photo, Courtesy Bell Aircraft Company).*


GENERAL ELECTRIC

AIR TRANSPORTATION

By M. L. ENGER
Dean of the College of Engineering

The war has crowded into a few years the development of air transportation which would have required decades under peace time conditions. Planes are being produced in numbers which seemed fantastic when first mentioned. Flights over oceans have become routine. After the war we shall have an over-expanded manufacturing capacity for planes of every type and a reservoir of pilots and other personnel needed to put them into use. The inevitable result will be a revolution in transportation which will produce social and economic effects of great consequence.

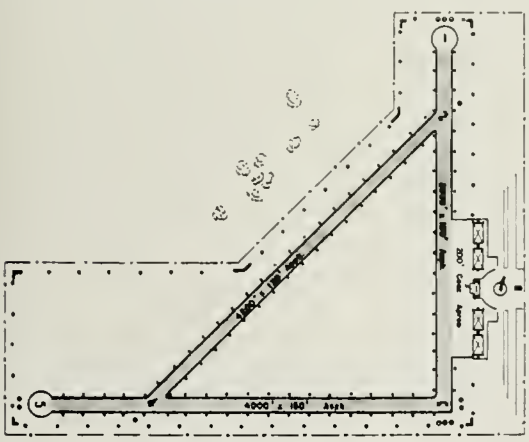
The growth of air transportation was very rapid before the war. Each succeeding year saw a great increase in the air transport of passengers, mail, and express. However, at its peak, air line service was available over a limited number of routes, and only a few hundred planes were in service. After the war there will be a great and sudden increase in all phases of air transport. Large cargo planes will compete with railroads for the perishable freight business. Smaller transport planes, and possibly gliders, will compete with trucks. Long distance passenger travel by airplane will increase. Air transportation is destined to become one of the great industries after the war.

A very large number of airports will be necessary before it will be possible fully to develop air transportation. Just as vast expenditures have been made for paved highways for automotive transportation, great expenditures for airports must be made for transportation by air. The time required to construct an adequate number of airports will be the principal factor in retarding the use of the airplane. The existing capacity for manufacturing airplanes exceeds by many times the available airport capacity. It follows that airport construction will be one of the major engineering activities in the decade following the war.

The Civil Aeronautcs Administration several years ago proposed Federal apropriations for a system of airports and airways which were attacked as fantastic and visionary at that time. It is evident now that the proposed system represented a very modest beginning of the much more comprehensive plan which is known to be needed.

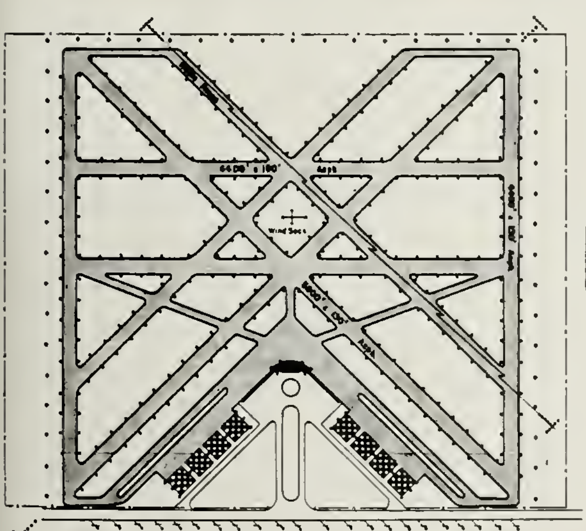
Airport planning and construction is in its infancy. Many airports have been abandoned as unsuitable after large expenditures had been made, because of inadequate areas or unfavorable locations. The Civil Aeronautics Administration recommends a square mile of land for important airports and has set up standards for runway lengths, widths,

(Continued on Page 27)



CLASS 3

PRESENT DAY TRANSPORT AIRCRAFT
UP TO 30 PLACE
ADEQUATE FOR AIRCRAFT FROM 10.000 # TO 50.000 # GROSS WEIGHT.
CITIES OF 25.000 TO 250.000 POPULATION ON AIRWAYS SYSTEM.
LANDING STRIPS 3500' TO 4500' LENGTH



CLASS 4

LARGEST AIRCRAFT NOW IN USE AND THOSE PLANNED FOR IMMEDIATE FUTURE.
50 PLACE AND LARGER
ADEQUATE FOR AIRCRAFT OF GROSS WEIGHTS OF 50.000 # AND OVER.
MAJOR METROPOLITAN CENTERS AND AIRWAY TERMINALS.
LANDING STRIPS 4500' LENGTHS AND OVER

Recommendations of Airport Section of Civil Aeronautics Administration for Airports for use of Transport Aircraft.

The Mechanism of Magnetism

By SIDNEY SIEGEL
Research Engineer, Westinghouse Electric and Manufacturing Company

Nearly a half-billion pounds of iron is used in the United States yearly for electrical purposes. The reason is, of course, that iron is the material most readily capable of becoming magnetized. Just what happens inside a transformer lamination or a lifting electromagnet element has been thoroughly explored and it is possible to describe fully and clearly the phenomena occurring while iron is being magnetized.

From the magnetic point of view, all substances can be grouped into two classes. In the first, the paramagnetic materials (such as aluminum, calcium, platinum, tungsten), the atoms of the substance have a permanent magnetic moment; ie., each atom even in the absence of an external field is a tiny magnet. The substances of this class all have nearly the same magnetic moment per atom, several atomic units of magnetism. Each atom is a miniature solar system in which free electrons revolve around a heavy nucleus of protons and neutrons. In addition to revolving about the nucleus, each free electron is also believed to spin about its axis, thereby producing a magnetic moment corresponding to the atomic unit of magnetism. The magnetic moment of the whole atom depends, of course, on the number of unpaired electrons in the orbits surrounding the nucleus.

When a paramagnetic substance is placed in a magnetic field, the atomic magnets tend to line up in the direction of the field against the disorienting effect of the random thermal vibration of the atoms. Most of these substances have a permeability (ratio of magnetic induction to magnetizing force) of the order 1.001, and are only weakly magnetized in the ordinary magnetic fields encountered in practice. The reason for this is that the disorienting effect of the thermal agitation, at room temperature, is far larger than the orienting effect of the applied field.

In the second class of substances, the atoms have no magnetic moment in the absence of an external magnetic field. These are the diamagnetic materials (such as silver, gold, zinc, bismuth), and have permeability less than unity, but by an amount so small that very sensitive apparatus is required to detect the difference. For example, the permeability of pure copper, which is diamagnetic, is 0.999999. For all practical purposes, all diamagnetic and most paramagnetic substances are usually designated "non-magnetic" due to the fact that their constant of permeability is nearly unity, within one part, or less, in 10,000.

A small group of paramagnetic materials namely, iron, cobalt, nickel, alloys and compounds of these metals, and certain alloys containing manganese, differ radically from all other substances. The outward difference between these materials, called ferromagnetics, and other paramagnetic materials, is in the magnetic properties and is well known. As shown in Fig. 1, it is possible to induce high flux densities in iron. These flux densities are much higher than those in most paramagnetic materials—about 1000 times as high. The reason for this difference is that in the ferromagnetics there is a strong interaction between the individual atoms of the solid tending to line up neighboring atoms so that the atomic magnets are parallel ,while in the paramagnetics there is no such interaction.

Ferromagnetic atomic interaction is so great, even without an external field, that a comparable magnetization intensity of the same magnitude in a paramagnetic metal could only be achieved by means of an external field of some 10 million oersteds. Such intense fields have never yet been attained by laboratory or commercial apparatus. (The oersted is the unit of magnetic field strength, equal to 1/0.4 pi ampere turns per centimeter. The earth's magnetic field is about one oersted; the exciting field in a transformer about ten oersteds, and the field in the air gap of a generator is about 10,000 oersteds.)

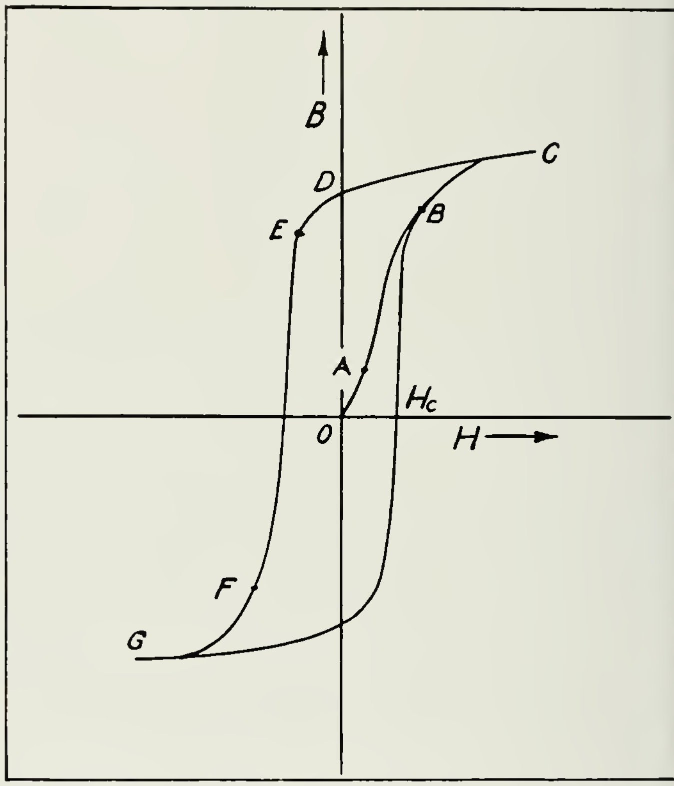


Fig. 1.—The magnetization curve of a ferromagnetic material with the induction B plotted vertically, the magnetizing field H plotted horizontally. A number of magnetization principles, discussed in the text, are indicated on the curve.

One feature of our picture of a piece of iron is, therefore, that nearly every atomic magnet is parallel to its neighbors, because of the interaction between neighboring atoms, even in the absence of an external field. This view, that ferromagnetic materials are spontaneously magnetized, is essential to our understanding of the behavior of a piece of iron in a magnetic field, and was first set forth by Weiss.[1]

If all the atomic magnets are parallel without an external field, how is it possible to obtain a demagnetized piece of iron? Weiss provided the answer to this question, too, by explaining that each piece of iron is divided into minute "domains of spontaneous magnetization." In each domain the atoms are all parallel, so that each domain is saturated; i.e., within each domain the ferric induction (fig. 1) is equal to its saturation value of about 20,000 gausses. The direction of the induction varies from one domain to another in such a manner that the induction of the specimen as a whole is zero, and the specimen is therefore demagnetized. In other words, whereas in each domain all—or most all—the atoms are oriented, the domains themselves are disposed at random, giving zero net magnetization.

The size and shape of these domains depend to some extent on the size and shape of the specimen, and on the nature of the material, but in a general way the dimensions of the domains are of the order one-tenth to one-thousandth cm, each containing about 10^{15} (a million billions) atoms. The domains exist as a result of a balance between two opposing types of forces. Consider a cylindrical single crystal of iron, such as is shown in Fig. 2a. The atomic interactions tend to make all the atoms parallel to each other. Were this tendency satisfied, the bar would be saturated and magnetized in the direction shown. The magnetic poles at the end faces of the crystal would give rise to a demagnetizing field in opposite direction to that in the crystal. This field would tend to reverse the atomic magnets. However, another force opposing the magnetization in the crystal is the thermal agitation tending to orient the atomic magnets in all directions. As a result, to preserve equilibrium, the crystal becomes divided into small regions, Fig. 2b. Each region contains a large number of atomic magnets oriented in one direction, and is therefore magnetized in the same directions, and the net result is that the crystal, or the whole piece of iron of which the crystal is but a part, is demagnetized.

The existence of these domains has been proved by many experimenters, the first direct visual evidence having been Bitter.[2] If a properly prepared collodial suspension of iron oxide is placed on the polished surface of a ferromagnetic material, and the surface examined under the microscope, patterns such as those of Fig. 3 are observed.

