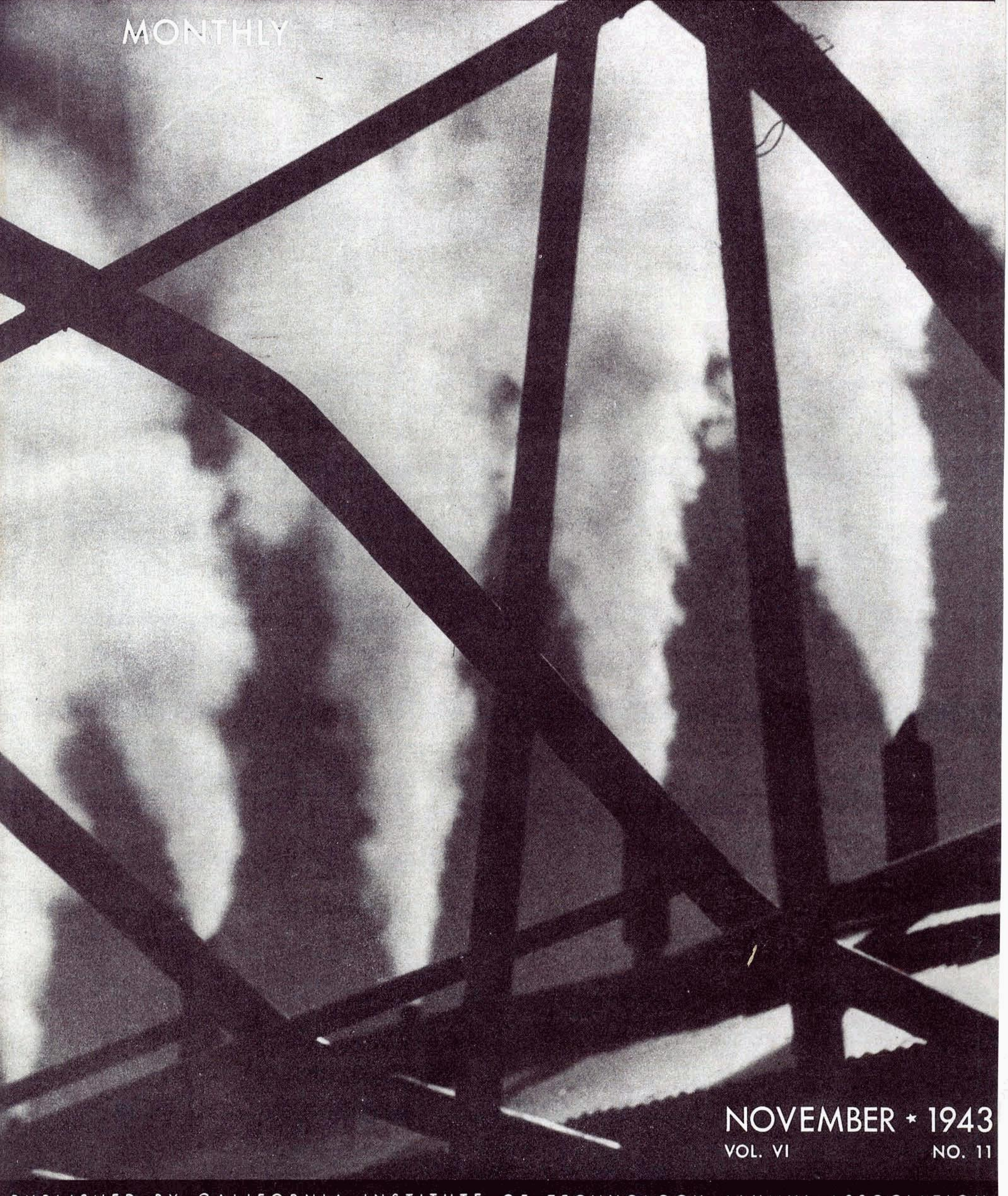
ENGINEERING AND SCIENCE

MONTHLY



NOVEMBER ★ 1943
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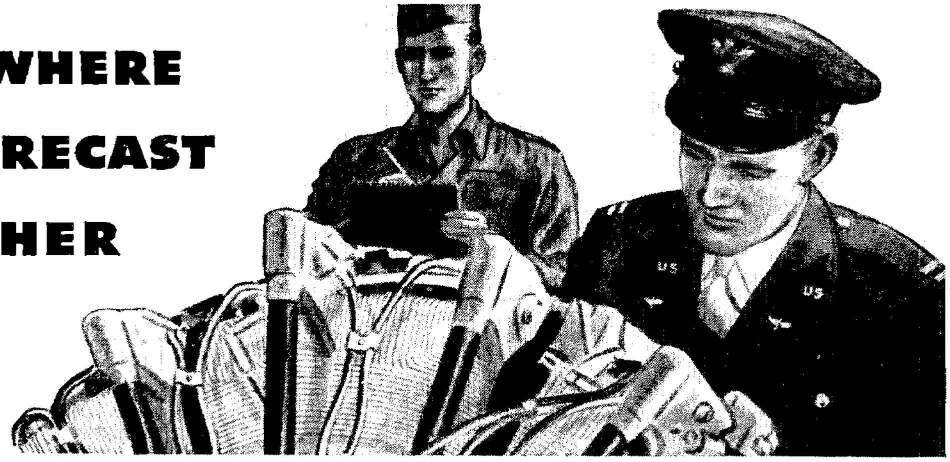
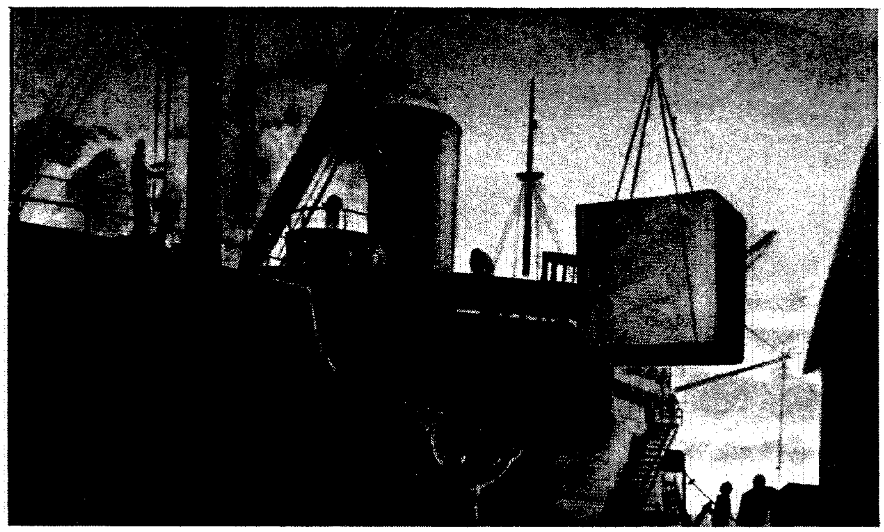
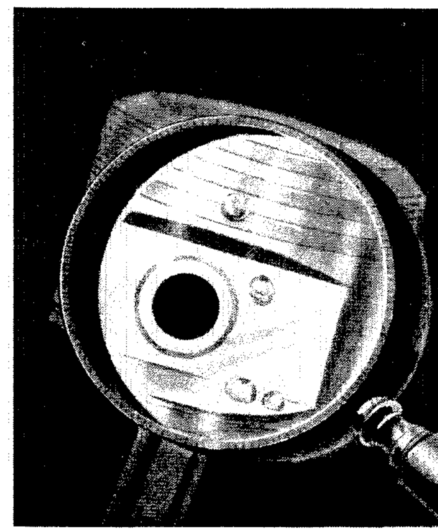
ONE PLACE WHERE YOU CAN'T FORECAST THE WEATHER



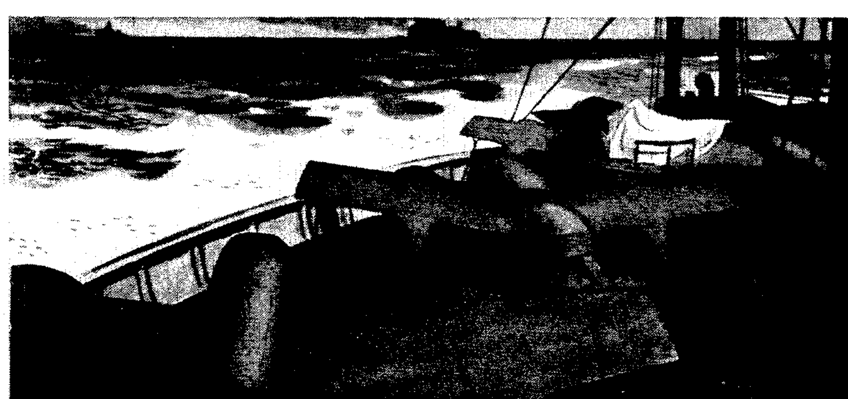




1. When the U. S. first began to ship aircraft engines all over the world, the "weather" inside those engines was a big problem. It was completely unpredictable. Condensation was apt to form at any time. And when it did, engines rusted.