All metals are crystalline, which means that their atoms are regularly distributed on the points of a space lattice. For iron crystals this lattice is a series of cubes each 2.86 x 10^{-8} cm (about one-hundred-millionth inch) on edge, with an iron atom at each corner and at the center of each cube. Since in a piece of iron such as a transformer lamination each crystal contains an enormous number of very regularly arranged iron atoms. Each crystal is divided, as we have seen, into many magnetic domains. The regularity of position continues from one domain to another within a single crystal, but the regularity of direction of atomic magnetic moment is continuous only over a domain. This situation is pictured in Fig. 2b. In iron these domains are not randomly oriented, for each domain is magnetized to saturation along one of the six possible directions parallel to the cube edge of the crystal in which the domain is situated.

Our picture of a piece of demagnetized iron is therefore the following: Crystal grains about one-tenth cm in size are more or less randomly oriented in the iron. Within each grain, many saturated domains of magnetization are present, with the direction of magnetization of any one domain restricted to one of the cube-edge directions in that crystal. There is an equal number of domains in each direction, so that each crystal shows no net magnetization, and the specimen as a whole is demagnetized. This condition is shown schematically in Fig. 3a, where two grains are shown, each divided into idealized square magnetic domains. The cubic axes lie along the lines in each crystal, and each domain is magnetized in the direction indicated by the arrows. Ths material is demagnetized, in the state given by the point 0 on the magnetzation curve of Fig. 1.

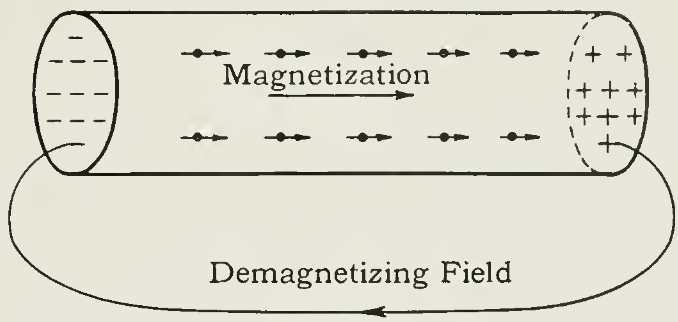
A small positive field is now applied, and the magnetization increases along OA in Fig. 1. This initial increase in magnetization occurs by a process of domain-boundary displacement. This is shown in Fig. 3b. Domain 1 in the upper crystal, for example, grows at the expense of its neighboring domains by shifting its boundaries to the position of the dotted lines. By this process, all the domains that are favorably oriented with respect to H, i.e., magnetized at a smaller angle with the applied field, grow at the expense of their less favorably oriented neighbors. This process is a nearly reversible one, and if the field is removed, most of the domain boundaries return to their original positions.

If the applied field is increased, and becomes of the order of the coercive force H_c, which in well-annealed, high-purity materials may be only a fraction of an oersted, a new process of magnetization comes into play. The boundary between domains shifts suddenly so as to wipe out entirely an unfavorably oriented domain, such as domain 2 in the upper crystal of Fig. 4b. This sudden shift of domain boundaries, in which entire domains change their direction of magnetization from one cubic axis to another, is known as the Barkhausen effect. Bozorth[4] has shown that practically all the change in induction from A to B in Fig. 1 occurs by this process of domain-boundary shifts. Because of these changes in induction occur rapidly, in about one ten-thousandth second, local eddy currents are induced in the neighborhood of each domain, and these dissipate energy. This energy is supplied from the power source that provides the current to magnetize the specimen, and is dissipated as heat in the iron. This part of the magnetization curve is not reversible; if the field is reduced, the portion BA is not retraced.

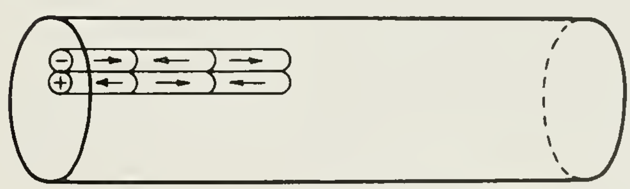
The magnitude of the field, H_c, at which there processes occur, is of great importance for the coercive force determines to a large extent the amount of energy dissipated as hysteresis in a cycle of magnetization. Detailed experiments on the energy dissipation during various parts of the cycle show that almost all the energy is lost on the steep part of the magnetization curve. It therefore appears quite probable that the loss is a result of these discontinuous boundary emotions. Extensive investigations by Yensen[5] have shown that the magnitude of hysteresis loss depends primarily on the impurities present in the material and on the internal strains in the structure of the specimen.

The position at which a domain boundary is situated is determined by the manner in which random internal stresses vary from point to point within a crystal. The ease with which such a boundary can be made to move; i.e., the field required to cause a sudden boundary shift giving rise to a Barkhausen jump in magnetization, depends on the internal

(Continued on Next Page)



(a)



(b)

Fig. 2.—(a) A single iron crystal which is entirely saturated because of the atomic interactions that tend to make each atom parallel to its neighbor. A demagnetizing field opposite in direction to that of the magnetization is produced. (b) Crystal divided into small magnetic domains so arranged that the sample as a whole is demagnetized, with no resulting external demagnetizing field.

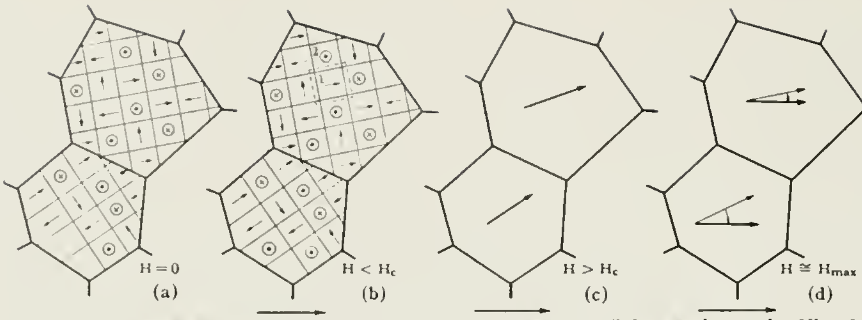


Fig. 3.—Grains showing effect of applying a magnetic field as shown in Fig. 1

a) Two grains, each one divided into idealized square magnetic domains whose magnetism is in the direction indicated by the arrow. As there is an equal number of domains in each direction, the grains as a whole are demagnetized. (b) The two grains are now subjected to a small positive field, which causes a slight domain boundary displacement. Domains favorably oriented with regard to the field are enlarged and those unfavorably disposed are made proportionately smaller. (c) Two grains showing completion of reversals of magnetism of individual domains and each crystal in effect a single domain with magnetic saturation along the cubic axis making the smallest angle with the applied field. (d) Saturation magnetization in each crystal swings gradually from the cubic axis of the crystal toward the axis of the applied field, when the applied magnetizing field intensity is sufficiently large.

stresses in the interior of a grain. If there are many impurities, or if there are internal stresses as a result of plastic deformation, these distort the lattice of the crystal and make the boundary between domains difficult to move; i.e., act as a sort of domain friction. As these impurities are removed, and as random internal strains are relieved by annealing, thereby lessening lattice distortion, the field H_c required to make a boundary move becomes smaller, and as the coercive force decreases the hysteresis loss decreases.

At this point it is appropriate to ask, "What is the correlation between mechanical strains and magnetic properties?" To answer this it is necessary to consider another magnetic phenomenon, magnetostriction. A piece of iron on being magnetized becomes longer by a very small amount, the longitudinal strain being about one part in one hundred thousand. Look again at Fig. 3b, and assume first that the material has no internal strains other than those caused by magnetostriction; i.e., that it is of high purity and has been properly annealed. Because of magnetostriction, domain 1 which is magnetized to the right is longer by one part in a hundred thousand in that direction. In order for the magnetization in domain 2 to change suddenly to that of domain 1, it is obviously necessary for the magnetic field to perform useful work against the elastic force caused by magnetostriction. The field strength necessary to perform this work in pure iron was found—both by calculation and experiment—to be approximately 0.04 oersted. Since the internal strain due to impurities or cold work may be on the order of the elastic limit, a strain of $\Delta l/l = 10^{3}$, the coercive force in such a case can be hundreds of times larger than it is in pure, well-annealed iron.

In most magnetic materials these discontinuous reversals of magnetization of individual domains are completed in fields of the order of several oersteds. The situation is now that depicted in Fig. 3c. Each crystal is in effect a single domain magnetized to saturation along that cubic axis making the smallest angle with the direction of the applied field H. While each grain is now saturated, the specimen as a whole has only the magnetization corresponding to the point B in Fig. 1, because crystals themselves are randomly oriented and contribute only the component of the saturation magnetization parallel to H. The amount of induction at the point B is determined primarily by the orientation of the crystal grains in the specimen. The two grains of Fig. 3d are randomly oriented. The component of B along H in the upper grain is about 90 per cent of saturation; in the lower grain it is 75 per cent of saturation. Such a material therefore has a lower permeability in fields of the order 10 oersteds than one in which the grains are oriented with a cubic axis along H. In the latter case each grain contributes its full saturation magnetization to the component of B along H. This property of iron, that the cubic axis is a direction of easy magnetization, is the basis for the higher permeability of the new magnetic material Hipersil, in which nearly all the grains are oriented, with a cubic axis along the direction in which the flux traverses the material.

If the flux is further increased, up to several hundred oersteds, the portion BC of the magnetization curve is followed. This rather slow approach to saturation at C is achieved by a process in which the direction of magnetization in each crystal rotates gradually from the direction of the cube edge to that of H. This process is shown in Fig. 3d, and at its completion the entire specimen is saturated. This rotation process is nearly reversible, and is accomplished by little dissipation of energy.

In following the magnetization curve from the demagnetized state at D, we have encountered three magnetization processes; first, the boundary displacement in fields less than the coercive force; second, the Barkhausen process in which entire domains suddenly change their directions of magnetization in fields of intensity approximating that of the coercive force; and, third, the slow, reversible rotation of the magnetization of entire crystals in relatively large fields until saturation is attained at the point C of Fig. 1. In a cycle of magnetization, such as occurs in an electrical machine, only the last two processes are constantly repeated; the first takes place only once. Thus in going from C to E we have mainly reversible rotations, in going from E to F almost entirely discontinuous jumps of the Barkhausen type, and from F to G again reversible rotations. The remainder of the cycle is of course identical with the portion CDEFG.

To summarize, in the demagnetized state, each crystal is divided into a large number of domains, each magnetically saturated along one of the cubic axes of the crystal. The saturation magnetization in each domain is determined entirely by the atomic properties of iron, and cannot be changed except by adding alloying elements to iron. When the field reaches the coercive force, favorably oriented domains grow at the expense of less favorable oriented domains. The magnitude of the coercive force depends on random internal stresses because of impurities or cold work, and can be greatly reduced by purification and strain-relief annealing. The final process consists of a slow approach to saturation through the rotation of the direction of magnetization in each grain from that of a cubic axis to that of the field. The magnetic induction at which this process begins depends primarily on the orientation of the grains, and can be controlled by special rolling and heat treatments, yielding a material such as Hipersil with pronounced grain orientation.

REFERENCES

1—"L'Hypothese du Champ Moleculaire et la Propriete Ferromagnetique," by P. Weiss, *Journal de Physique* 6 (1907), p. 661.

2—"On Inhomogeneities in the Magnetization of Ferromagnetic Materials," by F. Bitter, *Physical Review* 38 (1931), p. 1903.

3—"The Magnetic Structure of Cobalt," by W. C. Elmore, *Physical Review* 53 (1938), p. 757.

4—"Barkhausen Effect III—Nature of Change of Magnetization in Elementary Domains," by R. M. Bozorth and J. F. Dillinger, *Physical Review* 41 (1932), p. 345.