Immediately a request went out for a preventive that would stop rust and also neutralize acids caused by fuel residues left over from test runs. They got what they wanted. Union Oil Company came up with a product called Stop Rust B that can deliver a motor in "factory-perfect" condition to Africa, Salamaua, or the Aleutians. **It meets specifications AN-VV-C-576a** and is used in large quantities by the armed forces today.

2. Stop Rust B contains special compounds diluted with a top-notch lubricating oil. It is a preferential wetting agent that covers and protects metal surfaces completely. It won't drain off for months. It stays put as long as the engine is idle, neutralizes acids, keeps water away from metal surfaces. *It effectively prevents rust and corrosion!*



3. Stop Rust B has another important feature. It leaves no harmful residue when engines are put back into service. No flushing is necessary. The residue actually improves the lubricating oil—gives it a "break-in" quality.

4. So if you ship aircraft engines or other equipment that requires internal protection against rust and corrosion, get in touch with Union Oil Company of California by phone, wire, or letter. Stop Rust B can be supplied in 53-gallon barrels or bulk.

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OF CALIFORNIA
Los Angeles
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BY-LINES

ROBERT A. MILLIKAN

Dr. Millikan, Nobel Laureate, is chairman of the Executive Council at the California Institute of Technology and Director of the Norman Bridge Laboratory of Physics. Dr. Millikan has contributed extensively to advancements in the field of physics and has also taken an active part in other fields involving administrative duties.

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EDWIN F. GAY

Dr. Gay is a member of the research staff of the Huntington Library and is also an Associate in economic history at the Institute. Dr. Gay was formerly Dean of the Graduate School of Business Administration at Harvard University, and has written extensively in the field of economic history.

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WILLIAM H. PICKERING

Dr. Pickering, assistant professor in electrical engineering at the Institute, received his B.S. degree from Caltech in 1932, his M.S. degree in 1933, and his Ph.D degree in 1936. He is well known for the cosmic ray research he has done in conjunction with Dr. Millikan and Dr. Neher.

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GORDON L. BUSSARD

Mr. Bussard received his B.S. degree from Caltech in mechanical engineering in 1937. Since graduation he has been employed by the E. I. duPont de Nemours and Co., Inc., first in their Cellophane Division at Richmond, Virginia, and since 1938 in the Nylon Division of various duPont plants. He is now located in Martinsville, Virginia.

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WILLIAM B. MUNRO

Mr. Munro, Edward S. Harkness Professor of History and Government and member of the Executive Council, has been with the California Institute of Technology since 1925. Professor Munro is the author of numerous books on government and municipal administration which are used as textbooks in colleges throughout the country.

ENGINEERING AND SCIENCE

Monthly

The Truth Shall Make You Free

CONTENTS FOR NOVEMBER, 1943

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ENGINEERING AND SCIENCE MONTHLY

Edited at California Institute of Technology

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DR. MacMINN AUTHORS NEW BOOK

ONE of the most impressive works of California historical preservation of the last decade is presented in a volume entitled "The Theater of the Golden Era in California" which indicates years of painstaking research on the part of the author, Dr. George R. MacMinn, professor of English at California Institute of Technology.

This book is not only fascinating for the theater enthusiast; it is invaluable to any student of California history, revealing as it does that the argonauts of the gold rush were not entirely uncouth grubbers for wealth, as so often pictured, but that many of them brought along definite inclinations toward culture. Dr. MacMinn has wisely humanized his account into a readable story which shows how eager the forty-niner was for entertainment.

As he points out, through all the rapid changes in El Dorado, political, financial, social and cultural, the theater was generally looked upon as a prime necessity even in the remote gold camps, though naturally the gaudier exhibitions were offered in the tent-and-shack cities. In the gold regions of the central part of the state, the advent of genuinely meritorious theatrical entertainment followed close upon the arrival of the gold seekers. The theater-minded pioneers built playhouses in San Francisco and Sacramento before the end of 1849. There were circuses and an early equivalent of burlesque, but the outstanding novelty about early theater days of California was the addiction the largely masculine population displayed for Shakespeare.

Dr. MacMinn's carefully documented work is enhanced by the fine illustrations, many of them reproduced from rare originals in the Henry E. Huntington Library.

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"THE AMAZING PETROLEUM INDUSTRY"

AN excellent book for the non-technical reader, intended to give a brief popular outline of the manufacturing processes employed in the petroleum industry, was published recently by the Reinhold Publishing Corporation.* The book, "The Amazing Petroleum Industry," was written by Vladimir Kalichevsky, who received his B.S. degree from California Institute of Technology in chemical engineering in 1924. Any reader of the book will find that his knowledge of the manufacturing processes employed in the "making of oil" will be greatly increased.

Mr. Kalichevsky has had a colorful career. He was born in the city of Tiflis, in the Russian Caucasus, and when he was 15 years old he became a member of the Corps of Pages of the Russian Emperor and Empress. For outstanding scholarship, his name was inscribed on the marble plate of the Corps. He received military training at the Russian War College and subsequently became a lecturer on tactics and surveying at the Paulovskoe Military College. During World War I and the Siberian Civil War he served in the Imperial Russian Guards, rising from sub-lieutenant to captain. He was assistant military attaché in Denmark and was an officer with the Royal Rumanian Mission in Siberia and in Japan. Following service as manager of the topographical department of a mining organization in Japan, he came to the United States in 1921 and con-

*Publisher: Reinhold Publishing Corporation, 330 West 42nd Street, New York City. Price $2.25.

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ENGINEERING AND SCIENCE
Monthly

Vol. VI No. 11 November, 1943

The Month in Focus

Research Under Bureaucratic Control

A bill was introduced in Congress that should be of interest to scientists and engineers. The Kilgore Bill (S. 702) is entitled "A bill to mobilize the scientific and technical resources of the Nation, to establish an Office of Scientific and Technical Mobilization, and for other purposes." This bill may gain headway under the guise of war legislation, but actually it intends to continue in effect in peacetime. An analysis of the bill may be found in the August 6 issue of the magazine, "Science."

The act is intended to eliminate delay and ineffectiveness in meeting urgent scientific and technical problems and to correlate and more effectively utilize the work of scientific personnel. The Office of Scientific and Technical Mobilization is by this act to have power to establish rules and regulations concerning research and development by any agency or establishment which includes government, educational, private or industrial efforts. The controlling board is to consist of six members and an administrator appointed by the President. On this board there is to be a representative of industry, agriculture, labor, the consuming public, and two members who are scientists or technologists. A scientist or technologist is defined in this act as an individual who has had no less than an aggregate of six months training or employment in any scientific or technical vocation. The rules and regulations prescribed by this board are to have the force and effect of law of Congress. If such an organization were to be set up it would greatly confuse the work of the National Research Council, an agency of the National Academy of Science which was established by the government as an advisory group on research matters of importance to the United States. At the present time the National Research Council is closely allied with the Office of Scientific Research and Development.

Many technical organizations already have voiced their opposition to enactment of any bill of this character. This measure is a further indication of the tendency to vest more rights in political bodies. During wartime, personal liberties must be sacrificed, but we must be certain that such waiver of liberty is not permanent.

While these pages should not be devoted to political discussion, they will be used to bring important facts to the attention of our readers when the subject affects technical personnel. This particular matter of the attempt to establish an Office of Scientific and Technical Mobilization has more fundamental significance than the bill itself. A principle is involved which leads to a general discussion on increasing tendency toward greater government control. In a recent address to the Army Meteorologists receiving diplomas from the Institute, Dr. Robert A. Millikan pointed out the dangers of this tendency toward centralized control especially in education and research. This address is printed in this issue with Dr. Millikan's permission.