5—Chapter 4, by T. D. Yensen, in "Introduction to Ferromagnetism," Francis Bitter, McGraw-Hill Book Co., 1937.

PARACHUTES . . .

By WILLIAM G. MURPHY, C. E. '43

There is no feat of modern war that amazes and excites the lay public more than the Parachute Battalions dropping to attack by surprise some strategic position behind the enemies lines. In almost every newspaper there are accounts of investigations to determine the whereabouts of a parachutist reported to have fallen from the clouds. The development of the parachute for modern warfare has made people conscious of the danger of attack even in these spots remote from any theatre of war, but the parachute even today is still serving a purpose, the one for which it was developed, greater than that of transporting troops to a spot of launching a surprise attack. This purpose is the one that the Chinese and Leonardo da Vinci were thinking of when they conceived the idea of a free fall from the sky without injury, that of saving lives.

The early days of the parachute date back to the balloonist of the carnival era who used them to save themselves when their balloons caught fire. The unimaginative people of the time did not foresee the possibilities of the parachute; and therefore, progress was limited to a few courageous pioneers who experimented with different purposes but toward the same end — a safe fall from any height.

Andrew Jacques Garnerin, a Frenchman, is credited by all as the first parachutist even though there is some doubt as to whether he actually made the first jump. His first jump was on October 22, 1797 in Paris, France from a height of about 2000 feet. Five years later he is believed to have ascended to 8000 feet, but on this jump the "chute" oscillated and Garnerin was badly shaken up.

Another Frenchman, Lelande, is given credit for solving this problem by his suggestion that hole cut in the top of the canopy would equalize the pressure on the inside. This reduced the oscillation but "chutes" still rock, violently at times, and make the landings hazardous for the chutist.

In July, 1808, the parachute saved its first life when Kuparento, a Polish baloonist, was forced to jump when his baloon caught fire. In spite of the attempts of many men to develop the parachute, it remained only an amusement device for carnival and circus crowds until the development of the airplane.

In the early days of aviation many jumps were made, but Grant Morton is reported to have jumped from a plane in 1911. Captain Albert Berry made two jumps from a static "chute" in 1912 over St. Louis, Missouri. These were the first jumps recorded. Parachutes to this date were makeshift models that the jumper had made himself.

No aviators at this time considered the parachute as a safety device, and anyone who wore one was either a sissy or fool. French aviation officials were of a different mind on the problem. Colonel Lalance offered a prize and many experimental chutes were tried. None were satisfactory.

The period from 1914 to 1925 was very important in the growth of the parachute. Many observation baloonists lost their lives in flames when they fell in burning baloons. These caused the British government to develop a "chute" to be used by these men. The French and Germans also developed parachutes for the same purpose. Nearly a thousand lives were saved by chutes following this new use.

To offer some protection to pilots both the Germans and the Allies experimented with static line chutes. The static line was a cord of some sort which was fastened to the plane and pulled the chut from either a pack on the pilot's back or a seat pack as he jumped.

At McCook Field, Dayton, Ohio, the United States Army was making experiments which were not dropped at the end of the war. Major E. I. Hoffman was placed in charge and he and his staff made many valuable experiments in parachute design.

These men after many failures developed the forerunner of today's "chute of many purposes." All manufacturers of parachutes must use the Army-Navy specifications. Technical data, test records, and information showing the breaking strength, weight, thread count, tensile strength, and data on all other chute characteristics must be submitted. When this is aproved, functional tests using a 170 lb. dummy followed by a 600 pound lead weight and finally two live jumps with a rate of fall of not more than 21 feet per second. The chute must come through 100%. In addition the chute must be tested every sixty days.

Floyd Smith, one of the original group at McCook Field, is still active today as a manufacturer of parachutes. They are using a fifty foot steel tower with a swinging beam that rotates at 200 miles per hour. This invention proves itself invaluable time after time by enabling new designs to be tested without endangering the lives of test men.

In recent years the parachute has been used for many purposes such as carrying meterological equipment safely back to earth after registering conditions at high altitudes, dropping food and supplies to isolated communities, dropping medical supplies and doctors quickly at needed places, and perhaps the most spectacular, carrying soliders to a scene of battle.

Parachute troops are a recent addition to modern armies, but the idea is not new. Benjamin Franklin suggested dropping armies from the clouds in balloons while serving as our ambassador to France in 1784. It is also interesting that General Billy Mitchell first conceived the idea of a parachute army in modern times. In 1928 he arranged a demonstration and dropped a machine gun squad from Martin bomber. The operation was successful, but, was filed in the War Department and forgotten until some other country advanced the idea and used it with much damage.

The most important phase in the parachute is its growing importance in the field for which it was developed. Today many valuable, highly trained men are jumping safely from disabled planes to return to duty.

* * *

BIBLOGRAPHY:

Zim, Herbert S.; *Parachutes*
Harcourt, Brace, and Co., New York, 1942.

Synthetic Rubber—New Major Industry

By BYRON WELSH, M. E. '43

The only ingredient lacking in the United States for the production of ample quantities of good-quality, low-cost synthetic rubber is time. This country has all the basic materials in abundance. It has the know-how; in fact, one major problem has been which of several entirely practical products to select. Even the machinery for making synthetic rubber is familiar to United States industry; much equipment that has been used for years in petroleum, chemical, and rubber industries is applicable with modifications. However, an industry doesn't grow from an annual production of less than ten thousand tons to nearly a million tons—a hundred-fold increase—overnight. Not even in the United States, scene of many industrial miracles, can that happen.

The motorist, with an eye on the calendar and another on his fading tires, can be sure of only one thing. He will eventually get tires made of synthetic rubber and they will be as good or better than those before Pearl Harbor, although possibly not at first. Whether he gets them soon enough to keep his car going depends on how quickly synthetic-rubber plants can be built, and upon how much and for how long rubber is needed by the armed forces. This last is unknown; but out of the welter of plans, arguments, discussions, and investigations, which has appeared to be only confusion, the synthetic-rubber program is taking definite shape.

Plans are laid, plant designs are drawn, and equipment has and is being purchased for a total plant capacity of about 800,000 tons yearly. As of July 15, 700,000 tons of this annual capacity is scheduled to be the kind known as Buna S. Of the remainder about 60 per cent will be of a type recently announced, called Butyl, and 40 per cent of neoprene. Several other rubber-like materials may give an additional 50,000 tons yearly. It is expected that some 200,000 tons of the Buna S will be made from ethyl alcohol, which can be produced from agricultural products, petroleum, or coal tar. Thus, in the race of the several types it appears that w can expect Buna S to win, Butyl to place, and neoprene to show. Also, there is a dark horse, Thiokol, the oldest of them all, that may make a strong showing as the race progresses.

Four of the major rubber companies each have 15,000- or 30,000-ton plants that are or soon will be in operation. The first of the new government-financed plants should be producing early next year. It is expected that by the end of 1943 half or more of the total projected plants will be ready, and the remainder going full tilt sometime in 1944.

The 1938 rubber consumption was 660,000 tons. The program for synthetic rubber plants of nearly a million tons annual capacity for installation before the end of 1944 seems to give the answer as to "when." But it doesn't. It is estimated that not over 25,000 tons of synthetic rubber will be produced this year, possibly 350,000 tons in 1943, and 750,000 tons in 1944. Probably none of the 1944 production, and certainly none before then will be available for non-essential use. Little, if any, will remain after supplying our own military forces, essential civilian needs, and — what is so often overlooked — replenishing the dwindling rubber stocks of the United Nations. Synthetic rubber for your car and mine after 1944? Perhaps.

When chemists start out to simulate a product of nature, they ordinarily seek first to determine the molecular structure of nature's product, and then to duplicate it by factory methods. Nature makes the latex that flows between the inner and outer bark of the rubber tree by building a complex molecule from many simple molecules of a hydrocarbon called isoprene. This much was learned over eighty years ago but scientists have never been able to discover the secret of how the transformation is made, or exactly what the final molecular structure is, or — for that matter — the purpose of the latex. Not until chemists gave up trying to duplicate nature were they able to produce an acceptable synthetic rubber. This has proved fortunate

Courtesy Westinghouse.

because in endeavoring to match the properties of rubber instead of duplicating its chemical structure chemists have produced many rubber-like materials in many ways superior to natural rubber.

During World War I the Germans, under the pressure of dire necessity, made 2500 tons of so-called methyl rubber. It was of inferior quality, and the process was abandoned. The rapid gyrations in price of crude rubber after the war (reaching a maximum of $1.23 per pound in 1925) spurred research in Germany, Russia, and the United States. Out of that research has come not one but several synthetic rubbers, each important because of special characteristics.

Chemists in Europe discovered that a rubber-like substance can be made from butadiene, a hydrocarbon. In the presence of water, an emulsifier, and sodium serving as a catalyst, and with proper heat and pressure, 2000 or 3000 of the fundamental butadiene molecules (C_4H_6) are induced to join hands with each other, chain fashion. This chain-like structure is a fundamental characteristic of all rubbery substances. The chemical process by which many simple molecules are joined into a giant one is polymerization.

Germans later found that mixing small proportions of other substances with butadiene results in a better product. One such substance is styrene, which is added to the butadiene in the proportion of about one to three, to form Buna S. The second substance combined (co-polymerized) with butadiene to form a synthetic rubber is acrylonitrile, the resulting product being known as Buna N, or Perbunan.

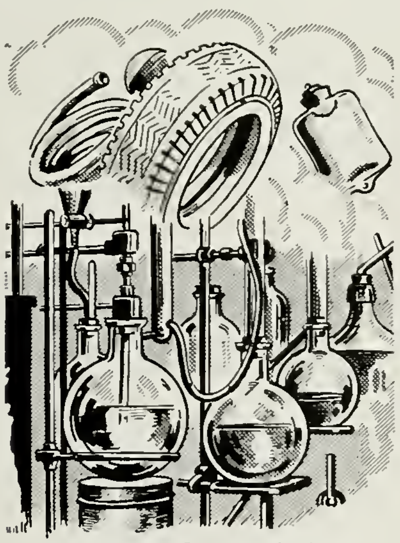
Buna S is the rubber used by Germany and Russia for their fighting forces. Accurate production figures are not available but it is believed that Germany, with coal as a source, produced about 3000 tons of Buna S rubber in 1937; 10,000 tons in 1938, and 20,000 tons in 1939. Reliable recent estimates are not available but present production is undoubtedly much higher. Production of Buna S in Russia, from alcohol, started earlier, has been much higher. Beginning with about 5000 tons in 1933, it had grown steadily to about 50,000 tons at the outbreak of the war.

While chemists in Europe were working with butadiene types of rubber, research men in the United States were busy along different lines. In 1931, Dr. J. C. Patrick, a research chemist for Armour & Company in Kansas City, mixed ethylene dichloride (Prestone) and sodium polysulfide together, in a search for a better anti-freeze. He expected a liquid. Instead a gummy mass resulted that looked, felt, and acted like rubber. This was Thiokol, the first commercial synthetic rubber produced in the United States.

In 1925 Julius Nieuwland, professor of chemistry at the University of Notre Dame, presented a paper on acetylene before a group of chemists. In his audience was Elmer Bolton, of the DuPont laboratories, who had been working on synthetic rubbers. Bolton saw in Nieuwland's results the missing key by which he was able to produce, in 1932, a product now known as neoprene. Neoprene has many rubber-like properties, yet it contains 40 per cent chlorine, which is not present in natural rubber.

Other synthetic rubbers followed in rapid succession. In 1933, a patent was granted to B. F. Goodrich Company on Koroseal, a plasticized polyvinyl chloride, that has many desirable properties of rubber. The Standard Oil Company of New Jersey developed in this country a rubber-like product from isobutylene, a petroleum product. This is called Vistanex, and was originally produced in Germany as Oppanol.