Cooperative Research

In contrast to the previous discussion there is considerable evidence to show that in time of stress the fund of information owned by competitors can be and is being thrown into the common pot for the solution of technical problems. Dr. Zay Jeffries in the October issue of Metals and Alloys points out that in World War I the "know how" of an individual company was used by that company in assisting its customers, but in the present war a new broader cooperative spirit has developed. Industries actually have shared their production information with competitors, and further they have made their research information and their plant equipment available to all for the solution of other difficult problems. The committees under the War Production Board and the National Defense Research Committee are cooperative groups of industry and technological institutions who are striving to solve the technical problems for the Army, the Navy and industry. The work of these committees includes also the development of new methods and devices. Very little can be published at present of the work of these committees, but it can be said that they are getting the work done. In view of the great progress made with this cooperative arrangement, the question has been asked whether or not its success did not prove the advisability of socialized research in peacetime. Actually it proves the reverse. In peacetime institutional and industrial research operating individually have supplied the stimulus of competition which is essential in a free economy. In wartime they have shown themselves capable of effective cooperation to meet the needs of the emergency. Why then should we sacrifice a system which has demonstrated by its flexibility its capacity to answer the needs of any situation?

Another Lesson from History

By ROBERT A. MILLIKAN

Members of the meteorological branch of the fighting forces of the United States:

Yesterday you were students of meteorology in an American university or technical school. You are today officers in the armed forces of the United States. In spite of that metamorphosis you have in no way altered your fundamental character as citizens of the United States. as voters on every fundamental issue that comes before a free country for decision by its citizens, at least 51 per cent of whom must be thoughtful. intelligent voters if the American way of life is to survive.

It is not. then, as university students and not as Army or Navy officers that I address you today. The momentous significance of events now transpiring makes distinctions of that sort unimportant. I wish. rather. to address you in your character of most supreme importance —that of citizens of this great republic in the greatest crisis in its history.

To understand what is involved in that crisis, I wish to direct your attention. first. to the words of one of the most penetrating political historians and philosophers of all time. a Frenchman, Montesquieu, who wrote in 1748. long before our American republic had been dreamed of. these pregnant words, which point out his conclusion as to the only way in which free representative government may be maintained.

> "If a republic is small it is destroyed by a foreign power: if it is large, it destroys itself by an inner vice. So it is very likely that men would have been forced to live always under the rule of one man had they not imagined a constitution which combines the advantages of a republican government and the external force of a monarchy. I mean a federal republic. Made up of small republics. it enjoys the high political quality of each (such small republic) and toward other powers it has by virtue of a federation all the advantages of monarchies."

Let me rephrase those principles as they now apply to the great republic of the United States. The principle of the federation of small republics was introduced by our founding fathers. and the federal government of the United States was created. primarily to give us the strength to defend ourselves against external aggression. The principle of state's rights and local self government was introduced to educate our citizens in self government and to enable each small community, when the cancer of political corruption gets started. to cut it out in the place in which it appears through the agency of the local community which is closest to it and suffers immediately from it. and thus to prevent that malignant disease from spreading throughout the whole country.

Today these two menaces to the life of our great republic. the "external foe" and the "internal vice." are threatening us at the same time more menacingly than they have ever done in our history. Listen to the recent voice of a distinguished Congressman from Texas. Hatton Sumners:

> "Our whole political system is based on the principle of local self-government. But two forces have been destroying this principle. One is the demand of the people for the Federal government to intervene in problems of every community and every class. The other is the ever-growing practice of passing all these problems on to the government in Washington. The last war gave this a big push. The postwar dislocation hurried it. The Great Depression raised it to avalanche proportions. The present war is completing the job. Every town and State. every trade association and trade union. every class and group of desperate minority. brings its problems to Washington. And Washington is gladly accepting that responsibility."

At this hour fortunately the prospect that we shall not be destroyed by a foreign foe is brightening. But is our great republic. then. to be destroyed after the war by its internal vice? That depends. if Montesquieu was right. upon how you and I vote after the war in the preservation of local self government.

But what concrete evidence have we that Montesquieu was right? I quoted his lines. not to hold him up as a superman. Indeed. if his spirit is here in invisible form in this coliseum today, as it may well be. I can see him entering a protest at the importance I have apparently been attaching to his statement of one of the greatest truths of human history. I think I hear him say:

"Pray. do not believe that I would for a moment arrogate to myself the authorship of the ideas behind those lines of mine. The words chosen may indeed be mine, but the ideas represent the sum and substance. the distilled essence, of both the thinking and the experience of mankind in its age-long struggle to eliminate the despot—the totalitarian state—and to achieve free, stable, representative government on earth. Pray. do not for a moment assume, for example, that those extraordinary men who devised your constitution got the ideas that underlie it from me. They were all, on their own account, profound students of the best thought and experience of mankind. That is where those ideas came from. We all drank from the same fountain of history. That is why they. on their own account, came to devise a federation of small republics, now numbering 48. and reserved to these and their constituent local communities all powers not specifically delegated to the central government which was to exist. as they clearly planned it. primarily for defending these United States against external aggression—federal government which was not designed to encroach in peace upon the powers of the states or of their constituent communities. If now the 150 years of history which you have had in developing. on the sound basis of those ideas. the highest standard of living for the common man that has ever existed anywhere in history. if that is not enough to establish their validity. then give the credit for these ideas not to me, but to the parallel history of the oldest. and unquestionably the most successful people in the exercise of parliamentary government. the British Commonwealth of Nations. For Britain has guarded the principle of local self government throughout the last hundred years more jealously than has the United States. and it has also kept itself much freer in that period from political corruption than has the United States. Probably the greatest political document of all history is the Statute of Westminster of 1931 which created the British Commonwealth of Nations. whose constituent parts are federated practically only for one purpose—a defense against a common foe. but which are otherwise a world encircling group of completely independent communities. Nowhere in history has the principle of local self govern-

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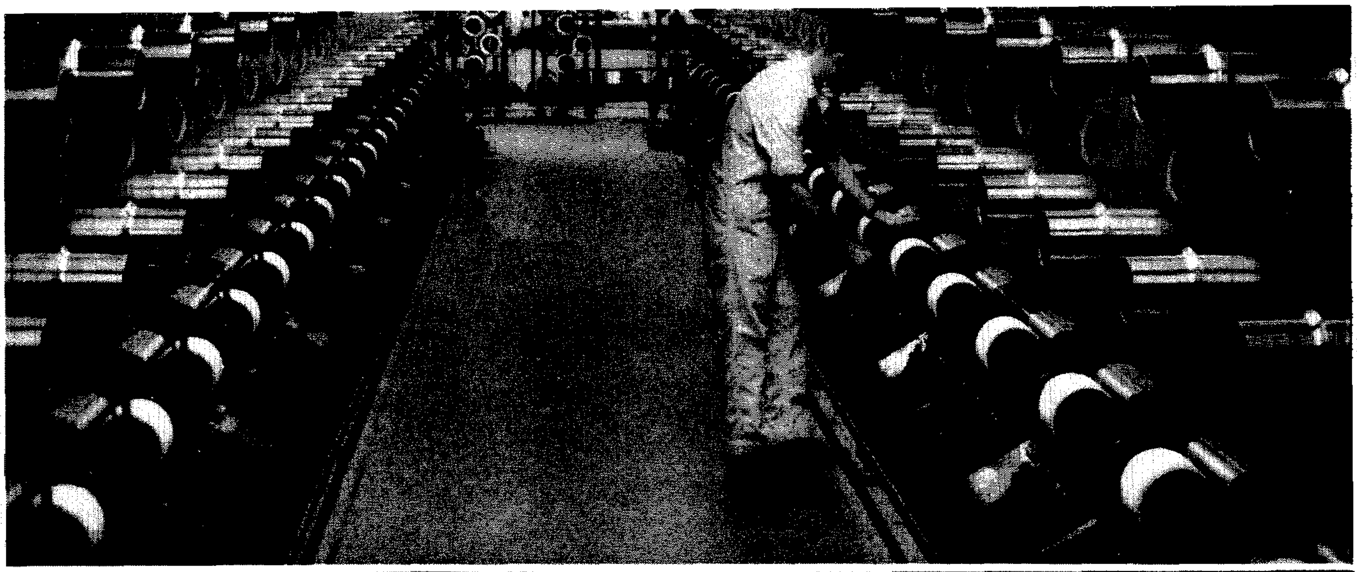


NYLON
Industrial Chemistry's Glamour Girl

By G. L. BUSSARD

NYLON, a peacetime product which was ready for military service when the need arose, is an illustration of what can be accomplished by coordination of scientific research, engineering skill and industrial imagination. The specific product was the result of an expanded program of fundamental research in chemistry which was instituted by the Du Pont Company in 1928.

The original aim was to fill some of the gaps in the knowledge of important chemical processes and to explore new fields in this division of science—let the results be what they may. As head of a group to engage in this type of research, the late Wallace H. Carothers, a chemistry teacher at Harvard University, was chosen. He was surrounded by a small team of well-trained organic chemists and was encouraged to work on problems of his own selection. He chose the subject of polymerization, the process by which small molecules of a chemical unite to form larger molecules with new and different physical properties. This is a process found frequently in nature; for example, in the formation of rubber, the muscle of men and animals, certain other proteins such as casein of milk, and cellulose, the building material of the plant kingdom.

Dr. Carothers was particularly interested in long-chain polymers. One of the first practical results to come out of the studies of his group was neoprene, the synthetic rubber-like material now performing vital tasks in military equipment and production machinery. The researches of the late Father Julius A. Nieuwland on acetylene were an essential contribution to the development of neoprene.

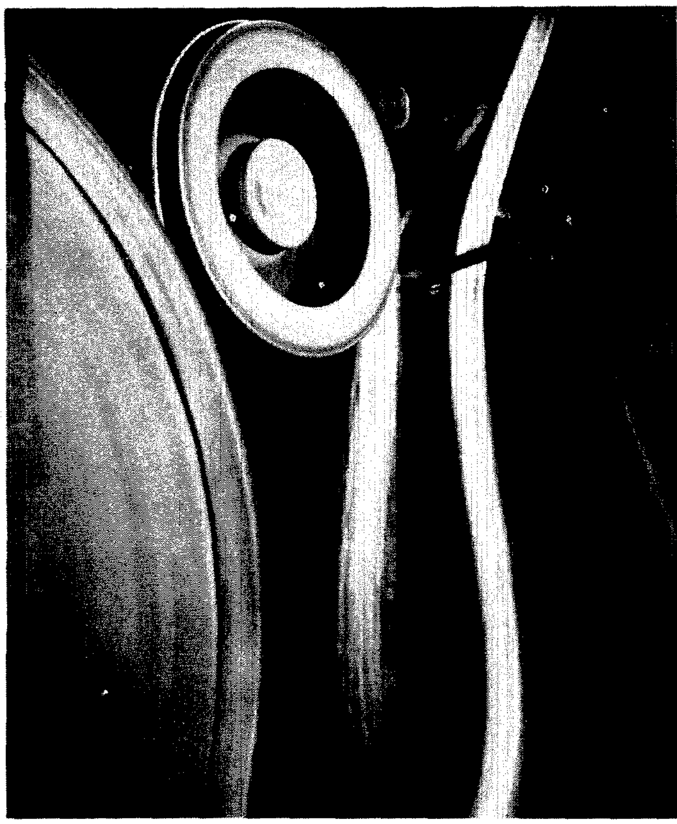
Another phase of this research, more closely related to the eventual synthesis of nylon, involved a group of ring compounds known as macrocyclic esters, most of which were derived from castor oil. It was noticed that some of them had an appealing musk odor, and the work resulted in the production of synthetic perfume chemicals which are now produced commercially.

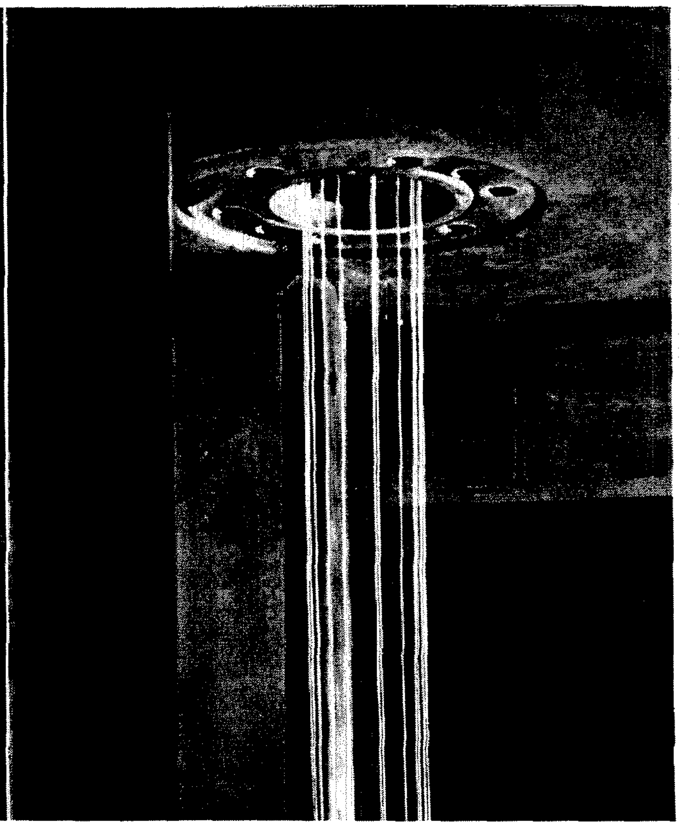
The group also worked with certain dibasic acids, including sebacic acid from castor oil, and alcohols of the type of ethylene glycol (used in radiator anti-freeze). When heated in a molecular still, the acid and alcohol combined to form polyesters having molecular weights up to 25,000. Dr. Carothers called these "superpolymers." In the spring of 1930, in removing one of the "superpolymers" from the still, Dr. Julian W. Hill, one of Dr. Carothers' associates, noted that it could be drawn out into a thin strand, like taffy candy. But unlike taffy, it was not brittle when it cooled. In fact, the cooled strand could be further drawn out to several times its original length. This cold-drawing made the fiber more transparent and lustrous, and what is more important, imparted increased strength and elasticity. It could now be tied in knots without breaking.

At this point the course of the Carothers group, which was working under the direction of the chemical department, left the somewhat meandering path of theoretical research for the specific road of practical development. This was the real beginning, back in 1930, of nylon. But while the road to successful production of this synthetic product was straight, it was by no means smooth. Many different chemicals were tried out and finally a combination which was practical and potentially available in the United States was chosen for commercial development. This was adipic acid and hexamethylene diamine. Polymer from these chemicals was called "polymer 66," because there are six carbon atoms each in the diamine and the adipic acid.

The first nylon filaments were made by forcing the molten polymer through a hypodermic needle. One might spin a single pair of hosiery for a princess this way, but before yarn in commercial quantities could be produced a whole set of new machinery had to be designed and built.

In 1936, the year after "polymer 66" was developed, the rayon department of the Du Pont Company assumed sponsorship of the research. The laboratory at the experimental station continued to improve and expand its facilities for producing the new material, and each pro-





AT LEFT: Original casting wheel, part of the equipment constructed in 1937 to make some of the first nylon. This original wheel (made over from an engine flywheel) is still operating. Extruded in molten form onto the wheel, a segment of which is seen at the left, the nylon solidifies into a plastic ribbon and is then carried up over the small take-off wheel and between air jets in the "blower offer," which dry it. The ribbon is then chopped into flake, which is in turn spun into yarn. AT RIGHT: The birth of nylon filaments. From tiny holes in this spinneret are extruded filaments of nylon. Filaments shown here will be wound together to form nylon yarn.

cess improvement was acclaimed as proudly as a baby's first steps. In March, 1937, 50 batches were run and 86 hours of continuous spinning were reached. In April the first experimental stockings were knit from the new yarn, which still was known only as "fiber 66."