Chemists of large rubber companies in Akron also developed butadiene typed of synthetic rubbers which are



—*Courtesy Westinghouse.*

being made in commercial quantities. Instead of combining styrene or acrylonitrile with butadiene they are using other, but undisclosed substances. The Goodrich-Phillips Petroleum product is known as Ameripol. The Goodyear variety is called Chemigum, of which there are three grades of hardness.

Newest of synthetic rubbers is Butyl, another product developed by Standard Oil Company of New Jersey. Butyl is made almost entirely from isobutylene obtained from petroleum, and a small amount of butadiene. This rubber may become very important. As compared with other Buna rubbers, the raw material cost is lower. Also it can be produced by a continuous process, instead of in batches, as is necessary at present with Buna rubbers. Butyl-producing plants are cheaper to build and require lesst steel and other strategic materials. It appears that tires made of Butyl, while not as good as from Buna because of the internal heat developed on flexing, will be satisfactory for low speed and light duty (figures of 10,000 miles and 35 miles per hour have been quoted). Butyl is still new and virtually untried; improvements can be expected, but time is not available for prolonged experimentation.

Buna S, Perbunan, Thiokol, neoprene, Butyl are the present headliners in the synthetic-rubber show; certainly they are the ones most like natural rubber. Because there is no synthetic counterpart of natural rubber, whether a product is classed as a syntheic rubber depends on how one chooses to define the field. It is a matter of degree; the boundaries of synthetic rubber are not clear cut. Many other plastics are rubber-like in some respects. Because each is superior to natural rubber in some ways they will replace natural rubber for special purposes even with a cost handicap.

Clearly, synthetic rubber has long passed the dream stage, although commercial production until now has been low. About 17,000 tons were produced in 1941 (which is nonetheless about four trainloads). Of this 1500 was Thiokol; 6500, neoprene; 4000 Bune types (Ameripol, Chemigum ,etc.); and 5000 tons miscellaneous. Unlike the situation in Europe where development was spurred by heavy government subsidy, new rubbers have been developed in this country by privately financed research, and were being given the usual careful tests before large plant expansions were planned. December 7 suddenly changed the whole program.

Buna S is the synthetic rubber of greatest immediate interest to us because it has been named to carry the burden in the absence of natural rubber. In making the selection, each synthetic rubber had to be reviewed in the light of its potentialities as tire rubber, the experience of the rubber manufacturers with it, its workability on existing rubber-mill machinery, the speed with which production could start, and the availability and cost of raw materials. Laying the blue chips on Buna S does not necessarily imply that it is superior in each of these respects, but simply that, all factors considered, Buna S is the most practical synthetic rubber on which, literally, to ride through the war.

"Is synthetic rubber as good as natural rubber?" A yes or no answer cannot be given. Nor can the question, "Are tires made of synthetics as good as those of rubber?" be given a categoric answer. It must be stated: "Can as good tire tread—or tire sidewalls—or inner tubes be made from synthetic as natural rubber?" Even at this early stage it appears that the answer to each specific question is "Yes," although even the experts are reluctant to commit themselves. Obviously each part of a tire—tread, sidewalls, carcuss, and tube—has its own requirements as to stretchability, resistence to abrasion, cutting, aging, strength, porosity to air, and many other properties. There are many kinds of synthetic rubbers and each can be compounded and processed in dozens of ways, making literally hundreds in all. Each variant must be tested for a score or more of physical properties, not only by itself but in various combinations with natural rubber. There simply has not been time enough for this. Selection is further complicated by the fact that there is no "best" tire. The rubber best suited for tread on a taxi is not the best for a tire in high-speed passenger-car service, or for a truck, or a bus. Which of the multitudinous combinations is best

(Continued on Page 28)

NAMES *in the* NEWS

By WILLIAM R. SCHMITZ, Ch. E. '45
and
LEE A. SULLIVAN, M. E. '46

BILL MARENECK

After Bill had worked for two years in the industrial world, he decided that they didn't appreciate his efforts enough, so he came to Illinois to become an engineer. And he has done very well since he came as shown by the very high scholastic average of 4.96.

Bill is ward president of MIWA, member of Phalanx, T.N.T., Tau Beta Pi, Phi Eta Sigma, vice-president of Pi Tau Sigma, vice-president of A.S.M.E., and is a Cadet Captain in the Engineers. He also puts in a good deal of time on house activities, and was president of Citadel this past year.

Most of Bill's available extra time is spent working in Talbot Laboratory. He is helping with a research project on rails investigation. This last summer, Bill worked for the American Association of Railroads. He made tests on engines to determine the effects of different methods of counter-balance of the cars and engines.

Claiming Lombard, Illinois, as his home town, Bill has

BILL

thoroughly enjoyed his college career at Illinois. His chief hobby is photography, but he also likes to swim. He takes in all big dances possible, and thinks the senior ball of last spring was the most outstanding. He rates Claude Thornhill as his favorite band, and he also has a collection of popular records.

DICK HORNING

Probably one of the most active engineers here at Illinois is Dick Horning. He is a member of Ma-Wan-Da, Band of X, president of Inter-fraternity Council, vice-president of the Student Senate, member of Illini Union Board, Illini Union student activity board, fraternity advisory board, Dean of Men's council, board of directors of Y.M.C.A., and was listed in the Who's Who among students in colleges in the United States. He is also a Cadet 1st Lieutenant in the Engineer's Corps.

Dick came to Illinois from Lancaster, Pa. He said, "This is the only university I ever visited, and both my mother and dad attended Illinois." Being a general engineer, Dick is more or less following in his father's footsteps. He has spent his last three summers working at various jobs in

DICK

the engineering field. He is specializing in machine design, and hopes to go eventually into sales production.

Like a good many other engineers, Dick likes to date. He is engaged to a girl on the campus, and likes dances, movies, parties, plays, and things in general. Dick also plays the piano and his favorite musical selection is *Rhapsody in Blue*.

The biggest trouble with engineers, in Dick's opinion, is that they need to broaden themselves. They should try to learn how to get along with other people without trampling on their toes.

HILMAR CHRISTIANSON

Hilmar Christianson, better known to all his friend as Bud, is one of the most likable engineers on the campus. In fact, Bud is such an agreeable fellow that there aren't many things that he doesn't like to do. He enjoys bridge, dancing, music, poetry, chess, and sports of all kinds. He also takes an interest in photography.

Bud was the winner of the high jump at the recent intramural track and field meet. He also plays touch foot-

BUD

ball, hockey, and is quite a wrestler. Bud found time to enter the election for president of the senior class, but was defeated by the narrow margin of three votes.

A civil engineer, Bud is a member of Phalanx, T.N.T., Tau Beta Pi, Triangle Fraternity, president of Chi Epsilon, and vice-president of A.S.C.E., and a Cadet Captain in the advanced ROTC Engineers Corps. In talking about the various campus organizations, Bud says that engineers should support the things they are interested in, quoting Bud, "You should go into an organization not asking how much you can get out of it, but how much you can give to it."

During the last few summers, Bud has worked for the Milwaukee Railroad Company. He says that he would like to combine his structural engineering with architecture. A civil engineer must not only know how to design structures economically, but they must be beautiful. It is his desire to be a gentleman, farmer, and an engineer.

BOB PAXTON

The chemical engineer you see over there behind all the retorts, flasks, and test tubes is Bob Paxton. He is one of the best chemical engineers ever to graduate from Illinois. He has a very excellent scholastic average of 4.97. At the present, Bob is doing some research on the equilibrium vapor pressure of carbon tetrachloride toluene system. Unless you are also a chemical engineer you wouldn't understand what Bob is doing, so we won't bother to tell about it in detail.

BOB

Bob is very interested in music and plays baritone in the Concert band. During his high school days at Waukegan, Illinois, he won second in the national contest. Bob is engaged to a girl on campus and generally spends most of his Friday and Saturday nights with her. He especially likes to go dancing or go to a movie.

Bob is a member of Tau Beta Pi, Phi Kappa Phi, Phi Lambda Upsilon, Omega Chi Epsilon, Phi Eta Sigma, A.I.Ch.E., and Alpha Chi Sigma, chemistry professional fraternity. He plans to graduate in June and then would like to do some graduate work. Process development or administration particularly appeals to him.

The biggest thrill that Bob has received so far was when he received his invitation to pledge Tau Beta Pi during his junior year. During the past summer, Bob worked as an inspector in a factory inspecting aircraft instruments. Last year he received the Gregory scholarship and this year he has received the Phi Beta Kappa scholarship.

PAUL FREELAND

Paul Freeland is a scholar, gentleman, statesman, and soldier. He is a member of Tau Beta Pi, Phi Eta Sigma, Pi Tau Sigma, Military council, and is Cadet Lieutenant-Colonel of the Signal Corps. He is also helping in getting the new Honor System installed for the advanced ROTC cadets.

PAUL

Hailing from Sullivan, Illinois, Paul doesn't think too much of the average co-ed here on the campus, particularly those who smoke. Whenever possible, Paul takes a week end off and runs up to Chicago to see his one and only. Paul is a quiet, dark-haired fellow and is easy to get along with.

Before the war started, Paul was a radio ham, and held a pilot's license. Since then, however, he has had to give up his airplane flying and radio operating. Paul has a low-power radio set at home on which he is able to contact every state in the United States. While he was in high school he served a term in the National Guard.

Paul is an electrical engineer and has been doing very well as shown by his good 4.65 scholastic average. He is also teaching G.E.D. 1. During his spare time he enjoys playing the piano and harmonica. Paul will graduate in February and then will go to one of the Signal Corps training schools where he will be commissioned a 2nd. Lieutenant in the army. He hopes to make the service a career.