In January, 1938, a pilot plant was authorized, which meant that the laboratory grew into a small-size factory, while retaining its research organization, facilities and viewpoint. The new building was finished in July and production at once increased. Meanwhile toothbrushes bristled with the new material had been manufactured and they were placed on the market in the fall of 1938. The new material was christened "nylon," a name which itself was "synthesized" after several hundred suggestions had been submitted. It had no special significance. It was merely distinctive and easy to pronounce, and it became a new word in the English language, a name for an entirely new family of chemicals.

The Seaford, Delaware, nylon plant started production in December, 1939; women's nylon hosiery made from nylon produced in the pilot plant was put on trial public sale in Wilmington, Delaware, in October, 1939; was made available in all cities in the country on May 15, 1940, and immediately became a success. Approximately 64,000,000 pairs of nylon hose were sold during the first year. By the close of 1941 enough nylon yarn had been shipped to make approximately 175,000,000 pairs. Nylon was also used for women's undergarments, girdles, and gloves, and neckties, fishlines and leaders, football pants, tennis racket strings, brush bristles, surgical sutures, and other articles.

The above historical sketch is given as a background against which the present activities of the nylon research laboratory and two nylon plants may be viewed.

Production actually starts, however, at the Du Pont Company's ammonia department plant in West Virginia, where high-pressure synthesis converts coke oven gases and coal tar fractions into adipic acid and hexamethylene diamine. One of the intermediate chemicals used is ammonia, which is also made by high-pressure synthesis. The elements entering into these compounds are carbon (from coal), nitrogen and oxygen (from air) and hydrogen and oxygen (from water). Hence the popular characterization of nylon as a product of coal, air and water.

At the West Virginia plant the adipic acid and diamine solutions are run together, in measured amount, into a stainless steel kettle. A reaction takes place and the two chemicals combine to form nylon salt, the scientific name of which is hexamethylene-diammonium-adipate.

For large-scale production the salt is in water solution to facilitate handling. It is run into tank cars, shipped to the nylon spinning plants and there piped to evaporators on the top floor to be concentrated to a certain salt percentage. The concentrated salt solution is put into a cylindrical autoclave and heated by "Dowtherm" circulating through a jacket and coils. ("Dowtherm" is a fluid which has a very high boiling point, vapors of which can therefore be circulated at high temperatures and low pressures.)

It is in the autoclave that the polymerization or linking together of small molecules into giant ones takes place. The nylon salt in solution is ionized and the diamine and dibasic acid parts are dissociated. Each of these parts may be considered as a short chain with a hook at either end. Under the influence of heat the hooks unite with each other. First a diamine unit hooks up with a dibasic acid unit. This leaves a diamine type hook at one end and an acid hook at the other end of the new molecule. Again a diamine and an acid hook unite, with the formation of a longer molecule. This linking up continues until extremely long molecular chains or polymers are formed. This particular variety of polymer, containing many amide groups, is known as a polyamide.

Theoretically this polymerization might continue until chains of infinite length were formed. However, the desired consistency can be obtained by carefully controlling the temperature and the duration of the process and by the introduction at the proper moment of a chemical, "a stablizer," which closes the "hooks" at the ends of the molecules and prevents further linkages.

When polymerization has been completed a slot in the bottom of the autoclave is opened and the viscous material is allowed to flow out on the surface of a broad, slowly-revolving wheel, termed a casting wheel (illustrated). A shower of water causes the polymer to harden into a translucent, milky-white ribbon. Two rows of air jets dry the ribbon as it leaves the casting wheel en route to the rotary cutter, which chips it into flakes. The flake is subsequently dried to a specified moisture content.

The next step is to blend the flake from several autoclave batches, to insure uniformity, and then to pour the blended flake into the spinning hoppers. Each charge of flake in the hopper is purged of oxygen by passing into it a blast of pre-purified nitrogen (nitrogen with an oxygen content of less than five-1000ths of one per cent). The nitrogen is then removed by vacuum and this "washing" process is repeated.

The valve at the lower end of the spinning hopper is now opened and the flake falls onto a melting grid, which looks much like the coiled heating unit of an electric cooking stove. Here again, circulating "Dowtherm" supplies the heat. The molten polymer passes through the grid into a funnel-shaped melt chamber from which it is squeezed by a special gear pump into and through the spinneret assembly.

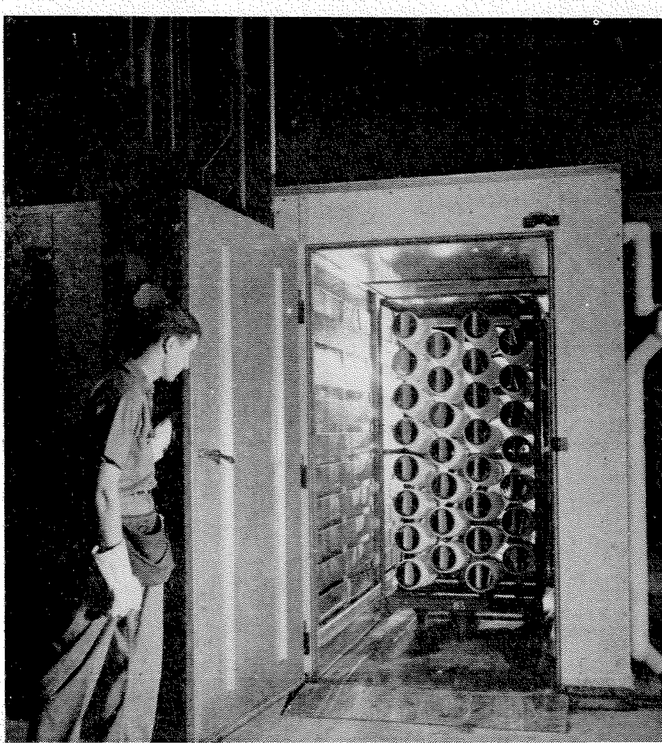
Both the pump and the spinneret are very important parts of the spinning machinery. The pump must squeeze all the bubbles out of the viscous polymer and must deliver it to the spinneret at a constant rate to insure uniform denier or thickness of the filaments. The spinneret itself is a thick disc of metal about the diameter of a silver dollar and it is pierced with fine holes, flaring out like tiny funnels at the upper ends where the polymer starts through. Before the polymer reaches the spinneret plate, however, it is filtered through a layer of sand, to insure smoothness and purity. In early experiments the filter was a layer of phonograph needles, packed together, points up, to give an assemblage of roughly conical passageways. But metal corrodes and is difficult to clean. Cloth filters would be destroyed by heat. Sand was chosen, therefore, because it will withstand high heat and because it is cheap and easy to handle. Spare spinneret packs, already heated, are kept on hand in a heated rack much like a restaurant steam table.

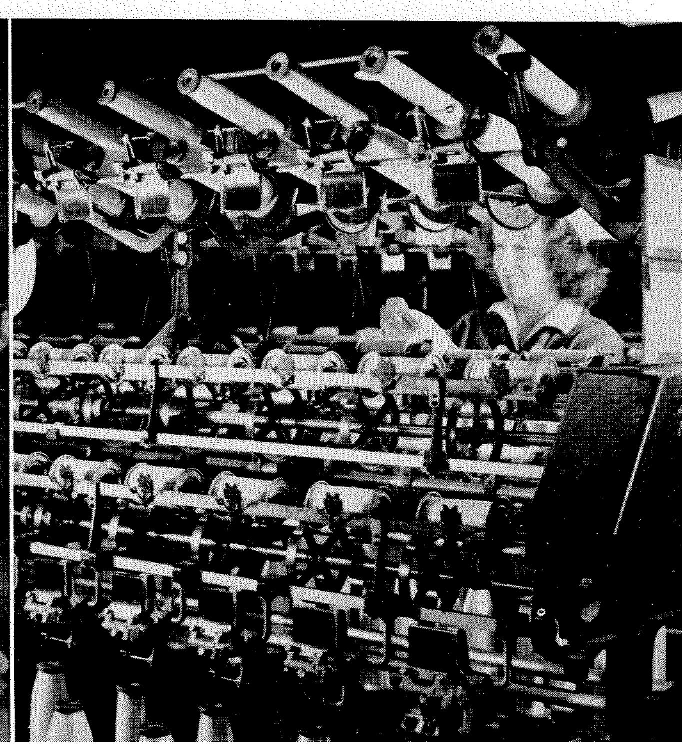
As the thick syrupy polymer is squeezed through the holes of the spinneret (illustrated) the filaments are formed, at the rate of about 1,000 to 3,000 feet per minute, and are air cooled. The filaments then converge and pass into a conditioner which moistens them sufficiently to make them stick together as a single strand.

During the windup process the yarn passes over a lubricating roll, which puts a finish on the surface. This also helps the filaments stick together and prevents the accumulation of static electricity.

The yarn is next pre-twisted, and several strands or "ends" may be plied together at this point to make a heavier denier yarn. Denier is a term relating to the

AT LEFT: Batteries of machines (see illustration, page 5) wind nylon yarn onto spools after filaments have been extruded from the spinnerets. Nylon yarn is "baked" in large "twist setting ovens" like the one illustrated, before it is wound on spools and cones for inspection and shipment. AT RIGHT: Spools of nylon getting their last windup before being shipped to converters and throwsters. This machine is one of a large battery now engaged in getting the yarn ready for shipment as rapidly as it can be manufactured.





weight, and therefore indirectly the fineness of yarn, particularly synthetic yarns. A one-denier fiber is one of such size that 9,000 meters of it (9,842 yards) weigh only one gram. A one-denier filament of nylon has a diameter of about one 2,500ths of an inch.

Up to this point the yarn has undergone no real physical change since it was first formed upon emergence through the spinneret. But now it is drawn, or stretched, by traveling between rolls revolving at different speeds, so that it becomes several times its original length. This cold-drawing makes the long-chain crystalline molecules of nylon snap out of their helter-skelter arrangement and line up parallel with each other and close together. This increases the opportunity for powerful intermolecular forces to come into play and the result is an exceedingly strong fiber. After the "draw-twisting," as this operation is termed, the yarn is again twisted and then, if desired, it is sized. An important sizing material used to protect the yarn during subsequent textile operations is polyvinyl alcohol, another synthetic polymer. The yarn is then twist-set in a steam oven (illustrated). This relieves the internal stresses, in a manner somewhat similar to the annealing of steel or glass, and prevents the yarn from kinking.

A number of tests are given the nylon to insure maintenance of strict standards. One of them is known as the creel mirror test. Several hundred spools are set up on a rack or creel and the ends are brought down in a broad band of parallel threads. These pass into a darkened booth. Here they are viewed almost end-on in a raking light, which throws long shadows and thus shows up the little irregularities and snarls that indicate broken filaments. The principle is the same as that which causes small pebbles in the road to stand out prominently in the low, straight-on beam of the headlight. A check is made of the number of broken filaments per 1,000 yards of yarn.

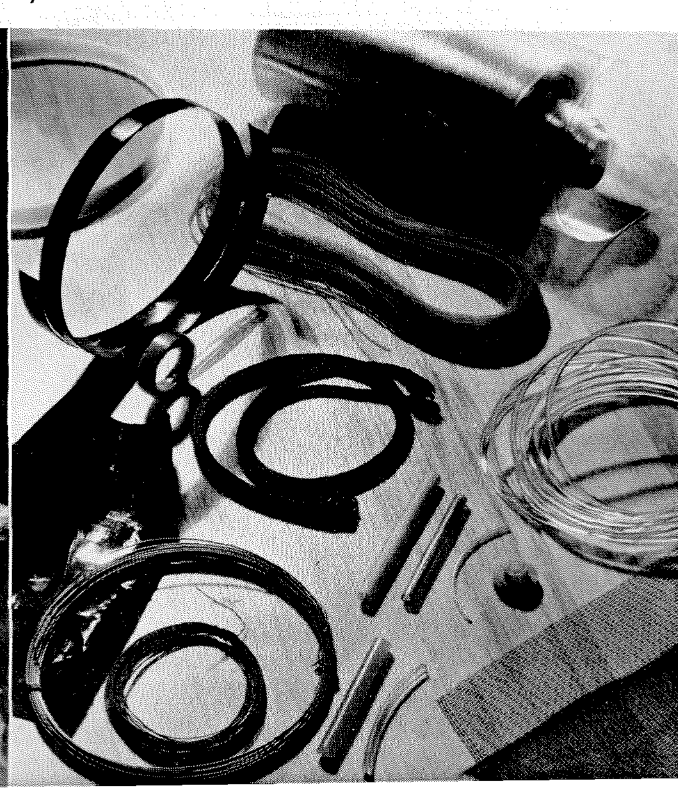
Another test, in which the yarn is made to support a weight attached to an indicating pointer, reveals the strength or tenacity and the percentage of elongation.

The nylon divisions' product development men became interested in nylon as a possible replacement for silk parachutes early in 1940, started an intensive program early in 1941 and had a product ready to do the job when the Pearl Harbor attack December 7, 1941, severed all connection with Japan and Japanese silk. Both nylon plants (a new one began operation at Martinsville, Virginia, in the fall of 1941) were diverted entirely to production for government purposes in February, 1942.

Some of the war uses for nylon are confidential and strategically important. But it is no secret that nylon supplies not only the canopy cloth of parachutes, but also the tapes, shroud lines and certain of the harness webbing and belting. Nylon rope is superior to any other existing fiber with respect to strength, lightness and durability. It has the additional property of elasticity, which makes it suited to such an application as the tow rope for gliders picked up by airplanes in a new maneuver which the Army has tried out. Nylon is also being

(Continued on Page 14)

AT LEFT: Some of the numerous new nylon products. Arranged clockwise, beginning at the paintbrush with tapered nylon bristles, are: parachute harness webbing, parachute shroud lines, heavy nylon rope for military gliders, cargo parachute cloth, camouflaged Army Air Force escape parachute cloth, and light nylon rope. Centered in the photograph are, left to right: experimental molded nylon plastic bearing, carburetor diaphragms of nylon fabric, and surgical sutures. AT RIGHT: Some of the plastic forms nylon takes, together with a few of its newest uses as a synthetic fiber. From top to bottom are shown extruded strips of the plastic, coated fabric made by applying nylon in solution, insulated wire, and a coil spring. In the center, from top to bottom, are: nylon film, extruded rattan, braided machinery packing made from the fiber, various sizes of extruded tubing, and two rods. At the right of this view are a coil of narrow tubing, an electric motor bearing of the plastic, and nylon window screen.



SOCIAL SECURITY

Its Limiting Factors

By EDWIN F. GAY

A RECENT news item reports that on an Hawaiian islet a few rabbits let loose by a passing ship have multiplied until when 1100 in number they devoured all the herbage and then all starved to death. A human colony, say on Pitcairn Island, makes a more intelligent provision for its continued existence. It is obvious that human societies, while subject to the basic natural conditions that frame their persistence, far surpass the longest existing societies of a lower biological order, such as the ants, not so much in adaptability to as in their progressive control of natural forces. The struggle for subsistence has always been the master problem; it has driven men to cooperation in societies and to their search for security. A precarious security for the early human groups was maintained only by the constraint of rigid custom imposed upon every individual. As security grew with the size and strength of organization, the members could with increasing impunity break the "cake of custom," and the widening range of individual initiative enriched the community's life. The history of the modern world from the Renaissance onward may be read in terms of the gradual liberation of the individual and his creative force in all fields of activity—political, social, and economic. As the movement reached its culmination, liberation became an end in itself, and its passionately convinced advocates, the liberals, dominated contemporary thought and legislation. The United States was founded and expanded under the impulse of liberalism, and its expansion further strengthened the liberal faith. The invigorating spirit and accomplishment of this faith have operated to make the nineteenth century outstanding and exceptional among historical periods in its immense material growth and in its advancement of scientific knowledge. Its work, though challenged, is by no means near its end.

The liberal faith was simple, dogmatic, and to its age convincing. The society which formed it and which it in turn reformed was so strong and vigorous that it could take security for granted. But its dogmas, essentially sound and stimulating as they were, were not axiomatic. The "inalienable right" of every individual "to life, liberty, and the pursuit of happiness" was not a "natural right." It was a social goal, based upon an older religious belief in the sacred value of a human soul. And the "pursuit of happiness" was an optimistic substitution for the earlier word "property." So also the maxim "laissez faire," that meant unimpeded liberty of action in the economic sphere, presupposed the guidance of Providence, a deity that ordered for social good the divergencies and apparent conflicts of self-regarding individuals. Again the dogma that men are created free and equal, often translated into equality of opportunity, is not a statement of fact but a combination of social aspiration and religious intuition. "When Adam delved and Eve span, who was then the gentleman" was one and an earlier expression; another springs from the answer to the question, "Am I my brother's keeper?" Liberalism furthered democracy and its most musical poet voiced the dream of the brotherhood of mankind, "The parliament of man."