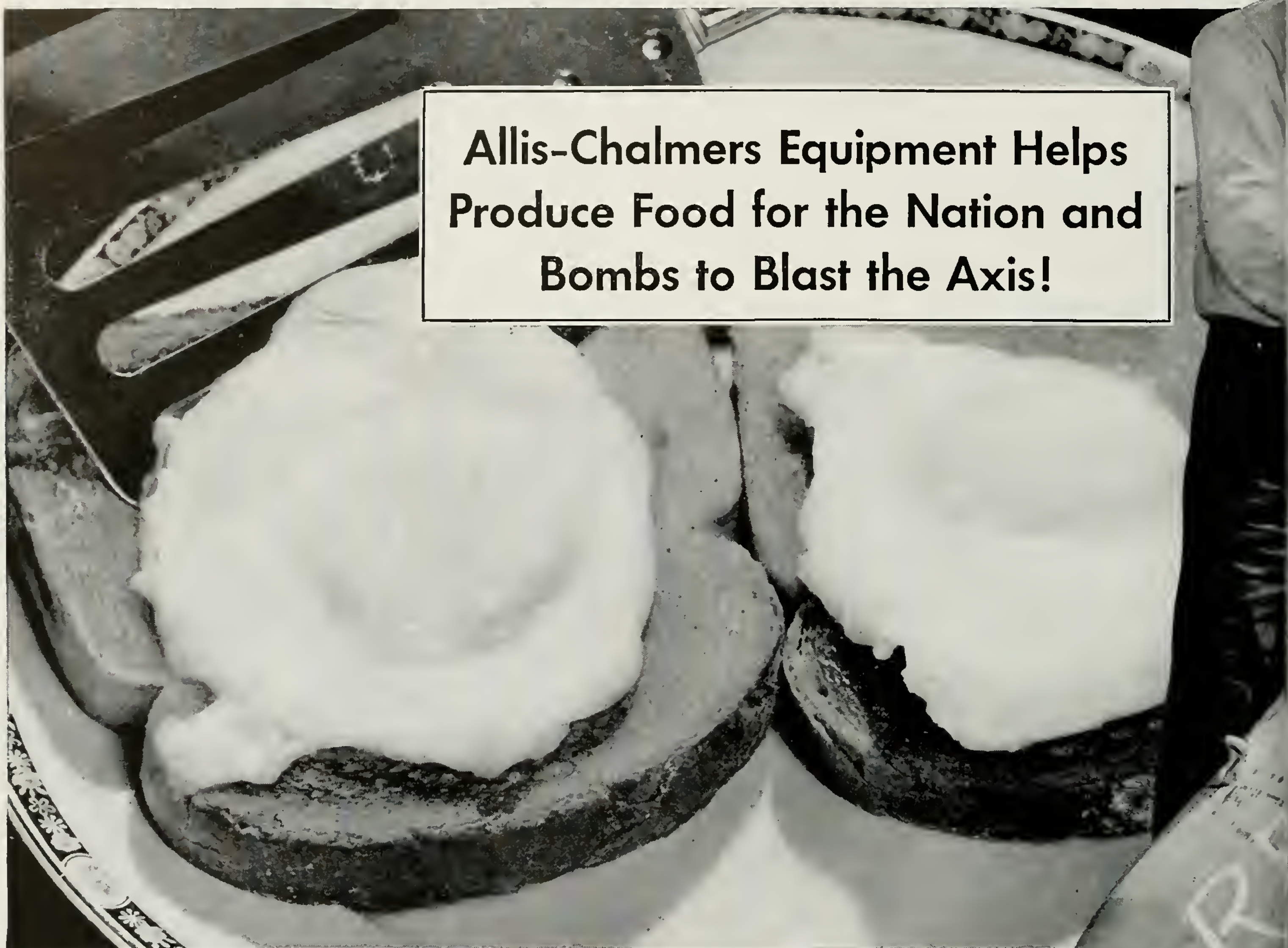
TOM CLOKE

One of the best military men to attend the University of Illinois in some time is Tom Cloke. He is Cadet Lieutenant-Colonel of the Coast Artillery, member of Scabbard and Blade, Pershing Rifles, Coast Artillery Club, Military

(Continued on Page 30)

TOM

EGGS...ON TOAST OR



HENS' EGGS—BOMBERS' EGGS...both are needed for Victory. And both are symbols of Allis-Chalmers all-out participation in the Nation's war effort!

From Allis-Chalmers plants come more than 1,600 different capital goods products...

—Tractors and other farm equipment which help feed the U.S.A. and the United Nations!

—Mining equipment, electrical equipment, pumps, turbines, drives...the greatest variety of machinery in the world to help manufacture bombs, bullets, guns, tanks, planes, ships!

Backing up the men and women working for Victory in our plants are Allis-Chalmers engineers in the field. They are helping manufacturers produce more—not just with new machines, but with machines now on hand!

Allis-Chalmers past experience is vital to the Nation now. Its present experience will be invaluable *after* the war to help produce more and better peacetime goods for everyone!

ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS.

ALLIS-CH

OFFERS EVERY MANUFACTURER EQUIPMENT AND ENGINEERIN

ELECTRICAL EQUIPMENT | STEAM AND HYDRAULIC TURBINES | MOTORS & TEXROPE V-BELT DRIVES | BLOWERS AND COMPRESSORS | ENGINES AND CONDENSERS | CENTRIFU PUMPS

TOKYO!

A-C Equipment helps produce both steel and explosive charge for demolition bombs like the one here.

A-C Plants are casting and finishing industrial machinery at a record rate!

Chalmers tractors and grad-
equipment are helping build
ary roads and airports.

VICTORY NEWS

Rosiclare, Ill.—91 Allis-Chalmers motors constitute the major portion of a connected load of close to 1,000 hp driving the new fluorspar mill of the Mahoning Mining Company here.

The efficient layout of flexible motors and drives is largely responsible for the plant's record production of high-grade fluorspar zinc-lead ore. Throughout the mill, the Allis-Chalmers motors operate dump hoppers, flotation cells, vibrators, kilns, pumps and many other machines.

"We're Buying and Building," an A-C workman tells MGM bond rally starlets, as he machines a Navy propeller shaft.

Milwaukee, Wis.—The "feed-back" system, which utilizes 85% of the enormous power expended in breaking in aircraft engines on test stands, has been adopted by Buick in its new plant in a mid-western city.

The new engines are connected by flexible shaft couplings to water-cooled magnetic couplings, which transmit power to 1200 kva synchronous generators.

Allis-Chalmers alternating current units are at work here. They not only help to crank the new engines, but they also operate as current absorption-type dynamometers—receiving power from the aircraft engine, turning it into electrical energy and feeding it back into the line. This test set-up provides a high percentage of the power required by this company's manufacturing operations.

FOR VICTORY
Buy United States War Bonds

LMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

TION TO HELP INCREASE PRODUCTION IN THESE FIELDS...

R AND SAW EQUIPMENT

CHEMICAL PROCESS EQUIPMENT

CRUSHING, CEMENT & MINING MACHINERY

BOILER FEED WATER SERVICE

POWER FARMING MACHINERY

INDUSTRIAL TRACTORS & ROAD MACHINERY

Our Societies . . .

By BYRON M. ROBINSON, M. E. '44

SIGMA TAU

Sigma Tau held its fall initiation and dinner at the Inman Hotel, on November 29. "Railroads in the War" was the very timely subject of Prof. H. J. Schrader, speaker for the evening.

Sigma Tau's annual award for excellence in scholarship during a student's freshman year was presented to Philip M. Dadant, E.E. The names of the newly initiated members are as follow: Raymond Ackerman, George Beck, Eugene Bierman, Pete Fenoglio, Evan Greanias, Lowell Lambert, Sheldon Leavitt, Gordon McClure, James Meek, Arthur Radke, George Roller, Harold Schick, Nathan Schwartz, Robert Settle, Robert Turner, Harold Wandling, and Homer Wong.

CHI EPSILON

Chi Epsilon held an initiation and banquet on November 18, at Latzer Hall, Y.M.C.A. Dr. Moore of the T. & A. M. Dept. gave a most interesting speech entitled "Is the Engineer Cultured?" His answer being that the engineer is cultured—he has a culture all his own. Pi Tau Sigma was a co-sponsor for the banquet.

PI TAU SIGMA

On November 18, seventeen new members were initiated into Pi Tau Sigma. The names of the new initiates are as follows: H. H. Aiken, C. C. Arnold, K. N. Drager, G. G. Greanis, J. W. Huff, P. Kohler, R. E. Kraft, D. J. Lattyak, J. J. Luza, R. G. Moldt, D. E. Muni, W. J. North, B. W. Porter, C. J. Roach, R. G. Settle, V. K. Viitanen, and W. J. Worley. Following the initiation, a banquet was held in Latzer Hall, Y.M.C.A., with Chi Epsilon as co-sponsor.

A Mark's Hand Book was awarded at a banquet held at the Inman Hotel on December 6. The recipient was Harold E. Secrest, sophomore, who had the highest grade average among freshmen M.E.'s last year. This is an annual award given by Pi Tau Sigma.

A.S.A.E.

At their last meeting on October 27, the Ag Engineers were privileged to hear Prof. P. E. Johnston. He spoke on the subject "Farm Labor and Machinery and the War." (The farm machinery situation should be good as long as baling wire is available.)

A.S.A.E. lost one of its most active members in Murray Forth. He was secretary of the A.S.A.E. before he was drafted.

TAU BETA PI

The semi-annual initiation of Tau Beta Pi was held November 28, 1942 on the third floor of the Illini Union. The following men were initiated: First semester junior honor man—George Roller, Ch.E; Seniors—M. C. Shedd, Arch.E.; O. E. Johnson, Agr.E.; Tom Baron, J. L. Erickson, N. W. Myers, and R. C. St. John Ch.E's; D. S. Bechly, H. B. Christianson, Sidney Epstein, C. E. Kesler, A. F. Kohnert, Jr., and O. W. Schact, Jr., C.E.'s; P. A. Freeland and S. D. Larks, E.E.'s; G. D. Schott, E.P.; W. A. Lindahl, G.E.; W. J. Gailus, G. G. Greanias, G. M. Long, G. E. Mays, Clarence Ritchard, O. R. Schmidt, R. G. Settle, O. M. Sidebottom, and Steven Yurenka, M.E.'s. A certificate of merit was awarded to Miss Marianna Schroeder for her outstanding achievement in Architectural Engineering.

Following the initiation, a banquet was held, faculty members, actives, and new initiates of Tau Beta Pi being present. Prof. J. J. Doland was the toastmaster, and Prof. H. E. Murphy was the principal speaker of the evening. After the banquet, the annual Tau Beta Pi dance was held.

A.S.M.E.

Every year, the A.S.M.E. presents the Charles T. Main Award of $150, and an engraved certificate for the best paper submitted on the subject selected by the Board of Honors and Awards. The subject for 1943 is "Government as Affected by Engineering."

Two awards of twenty-five dollars each will be given for the best papers on any engineering subject or investigation written by a member of the student branch at this university—one award for a graduate student—one award for an undergraduate.

This competition is restricted to student members of the A.S.M.E. The awards will be given for the best papers, judged from the standpoint of applicability, value as a contribution to mechanical engineering literature, completeness, and conciseness. For further information, see Paul Salerno, or Prof. P. E. Mohn in 104 M. E. Lab.

S.B.A.C.S.

It was on the night of December 10, that the annual Ceramic Department pig roast was held at the Y.M.C.A. The Seniors really roasted the faculty, but then the professors were not lacking for choice bits of interesting dirt, either. Coach Hek Kenney gave a demonstration of rough and tumble fighting.

On the pig roast committee were Ray Davies, in charge of arrangements, and Eugene Lynch, in charge of favors. The favors were little white porcelain pigs shaped so that they could be used either as cigarette trays or cream pitchers. These useful articles were made by the ceramic students.

KERAMOS

The members of Keramos indulged in the Ceramic Department pig roast on December 10. Plans for the Keramos Senior Banquet to be held in January, are not yet complete.

M.I.S.

At the November 11 meeting of M.I.S., Mr. G. W. Bruce, Assistant Superintendent of Open Hearth No. 2 at Carnegie Illinois Steel Company South Works in Chicago, spoke on general plant practice. The main purpose of his speech was to show the practical side of production in the steel mill.

On December 3, three very interesting sound films were presented to M.I.S. by the Aluminum Company of America. The films shown were *Aluminum—Mine to Metal*, *Aluminum Fabricating Processes*, and *Unfinished Rainbows*; the latter being a Kodachrome film of the history of aluminum from its beginnings, the discovery of the electrolytic process, and the progress aluminum has made since then, and its possibilities in the future, which prompted the title of the movie.

(Continued on Page 24)

2
3
4
5
6
7
1
COMMUNICATIONS
...directing arm of combat
This battle drawing was prepared with the aid of Army and Navy authorities.
IN modern battle, our fighting units may be many miles apart. Yet every unit, every movement, is closely knit into the whole scheme of combat—through communications.
Today much of this equipment is made by Western Electric, for 60 years manufacturer for the Bell System.
Here are some examples of communications in action.
1 Field H.Q. guides the action through field telephones, teletypewriters, switchboards, wire, cable, radio. Back of it is G. H. Q., directing the larger strategy . . . also through electrical communications. The Signal Corps supplies and maintains all of this equipment.
2 Air commander radios his squadron to bomb enemy beyond river.
3 On these transports, the command rings out over battle announcing system, "Away landing force!"
4 Swift PT boats get orders flashed by radio to torpedo enemy cruiser.
5 From observation post goes the telephone message to artillery, "Last of enemy tanks about to withdraw across bridge . . ."
6 Artillery officer telephones in reply, "Battery will lay a 5 minute concentration on bridge."
7 Tanks, followed by troops in personnel carriers, speed toward right on a wide end-run to flank the enemy. They get their orders and keep in contact—by radio.
Western Electric
ARSENAL OF COMMUNICATIONS

TECHNOCRACKED...

By PAUL SALERNO, M. E. '43

A chemical genius south of Green Street has completed an exhaustive study of an element that has long puzzled the greatest scientific minds.