Liberalism, engaged in its first great task of tearing down the restrictive regulations and hampering traditions of what is called an outworn age, and absorbed in its newfound vision of progress, overemphasized in good faith the right of the individual to pursue his private gain. But it soon found that harmony in the unrestricted play of self-interest could not safely be left to divine providence. No sooner, for instance, were the older protective regulations on handicraftsmen removed, than labor in the new expanding factory system required an equally expanding legislation to prevent exploitation and other abuses. It was discovered that the economic motive could not be allowed to rampage, like a loose cannon on the deck of the ship of state. Other similar discoveries discouraged the too easy optimism of liberalism. It had minimized the state, the central creation of organized society. Liberalism as a political force gradually declined and the state in our time has reasserted its corrective and guiding power. The age-long problem has again emerged of adjusting the shifting balance between individual liberty and state control, and between the social aggregations operating in and under that control. That we are entering a new historical period is evident from the urgency of this problem.

An enhanced sense of social responsibility is also clearly apparent and witness to it is the spread of the movement known as social security. This is to replace or supplement by state conducted or aided insurance the relief, either private or public, which has long been given by charity to the needy and the unfortunate. With the rise of the modern state the duty of maintaining public order, of finding refuge and perhaps some work for the able-bodied poor, of suppressing vagabondage, of succoring the aged, was taken over by local authorities under command of state legislation. There was scant humanity in the execution of the early poor laws. The human refuse-heaps, a menace and an eyesore to the community, were brushed aside into poorhouses or dumped into another parish. But, however imperfectly, a social obligation was recognized by the state. The English liberals of the early nineteenth century were shocked by the mounting expense and the manifold abuses of the poor law system. They preached "self-help" and confined the poor more vigorously in bigger if not better poorhouses. They thought their new world of free enterprise and more abundant employment, together with their condemnation of poverty as a sin, would ultimately solve the problem. Again their concepts proved too shallow and inadequate. Population and employment, it is true, greatly increased; after the mid-century the wage level and the standard of living gradually rose, but the factories continued to cast out their used-up human wastage and the depressions of the business cycle periodically created involuntary idleness and widespread distress. Despite emigration, the derelicts of civilization still pullulated in the festering slums of the great cities. The giants, as Sir William Beveridge calls them, of want, disease, ignorance, squalor, and idleness were not yet vanquished.

On this side of the Atlantic the giants did not stalk so conspicuously. But the frontier of free land gradually closed: huge industrial corporations and great factory populations arose: masses of men became more exposed to the repeated fluctuations of economic forces and more helpless in meeting them. To the American of the twentieth century, or even two or three decades earlier, the land of unlimited possibilities seemed increasingly a mirage. The common citizen amidst incessant change and risk longed more and more ardently for security. The government virtues of competition were no longer vaunted. In the depression and long downward swing of prices that followed the crisis of 1873, business men still paid lip-service to the old maxim, "Competition is the life of trade," but they added, "cut-throat competition is its death." They sought increasing protection, the manufacturer and trader in tariffs ever higher and higher against competition from abroad and in trade associations and combinations, ever greater and more inclusive, against competition at home, the workingman in steadily extending labor-union organization. Everywhere, indeed, the building of social dikes and ramparts went on apace, until in the interval between the two world wars, accentuated by a deep depression, it climaxed in a frantic search for security, in a throttling net of restrictions. To Sir William's five giants we must add a sixth, Restrictionism, in all its forms, national and international, and as practiced by both capital and labor.

In the meantime, the general quest for security has also taken other, less malign, forms. Humanitarianism, the twin of liberalism, arising from the sense of brotherhood implicit in democratic equality, has been intensified. It played its part in the abolition of slavery. It has animated such agencies of mercy as the Red Cross. The public conscience has become more tender, more aware of distress abroad and at home and more anxious to remedy wrong. Jacob Burckhardt, the Swiss historian, noted in 1870 that "the realization and impatience of suffering is visibly and rapidly growing." His remark was made not in praise but with regret if not with grim disapproval, for he was an admirer of the colorful but tough individualism of the Italian Renaissance. He hated the coming of the great state, which he foretold, and its domination over the soft-minded, subservient masses. This acute observer only confirmed the fact of a change in public attitude that soon affected the problem of want in the midst of increasing abundance. To the old practice of public relief of distress was now added the new principle of national insurance. The state began to take over and to extend the private industrial insurance that was already spreading through the efforts of labor unions and private insurance companies. The German Reich in the 90's led the way, perhaps supposing that accident, sickness, and old-age contributory insurance, as a measure of state socialism, could act as an antidote to Marxian socialism. In another two decades Great Britain swung into line, and step by step since 1911, in piecemeal fashion, a large proportion of its working population has been included in state schemes of insurance, widening from industrial accidents and sickness to old-age pensions and unemployment. Now Sir William Beveridge, under government auspices, has brought forward a notable plan for consolidating and enlarging all these services on a nationwide scale. The workers are to continue to contribute a share, that entitles them to relief not as a charity but as a legal right: the employers contribute in recognition of their special social obligation to those by whose labor they have profited: and the state, that is the body of taxpayers, takes over a greater proportion of the expenditure and the management. The benefits cover literally most of the practicable insurance risks from the cradle to the grave, with grants to mothers for child-birth, to families for the rearing of children, to the workers for unemployment (limited after six months by the worker's acceptance of retraining for another occupation), to the aged for pensions, to relatives of the dead for funeral expenses, and to all a comprehensive health service.

Against criticisms of undue and demoralizing benevolence, Sir William Beveridge answers that "The proposed program is not a device to permit permanent retirement on a secured income or to induce idleness." The benefits are calculated to provide only a minimum of subsistence, a floor against the abyss of sheer want. It is not to provide an income for those who do not or will not work, but only for those who for any reason *cannot* work. Above that floor incentive remains and is reinforced for the exercise of self-help and initiative to attain the larger ends and amenities of existence. The floor provided by state-aided and controlled insurance leaves room for the added benefits of private insurance.

The modern plan is not like that of ancient Rome. It provides bread, but not wholly as a free gift, and it omits the circuses. But the familiar analogy is a reminder of the danger in a democracy that accompanies any state-aided benevolence. Political influences may attend its administration, and most to be feared is the pressure to increase the benefits. The operation of social security measures would then become not beneficent, but socially disintegrating. Therefore strict adherence to the rule of minimum adequacy is the main limitation to be observed. The rule, for public safety, requires the floor and nothing more.

Even this minimum, if applied to the United States, will call, it is roughly estimated, for an annual expenditure of at least twelve billion dollars. The more careful estimates of the Beveridge proposal put the initial cost for Great Britain at about four billion dollars. The present British government, while accepting the plan in principle, has, in view of the staggering war and postwar burdens and economic uncertainties, postponed its actual establishment. For the less unified and centralized conditions of this country much greater difficulties are to be met. Cooperation between the Federal government and the 48 states with their varying provisions for social security involves problems not as yet satisfactorily solved. And the sectional differences in standards of living and wage-levels, unless somewhat ironed out by war and postwar changes, cause further complications of adjustment. It would seem, therefore, to be the part of wisdom to push forward the study begun by the National Resources Planning Board, to make a more detailed plan for the necessary administrative integration and an estimate of the costs, but to defer the final adoption of a comprehensive measure to a period somewhat less abnormal than the present. State finance and the business community have still to learn how soon and how steadily after the war they may recover their balance.