ELEMENT: Woman.

SYMBOL: Wo.

ATOMIC WEIGHT: About 120.

OCCURRENCE: Can be found wherever man exists—always appears in a disguised condition—surface usually covered by a film of powder—boils at nothing and may freeze at any moment.

CHEMICAL PROPERTIES: Extremely active — possesses a great affinity for gold, silver, platinum, and precious stones of all kinds — able to absorb tremendous quantities of expensive food at any time — undissolved by liquids, but activity is greatly increased when saturated with alcohol — turns green when placed next to a better sample — ages rapidly — very dangerous and highly explosive in inexperienced hands.

* * * * *

Maybe you've heard this story about the draft dodger who said, "What chart?" to the army doctor. After being deferred because of near blindness, he went to a movie to celebrate. Imagine his dismay when he saw that the same doctor who examined him was sitting in the next seat. Thinking fast, he reached over and tapped the doctor on the shoulder.

"Pardon me," he asked politely, "Is this where I catch the bus to Chicago?"

* * * * *

Skidding is the action,
When the friction is a fraction,
Of the vertical reaction,
Which results in traction.

* * * * *

First small boy: "See that little girl over there? Her neck's dirty."

Second small boy: "Her does?"

* * * * *

HE: "Are you free tonight?"

SHE: "Well, not exactly free, but very inexpensive."

The latest addition to the women's auxiliary services such as the WAVES and WAACs, are the WORMS.

They're in the Apple Corp.

* * * * *

Two pigeons were flying over Tokyo.
"Say, isn't that Hirohito down there."
"I think it is."
"Well, what are we waiting for?"

* * * * *

ODE TO A SCREWBALL

You try to be clever
And what do you get?
You're marked down forever
As strictly all wet.

You try to be witty
And what's the reward?
A few laughs or pity
In some minor chord.

You try to be humorous
But strive as you may,
The slams will be numerous
And they'll all come your way.

The moral is clear
If your life would be sunny
Don't try to be FUNNY!!!

* * * * *

A rookie paratrooper was receiving orders from his commanding officer just before his first jump.

"Remember," he was told, "your chute will open as soon as you leave the plane. If it doesn't, pull this emergency rip-cord. It will always work. A jeep will be waiting for you when you land. That is all."

The soldier jumped. Nothing happened. He pulled the emergency rip-cord. Still nothing happened.

"Damn," he muttered, "I'll bet that jeep won't be there either."

* * * * *

Wife: Did you see those men stare at that pretty girl as she went up the stairs.

Husband: What men?

Report on the A. S. C. E. Conference

By WILLIAM G. MURPHY, C.E. '43

The Second Annual Midwestern Conference of the Student Chapters of the American Society of Civil Engineers was held at the University of Illinois on November 13 and 14 in spite of gas rationing, rubber rationing, and transportation difficulties. The decision to have a conference this year came after the Executive Council had considered every angle and it was recommended that the conference be used as a means to direct the students minds toward engineering and the war effort.

Iowa State College, Illinois Institute of Technology, Northwestern, Illinois, Purdue, Rose Polytechnic Institute, University of Wisconsin, and the University of Iowa were represented at the conference. The delegate who received the most attention was the girl who attended from Iowa State.

The conference was directed by Sterling Snyder who was assisted by three co-ordinators: Marianna Schroeder, William Murphy, and Bud Christianson. The co-ordinators were responsible for the work of the committees who made the arrangements for the meeting.

The Conference opened with a welcoming address by Dean M. L. Enger, a talk by Dean H. H. Jordan on "What This Conference Should Accomplish," and a talk by Professor W. C. Huntington on "The Chapter and The Department." Dean Enger cranked the conference bandwagon, Dean Jordan put in the right fuel—profession solidarity, objects and ethics of the society, and the preamble of the Constitution of the Conference, and Professor Huntington got the program off to a fine start with his talk.

The afternoon of November 13 was saved for Structural Engineering in Defense with talks on "Timber Construction" and "Fatigue of Welded and Riveted Joints" by Mr. J. F. Seiler and Professor W. M. Wilson, respectively. Mr. Seiler of the American Wood Preservers Association emphasized the importance of timber due to the priorities on metal, and told how the Armed Services are using composite construction to preserve the metal. The first talk was concluded by slides showing various uses and processes in timber construction.

Professor W. M. Wilson, research professor in Structural Engineering, spoke on the results of his research on the fatigue strength of riveted and welded structural members. One of the most difficult problems of the investigation was the design of a machine to use in the project. Professor Wilson's talk centered on the highlights of his work for the last six years.

Saturday, November 14, was set aside by the program committee for Sanitary Engineering in Defense with addresses by Mr. William Wisely, Executive Secretary of the Federation of Sewage Works Association, a worldwide organization; and Mr. C. W. Klassen, Chief Engineer of the Illinois Public Health Department.

Mr. Wisely spoke of some of the experiences that he had had in the field of Sanitary Engineering. Some of his talks appeared humorous to the audience but they were very real problems in dealing with people that a sanitary engineer must face. In his conclusion Mr. Wisely stated that Sanitary Engineering is a profession that: brings cleanliness into this civilization, helps cities abide by the Golden Rule to meet moral as well as legal obligations, and conserves not destroys the natural resources loaned for use.

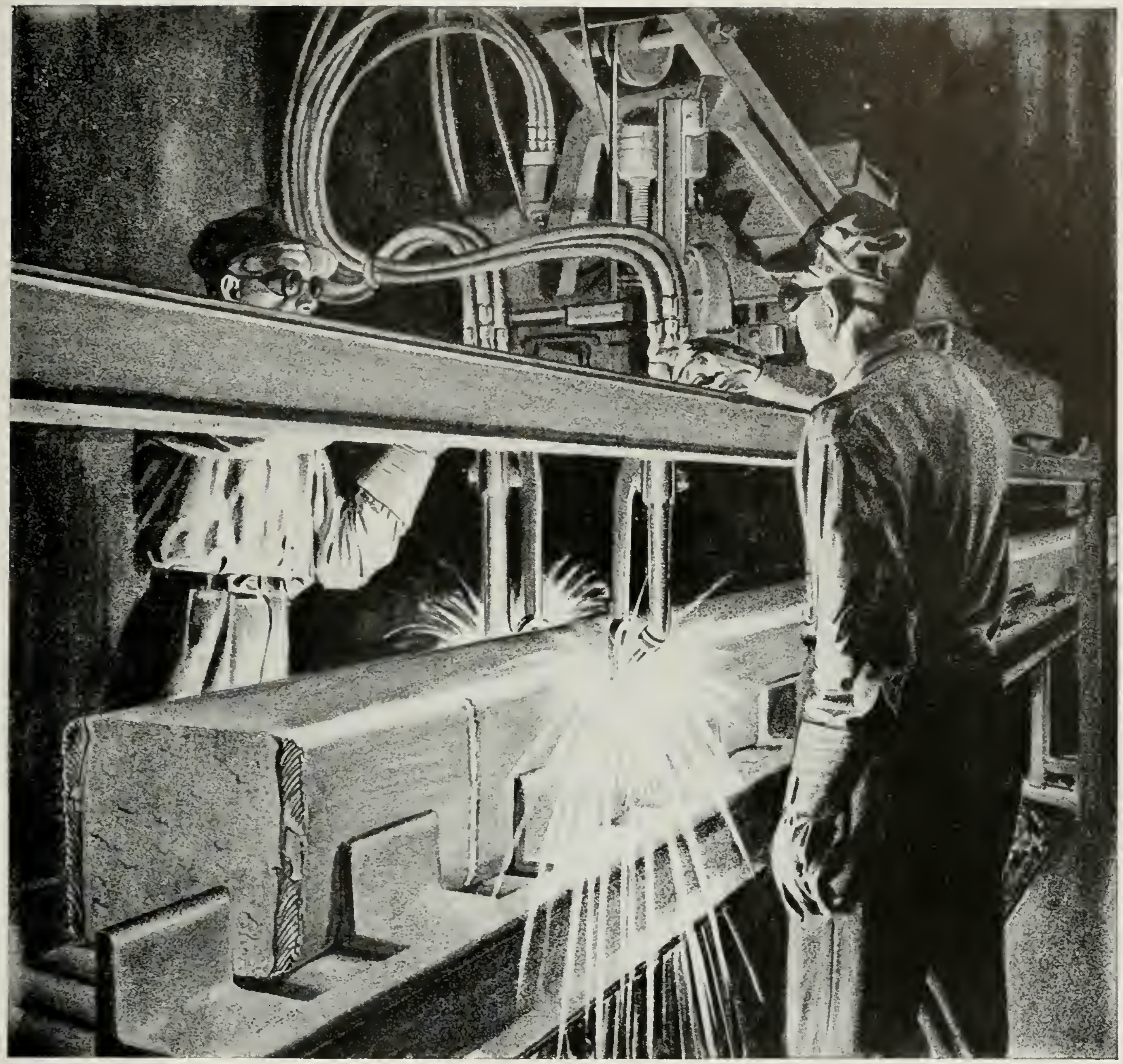
Mr. Klassan spoke on the "Plans for Supplying Sanitary Engineers in War Time." The demand greatly exceeds the supply according to the speaker and the requirements and age limits are going to have to be cut in order to obtain the number that will be needed for the progress of the war. Mr. Klassan illustrated his talk with slides of disasters in Illinois.

The afternoon session of November 14, consisted of two speeches: Dean M. L. Enger on "Airports" and Mr. Fullenwider of the State Highway Department on "The Effect of the War on Highways."

According to Dean Enger the war has accelerated the development of air transportation and the post war era will see a very rapid change in the transportation of freight and passengers. Many engineers and scientists will be needed to design the necessary airports to carry all the traffic that is anticipated.

Mr. Fullenwider told the assembly that the only roads being built in the state at this time are the necessary trunk lines for military transportation. There is, however, a great deal of maintenance work being done to preserve the existing system until after the war. Priorities are causing the big problem in the field today. Recently specification for highway bridges made a transition from all steel construction to one of timber with steel connectors.

The members of the local chapter made every effort to impress the visitors with the excellence of the engineering department here. How well they succeeded can be shown by a story told by the president of the conference. He told of a dream where he had gone to Heaven and while on a tour of his new residence with Saint Peter he learned that all the people of the various professions live in separate communities according to their profession here. Suddenly his guide directed him to remain quiet while going through a village and to ask no questions. After passing the village and being unable to control himself any longer he asked Saint Peter what that last place was. Saint Peter answered, "Those are the boys from Illinois, they think there isn't anyone else up here."



TAU NU TAU

(Continued from Page 18)

On December 8, the Bofors 40mm anti-aircraft gun was demonstrated. The gun's various accomplishments were enumerated, and its mechanism was thoroughly explained.

The annual T.N.T. dance will be held January 9, 1943 in the Illini Union. This dance will be sponsored jointly by T.N.T. and C.A.C., and will be uniformal. There are to be no corsages of any sort for the dance.

The final meeting of T.N.T. for the semester will be January 12, 1943, with election of officers for the coming year.

NEW ANTI-AIRCRAFT GUN

Workmen, men and women alike, wear a bronze button with an E on it around a certain Pontiac plant somewhere in Michigan. Henry Klingler, the head of the company wears one of these little bronze E buttons, too. He's proud of it and is working hard, and overtime for the right to wear it, for the right to fly that beautiful E pennant from the flag staff of the factory. For that Navy E means "excellence," and denotes that this factory and these workmen are doing a great job for their navy. The job they're actually doing is helping to keep the deadly enemy dive bombers flying high, keeping them from effective bombing, and shooting them out of the sky if they dare it. For Pontiac has made a record manufacturing the famous Oerlikon 20 millimeter (that's a little better than a half inch) antiaircraft cannon. This Oerlikon shoots like a garden hose, spraying 450 shells a minute. That's almost eight shells a second. And you just lay back in a cradle and sight it like a shotgun or a garden hose. Eight deadly half-inch shells a second, in one-two-three order. First an explosive shell, then an armor piercing, and the third a tracer. You can see how you're shooting with that dotted line of tracer shells splitting the sky.

Now a dive bomber is well in the range of fire from an Oerlikon cannon for 17 seconds. That means that a gunner can get in more than 100 shots — allowing for a change of shell holder — during the time the dive bomber is well in the range of his fire. And no bomber can take that kind of rough treatment. Even a single explosive shell through a wing would knock it off its flying course and spoil its bomb aim.

It's a marvelous little gun with quite a romantic history. A German inventor sold his patent to a Swiss gun maker who named the weapon after the little Swiss town of Oerlikon, where the gun was made. At the fall of France, a certain British naval commander assigned as an inspector at the plant, grabbed up the plans and flew them out via Roumania. From England the plans reached us.

Now it took the Swiss armament maker eleven and one-half months to get this gun into production. In England it took an armament firm nine and one-half months to start turning out the gun. But Pontiac, without any previous experience in armament making, got into production in exactly seven months, including getting the subcontractors going.

But the swiftly moving American efficiency didn't stop with getting into production. All along the line, time schedules were speeded up. It was an entirely new and different method that American mass-production genius pioneered here. It was a case of transforming "the whittle and yodle school of Swiss manufacturing," where there was plenty of time, to the quick, vibrant, highly efficient speed-up of American industry. In the old methods, breech-block castings weighing around 170 pounds, had to be bored, worked, filed, and babied by hand. Today 240 separate operations are performed by machines. And when the job is over, that 170-pound casting comes out a beautiful breech-block, weighing exactly 41 pounds.

When the government gave out the order, 10 fine machines for boring gun barrels lay boxed on the docks in New York, ready for shipment to France. Henry Klingler grabbed these and set them up in his plant. Each machine could bore out a solid gun barrel in two hours and 16 minutes. That was pretty fast. But the brand new boring machines today do a gun barrel in six minutes; and the ten old machines have been replaced by two special outfits, that don't even work all the time at that.

Now from the "whittle and yodle" European school of manufacturing, to the mass production of the transformed and transmigrated American motor industry, is a leap from the past to the future. This beautiful Oerlikon killer of enemy dive bombers, and protector of American ships and American sailors, is like a Swiss watch. Yet it is now being made even more accurately under super-modern American mass-production methods.

From one end of America to the other, this miracle of the "change-over" is going on. You don't turn a faucet or a crank, and have tanks or bombers or fast-firing cannon roll off the same assembly lines that once turned out our automobiles or tires or sewing machines. Most of the old machines of industry must be scrapped and shoved aside and special new machines built — new jigs, dyes, tools of every kind. It's been a hard, slow and often discouraging job. But America has done it, and the world has never seen such a flow of war goods as this very day are pouring from thousands of factories and plants.

Within a very few months we will reach our peak production. But there is no moment to lose. Destiny does not wait for her appointments. And we do have "a rendezvous with Destiny." Let's keep it.

New Multicircuit Switch for Aircraft Service

A new multicircuit switch which opens, closes, or transfers as many as 20 circuits simultaneously by means of a two-position operating knob, has been announced by the General Electric Company for aircraft service.

The contact mechanisms used are G-E switchettes stacked in pairs. The switchette is snap action, doublebreak in construction, giving it a high current rating. The switch is available with from 8 to 20 switchettes, and in either single-circuit or two-circuit form. A shaft toggle switch insures positive switch position.

The multicircuit switch meets specifications set up by the U. S. Army Air Forces for devices of this type. Weight varies from $5\frac{1}{3}$ ounces to $10\frac{2}{3}$ ounces, depending upon the size selected.

New Relay in Line of Aircraft Control Devices

A new four-pole relay, designated CR2791-GLOOK, has been added to the line of General Electric control devices for aircraft applications. Features of the new relay are lightweight, permanence of contact position and assurance of operation under severe vibration conditions, and operation at high altitudes at rated current.

The relay has a maximum continuous current rating of 10 amperes at 12 or 24 volts d.c., and a maximum make or break current rating of 50 amperes at 12 or 24 volts d.c. The normally open contacts have a tip travel of 3/64. Coil wattage is 1.80. The relay weighs .281 pound.

Dimensions are: length, 2½ in.; width, 1 5/32 in.; and height, 1 25/32 in.

NEW SMALL MOTOR FOR AIRCRAFT SERVICE

A new small fractional-horsepower frame motor for aircraft service has been added to the line of General Electric motors for specific aircraft applications. The motor, designated BA-10, is designed for use with control and protective devices.

The BA-10 motor weighs only eight ounces, is 3 9/16 in. long, 1⅜ in. in diameter, and includes a gear reduction to a speed of approximately 125 rpm. The motor is also available without gears, or with additional lightweight gears to give an output speed as low as 1 to 2 rpm.

TINY LIMIT SWITCH FOR AIRCRAFT SERVICE

A new lightweight limit switch designed especially for aircraft applications has been introduced by the General Electric Company.

The contact mechanism used is the G-E switchette. Snap action and double-break operation give the switch a high current rating. The switch is designed to meet all U. S. Army Air Forces stipulations. The plunger operates with a 7/32 in. overtravel, which increases the number of applications for which the switch can be used.

The aluminum housing is made dustproof by the use of a gasketed cover. There is adequate space inside the housing for easy wiring. The switch is available in three contact arrangements: single-circuit, normally open or normally closed; and single-pole, double-throw.

Each form can be furnished with a contact air gap of .010, .020, or .030 in. The switch weighs .13 lb.

★ Buy U. S. Defense Bonds and Stamps ★

AIR TRANSPORTATION

(Continued from Page 7)

and grades, for permissible heights of obstructions in the vicinity of the field, for field lighting, radio and other facilities. It is recommended that no field be selected which cannot be enlarged to a square mile if future traffic should demand. Light planes can take off and land safely on sod runways 1800 feet long, but heavy transports require paved runways 4500, or more, feet in length. Future developments in the airplane may make shorter runways possible, but the present trend is to large, fast planes which may require even greater runway lengths.

Engineers and scientists will be needed for the design, construction, and operation of airports, flight strips, and airways, and for the design and manufacture of engines, propellers, airplanes, instruments, and other equipment, and for research and development. The business operations of air lines will require accountants, lawyers, and other graduates. In order that the University may provide education and research in air transportation it is recommended that a Class 3 airport be constructed near the campus. Such an airport would require 640 acres of land, three paved runways each 4000 feet long and 150 feet wide, field lighting, hangars, shop, laboratory, and an administration building.

TRIM TAB FOR AIRPLANES WINS

Top award in the Transport Group of the Fifth Annual Modern Plastics Competition sponsored by Modern Plastics Magazine goes to the Glenn L. Martin Company, Baltimore, Md. for laminated plastic airplane trim tabs developed in conjunction with the Formica Insulation Company, Cincinnati, Ohio, and the Taylor Fibre Company, Norristown, Pa.

The trim tabs developed by each of the collaborating companies differ in size and detailed design and apply to different airplanes. The basic purpose of the trim tabs is to relieve the pilot of unnecessary forces on the normal flight controls. The tabs are adjustable from the cockpit and by varying their setting, relative to the surfaces to which they attach, the pilot is able to balance the airplane for various conditions of flight, such as, cruising, climbing, or gliding. The controls leading to these tabs are non-reversing in character and therefore the settings are continuously maintained until the pilot desires to change them. If it were not for the trim tabs, the pilot would have to hold the airplane in the desired condition of flight by continuously exerting appreciable forces on the control column and rubber pedals, and this would soon become very tiring.

Designed for use on ailerons, elevators, and rudders, these plastic tabs are to be used in place of metal or fabric parts and combine valuable features of lightness and strength. The laminated phenolic fabric base structure weighs appreciably less than aluminum and on strength tests has far exceeded specifications established for metallic tabs. The resiliency of the laminated structure causes the tab to keep its shape under stress where metal parts are often permanently distorted. The smooth uninterrupted surface of the plastic tab offers many advantages over a metal tab having projecting rivet heads or overlapping seams. Moisture does not affect the material and it is not subject to corrosion.

The flat longitudinal strengthening bulkhead inside the tab increases very greatly the rigidity of the exterior surfaces. This bulkhead also provides an ideal attachment and supporting surface for the hinges, control horns and other similar parts. The interior bulkhead is made integral with the exterior part of the tab so that a homogeneous structure of great strength is produced.

(Continued on Page 30)

Synthetic Rubber — New Major Industry

(Continued from Page 13)

could be and will be determined by extensive experience. However, the situation at present is controlled by the necessity for an adequate solution quickly, not in achieving the ideal. Even so it is likely that inner tubes, tire carcass, sidewalls, and tread will be made of different synthetic rubbers, either alone or in combination with natural rubber. Furthermore, this practice probably will continue even when plantation rubber becomes available again because a superior tire will result from making best use of the advantages of both natural rubber and each of the synthetics.

As to elasticity and rebound, natural rubber is still king. The stretchability of some synthetics closely approaches, at certain temperatures, that of natural rubber, but none are quite as good under all conditions. Natural rubber is also superior in a few other important respects. It is softer than synthetic rubber, and hence is easier to process or work in rubber mills. Rubber is more resilient than nearly all of the synthetics. This means it has low energy absorption, or hysteresis, and consequently does not build up temperature on repeated compression and extension. Low energy absorption is not always an advantage, however. For vibration absorption, as for engine mountings, this quality of natural rubber may be a distinct disadvantage. Lastly, rubber is more resistant to stiffening at low temperatures than most synthetic rubbers, but improvement of synthetic rubbers in this respect can be expected.

Natural rubber, properly compounded with carbon black, has good tensile strength, generally given as from 2400 to 4500 pounds per square inch. Some synthetic rubbers equal it, but none are markedly better at normal temperatures. However, synthetic rubber, almost without exception, retain their initial strengths under conditions of sunlight, ozone, chemicals, heat, etc., far better than does rubber.

Abrasion resistance is of particular importance in tires. In this respect several synthetics are as good, and Buna S and Perbunan are appreciably better than natural rubber.

It is in resistance to sunlight, ozone, chemicals, oils, etc., that the real superiorities of synthetic rubber appear. Thiokol, neoprene, Perbunan, Koroseal, and others are highly oil resistant and have already largely replaced natural rubber in hose for oils and gasolines. They are also used in printing rolls and engraving plates. Koroseal makes superior seals, gaskets, and diaphragms for oil pumps. Oil-resisting gloves are made of neoprene. Thiokol, neoprene ,and Koroseal are outstandingly resistant to sunlight and ozone, both of which shorten the life of natural rubber. They are accordingly used in many airplane parts such as de-icers, which are subject to direct sunlight. Gas-cell fabrics of balloons and airships are coated with neoprene and Thiokol, which, in addition to their resistance to sunlight, are far less permeable to gases than is natural rubber. Some synthetics are as much as 25 times more impervious to gases than rubber, so that inner tubes made of them would hold air indefinitely. Synthetics, neoprene and Koroseal in particular, are being adapted extensively for insulated wire. This is not because of electrical superiority, as some are slightly inferior, but because of their better resistance to burning and to deterioration by ozone. The dielectric constant of the Buna rubbers, except Perbunan, is about the same of slightly lower than natural rubber, but the others are higher. The power factor of Vistanex is lower than for rubber; Buna S about the same; and Thiokol and neoprene, higher. The conductivities of all synthetics, except Vistanex and Koroseal, have higher dielectric strengths than natural rubber, while the strengths of Thiokol and neoprene are slightly less.

The point is, rubber is an engineering material having many properties; not elasticity alone. In synthetics we have a group of materials of specialized, superior properties, that can compete with tree-grown rubber for many uses. They were beginning to do so before the war, even with a three- or four-to-one price handicap. To what extent they will continue to supplant natural rubber when free trade is resumed depends on (a) the cost of plantation rubber, (b) the costs of synthetics when produced on a high-production basis with a background of technical experience and (c) the improvements that will undoubtedly be made in synthetic rubber.

Tremendous amounts of steam are required in the various processes involved in the manufacture of raw materials—butaduene and styrene—for Buna S rubber. In fact, the steam for a single 50,000-ton annual capacity butadiene plant, if supplied at about 800 pounds to noncondensing power turbines exhausting at 150 pounds, will produce about 40,000 kw in electrical energy, only about one-half of which is required by the electrical equipment in the plant.

The synthetic rubber plants are installing turbo-generators to recover this by-product power. These turbo-generators are tied in with existing utility systems, providing a back-up service to give to the operation of the synthetic rubber plant a maximum of reliability.

The main turbines in these butadiene and styrene plants will receive steam from 750- to 800-pound boilers. They will exhaust at from 150 to 190 pounds for process requirements and to mechanical-drive turbines, which in turn provide 15-pound process steam. Steam will also be bled from these electric-power turbines at 450 pounds, which may be supplemented by steam from 450-pound boilers, to supply mechanical-drive turbines and high-pressure boilers, high-pressure power-generation bleeder turbines, and mechanical-drive turbines give a flexible system by which efficient heat balances can be maintained for all the process work.

The rubber mills in which the raw synthetic rubber will be processed into finished articles will not require fundamental changes in electrical equipment. Because synthetic rubber is stiffer than natural rubber, the rubber-working machinery will require more horsepower per ton produced.

The rubber industry is old and well established. Great improvements have been made in processing natural rubber, as those who drove a car 25 years ago can testify. Synthetic rubber is new. Much remains to be learned about the best methods of handling and compounding the types already known, and new types will undoubtedly be discovered. The possibilities are almost limitless; already over 6000 co-polymers with butadiene have been tried. New synthetic rubber, improved synthetic rubbers are sure to appear.

Come the peace and whatever will then constitute normal times, the engineer will have at his command a large family of rubber-like materials, each with its special merits, which can be used along with natural rubber to produce better tires, tubes, belts, gloves, hose, vibration absorbers, electric insulation, and literally thousands of other necessities. The synthetic-rubber industry is here, and it is here to stay.

DEATH CAR...

Only a child's toy on an unlighted stairway. Yet as lethal as a speeding truck for killing or crippling. For causing heartbreak and tragedy in someone's home.

Accidents . . . in the home . . . on the highways . . . in factories and offices . . . cost this nation 102,500 lives last year. This tragic toll, preventable to a great extent, was augmented by the permanent disabling of 350,000 other people . . . by 9,000,000 lesser casualties.

Production-wise, America's war effort lost heavily. In all, 480 *million* man days were lost forever. Enough to have built a total of 20 battleships, 100 destroyers, 9,000 bombers, and 40,000 tanks! Money-wise, the loss was almost 4 *billion* dollars!

Where did these accidents happen? Two-thirds of them happened outside of industry. In the home, where workers take chances they would not dream of taking on the job. They happened in darkened hallways . . . in bath tubs . . . in garages and basements. They happened in industry where someone gambled with safety.

No matter what you do, your life is precious to this nation. Don't take chances with it. Guard it for America . . . at day . . . and at night. Fight carelessness, the Master Saboteur! Join the anti-accident crusade! Help save a life!

The perfection of the famous "Eveready" fresh DATED *flashlight battery called for coordination between various Units of Union Carbide and Carbon Corporation. The exact grade of graphite necessary for the "mix" was developed by the Acheson Graphite Corporation. Special alloy for protecting molds and machinery was produced by the Haynes Stellite Company, and Carbide and Carbon Chemicals Corporation provided a specially prepared paint made of "Vinylite" resins for the spun metal cap.*

"EVEREADY" FLASHLIGHTS AND BATTERIES

NATIONAL CARBON COMPANY, INC.

30 East 42nd Street · New York, N. Y.

Unit of Union Carbide and Carbon Corporation

UCC

The words "Eveready" and "Vinylite" are registered trade-marks.

Plastics Vital to War and Industry

Not only are plastic parts used in the manufacture of vital war products but they are also better than metal for some heavy-duty applications in steel mills, Dr. G. Frank D'Alelio, head of the General Electric plastics laboratory at Pittsfield, Massachusetts, declared in a General Electric Science Forum address here.

For military use there are plastic helmet liners, plastic parts in every gas mask, and plastic bayonet handles, according to Dr. D'Alelio, whose company is the largest molder of plastics in the industry. He said that the average battleship has more than a thousand different plastic parts on it, and each tank and each airplane contains hundreds of plastic parts. Mortar shells have plastic fuse caps, and bombers have plastic noses. Training planes, landing barges, torpedo boats and invasion gliders are made of plastic-bonded plywood.

Plastics are found in supercharger manufacture, in gun control mechanisms, in radio antenna housings. Firing pins of anti-aircraft shells are made of plastics. There are plastic detonators on torpedoes.

Dr. D'Alelio also mentioned that many of our new vessels will have plastic bearings on their drive shafts, because plastic bearings wear longer and can take tougher punishment than can any other bearing.

"The development of the plastics industry in the last few years, frankly, has been astonishing," Dr. D'Alelio pointed out. "Plastics had long been considered a 'future' even by those most intimately associated with it. Yet, before our very eyes, and under the dynamic compulsion of war, plastics suddenly walked the stage of the present in a major role.

"The military applications of plastics merely prove that plastics can no longer be thought of as an industry devoted merely to making gadgets," the plastics chemist continued. "Our chemists have produced plastics that are crackproof and shatterproof, that are strong and tough; that can do jobs other materials cannot do as well. In a word, plastics are no longer substitutes for metal.

"Plastics today can stand on their own feet, because they can do certain tasks better than any other material.

"For instance, there are heavy-duty bearing applications in iron and steel mills where plastics outlast and outperform metal.

"Rayon manufacturers use plastic rayon-spinning buckets. Why? Because these buckets spin at 10,000 revolutions per minute, are in constant contact with acid and salt solutions, and must operate every hour of the year. No other material can equal the performance of plastics for these spinning buckets, which have an average life of 4½ years.

"For high-frequency radio devices, certain parts must be made of plastics—no other material can give the required performance," Dr. D'Alelio added. "The same is true of hundreds of electrical applications."

Plastics are not one material, according to Dr. D'Alelio. "Many persons believe that cosmetics cases, bomber noses, and bearings for warships are all made of one and the same plastic," he asserted. "To appreciate fully the importance of plastics and the significance they have in the war of today, we must firmly grasp that the term 'plastics' refers to a whole family of materials. There are actually thousands of them known. Probably a little more than a tenth of this number have wide industrial use.

"Some of these plastics are opaque, others are transparent, some are suitable for use in the freezing temperatures of the Arctic. One type will resist acids, another will stand the abuse that strong alkalies, like postash, can give it. Certain classes will not burn; others will withstand the deteriorating effects of high octane aviation gasoline. Some can be spun into fibers, and others drawn into either flexible or rigid tubing to replace copper and other valuable metals.

"The new synthetic rubbers we hear so much about belong to the family of plastics. Besides the many plastic materials we have today, we are constantly discovering new ones in the laboratory."

The wonderful wartime developments in the plastics industry indicate that after the war we will find plastics of much greater importance in our everyday life, said Dr. D'Alelio. He predicts that houses will have a great deal of construction embodying plastics, and that our very clothing will be made of plastic materials.

NAMES IN THE NEWS

(Continued from Page 15)

Council and is a mechanical engineer with a respectable 3.84 scholastic average.

Tom is quite interested in aeronautical engineering. He thinks the one thing lacking at this University is a good course in aerodynamics and aeronautical engineering. His ambition is to be an aircraft designer. He has a couple of new ideas that he would like to try, one of them being an inline air-cooled airplane engine.

Naturally, Tom has enjoyed his military work the most during his four years at Illinois. At the present, he is busy trying to get the new Honor System installed for members of the advanced ROTC. It will be a system similar to the one at West Point, and Tom thinks the cadets will like it very much. It will make the cadets more conscious of the trust and authority that they carry.

Hailing from Park Ridge, Illinois, Tom is engaged to a certain little co-ed on campus. He thinks his four years at Illinois have been a grand experience. He says, "If you don't think before you get here, you will afterwards."

TRIM TAB FOR AIRPLANES WINS

(Continued from Page 27)

The use of plastics eliminates many operations formerly necessary when metal was employed. For instance, the outer skin and longitudinal interior support are fabricated in one piece by a single application of heat and externally applied pressure. Formerly, it was necessary to cut the metal, bend it to form and hold it together by rivets.

Tests prove that the laminated tab possesses a greater resistance to buckling than metal and 25 per cent to 35 per cent more resistance to bending. These tabs have withstood twice the required hours on the vibration tests as compared to a metal piece of similar outside dimensions.

Laminated plastic tabs are valuable in time of war, not only for their lightness and strength, but also for the fact that they may be readily manufactured in mass production by concerns who are not normally burdened with war orders.

Formal announcement of all awards for entries in the Competition was made in the October issue of Modern Plastics magazine, followed by a Presentation Dinner at the Waldorf-Astoria Hotel, New York City, on October 15th.

G-E Campus News

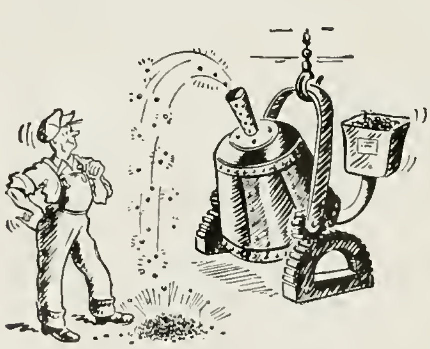
THE HOME GUARD

A DEVICE which can be installed in the home to give both audible and visible warning of air raids has been developed by J. L. Woodworth (U. of Idaho, '24) in the G-E Carrier Current Laboratory.

Designed to operate on carrier current systems, the new gadget makes it possible to contact air raid wardens and civilian defense workers without increasing the load on telephone lines.

When the air raid signal is sent from the transmitter at the power station, the home warning device (which resembles an ordinary house meter) begins to buzz.

After it has thus called attention to itself, the device lights up, and on its dial will appear a colored signal—yellow for preliminary caution, blue for advance caution, red for air raid, or white for all clear—that corresponds to the signal sent from headquarters.



"VEE" JEWELS

THE General Electric Company has developed a method of fusing a special type of glass and forming a miniature jewel. How it's done is a military secret, but the jewels are made on a mass-production basis.

The jewels, called "Vee" jewels (not V for Victory, but "Vee" for the V-shaped depression in which a cone-shaped steel pivot rotates), are in great demand for use in the indicating instruments that measure the flow of electricity in wartime fighting and industrial control equipment. The moving parts of these instruments are of watch size and delicacy, each requiring two Vee-shaped jewels about the size of the head of a pin.

The G-E "gem" has been developed as a substitute for the "Vee" jewels made from sapphires formerly supplied by Swiss craftsmen.

YOUR SMOKE IS SHOWING

A TRAIL of smoke often leads enemy submarines to their intended victims, but an electronic tube might help to give the subs the slip by instantly warning the ship's fireman when smoke is coming from the vessel's stack.

General Electric has already put the phototube, most versatile of the electronic tubes, to work in industrial plants to warn of smoking stacks and to save fuel. W. C. White (Columbia, '12), director of the G-E electronics laboratory, thinks a similar arrangement might be used in ship stacks.

A beam of light, thrown across the smoke column in the chimney, shines on the tube. When the smoke gets too thick, the light is blocked and the phototube works a relay which sounds a warning for the fireman.

GENERAL ELECTRIC

953-50-211