Sir William Beveridge raises a further doubt as to the expediency of launching an ambitious program. It would be hardly worth while, he says, unless the state by appropriate measures maintains and guarantees "full employment." This guarantee would require, according to some prominent advocates of the proposal, not merely reliance on a policy of public works for temporary relief in times of depression, but a substantial intervention by the state in the sphere of private enterprise. Their simple theory ascribes depressions to the recurrent unbalance

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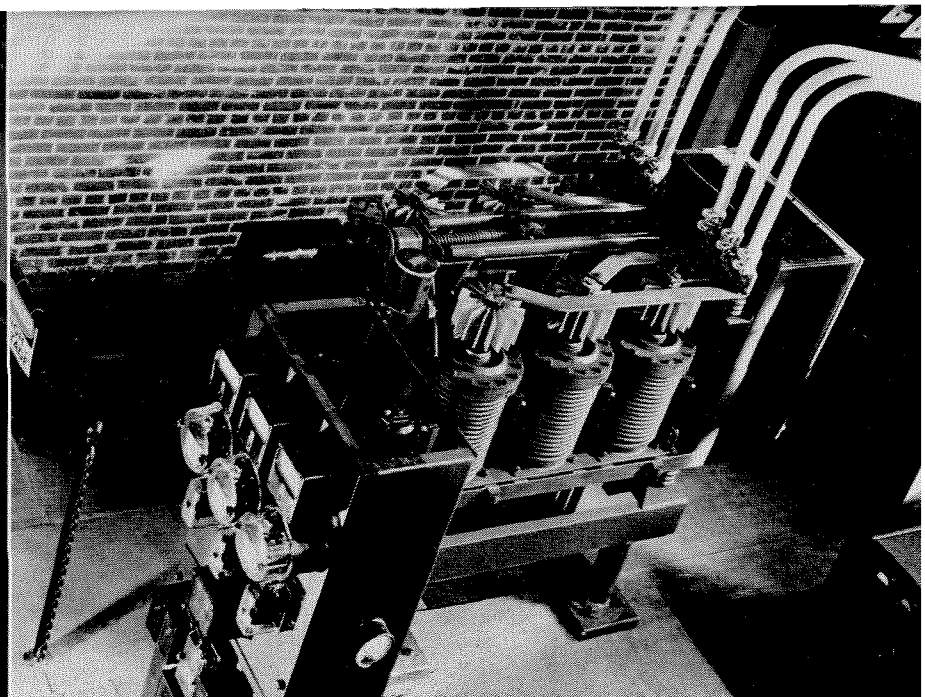


AT LEFT: A new mass spectrograph. This instrument uses beams of electrons and of positively charged particles to analyze the chemical constitution of complex organic gases. AT RIGHT: Typical ignitron rectifier substation for the production of d.c. power.

Electronics in a Postwar World

By WM. H. PICKERING

SOME of the most spectacular technological advances of the war have been in the field of electronics. Many of these are directed towards purely military ends and their details will not be divulged until the war ends. Many others, however, have been in industrial fields and these may serve to point the way for an estimate of the part electronics will play in the postwar world.

Until a few years ago the vacuum tube was used almost exclusively for communication purposes. Both radio and long distance telephone service would be commercially impractical without it. With the coming of sound motion pictures a major field outside of the communications services was opened up, and although this particular field involved essentially the same tubes and circuits as were used for communications, the possibilities of other applications gradually became apparent. In the early nineteen thirties the first tubes were produced for purely industrial use and, in a very small way, a new tool had been provided for industry.

Industry was not impressed. The circuit engineers could dream up various wonderful devices, perhaps they could even demonstrate their gadgets, but to the factory manager, vacuum tubes were used in radio sets and they were always burning out or getting broken. In general they were thought of as being fragile and unreliable and not to be trusted in a factory, particularly since most of their applications seemed to involve control or measurement. The criticism was partly justified. The design engineer had not yet learned how to make his circuits "foolproof," or to make his equipment stand up to the abuse accompanying its operation by unskilled personnel. In actual fact, however, these difficulties had been completely removed by the time the war began and there remained only the "sales resistance" to a new idea. Wartime necessities and production schedules have removed this last obstacle, electronic gadgets are definitely accepted by industry, and the next few years may well show the vacuum tube to be one of the most useful and universal tools yet invented.

In attempting to survey the future possibilities of electronics, let us divide the field into three categories: entertainment, communication and industrial applications. Of course there will of necessity be a certain amount of overlapping, but these will serve as a basis for discussion.

Every house has now at least one radio set under the family roof and probably another in the garage beneath the family steering wheel. Will the wartime developments make these as obsolete as the "Model T" Ford? There have been two improvements in radio entertainment that have been technically ready for a few years and that appeared commercially shortly before the war. These are television and frequency modulation. For various technical reasons both of these require the use of very high frequencies and they cannot be received by adaptation of ordinary receivers. Special sets will be necessary for these signals. These sets will probably be designed to receive the ordinary broadcast and short wave signals as well as the television and frequency modulation, so

AT LEFT:

Flyers call this the "Gibson Girl" radio, the name being derived from the equipment's rather well-defined curves. It is a hand-powered transmitter which can be used by flyers forced down at sea. The aerial is supported either by a kite or a balloon.

that one rather large and expensive set will receive all the entertainment provided on the ether.

Television has been "just around the corner" for so long now that its actual arrival may well be somewhat of an anti-climax. If it is to be adopted on a large scale, the following questions among others must be answered. How will the listening habits of the public be changed? At present we are accustomed to having the radio playing in the corner of the room while we go about our daily business, study or play bridge. With television we must watch the screen, and perhaps even darken the room. It will require a definite planning of our time to be able to sit down and enjoy the show. A second question concerns the matter of expense. How will the television show be financed? A good show will presumably cost much more than a sound broadcast. At the same time, the listening public will be few in numbers for some years. One possible means of spreading the cost will be to use televised films in the same way that transcriptions are used today. Another question concerns the audience. How will the householder know that he will have satisfactory reception? Television must use very high-frequency waves and one of the vagaries of these waves is the fact that for satisfactory reception there should be a clear line between the transmitting antenna and the receiving antenna. There are numerous exceptions to this rule, but by and large it is true. Consequently, to take our local situation, a resident in La Canada would not be able to receive the television signals from the Don Lee station above Hollywood. In some urban areas this might be a serious handicap no matter where the transmitter is located. One technical question, does television suffer from static? The answer is: from natural static, no; from man-made static, yes. The most serious source of static in residential areas is the automobile. Automobile ignition systems cause spots and flashes to appear on the screen. The only solution is an extensive use of suppressors and shielding in all automobiles.

Frequency modulation has been presented as a means of providing static-free entertainment of high quality, and indeed there is no question of the technical improvement possible. However, we must again ask, what about the listening habits of the public? The ordinary citizen is accustomed to having his radio sound like a radio. He usually adjusts the tone control to give lots of bass and is delighted with the result. It will take considerable education to persuade him that he wants to listen to a true reproduction of the original music. Furthermore, good quality of reproduced music is difficult to attain without using relatively large loudspeakers and baffles and without considering the acoustics of the radio in the room in which it is to be used. The cheap portable radio will not be able to offer any improvement of quality by the use of frequency modulations; it cannot yet take advantage of the quality of present broadcast music. Another factor with frequency modulation is the fact that these signals also use the very high frequencies. Among other things this means that the effective coverage of a frequency modulation station is only some 30 or 40 miles radius. Over these short distances, reception from standard broadcast stations is normally free from static except in some urban areas where man-made static is very bad or during thunderstorms. The advantage theoretically possible with frequency modulation might not prove so significant in practice.

These facts should be sufficient to indicate that the new types of signal will not supplant the present standard broadcasting. They will provide additional entertainment for those willing to pay the increased cost, and presumably, through the years, will become increasingly important. At the same time these developments will lead to some improvements in existing receivers and transmitters, but nothing startlingly new has yet been revealed.

In the field of communication, one of the more attractive new developments is the "walkie-talkie" of the Armed Forces. Some enthusiasts have jumped to the conclusion that after the war we will all have telephones in our automobiles. This is a very long extrapolation, and one which, although technically possible, is practically impossible. At one time or another we have all seen a little item in the newspaper about the local police radio getting mixed up with signals from Podunk and sending the patrol cars on a fruitless search for the drunk on First Street. Imagine the possibilities for confusion if one million automobiles had radios, and you tried to get a message to the wife about the flat tire that was going to make you late for dinner!

Although it will not be used as universally as the telephone, there are many places where the walkie-talkie will become invaluable. For example, on large construction jobs, in fire fighting, for short range marine service, in forestry service, in railroad service and in highway emergencies it is easy to see the value of such equipment. Doubtless the reader can imagine many other applications.

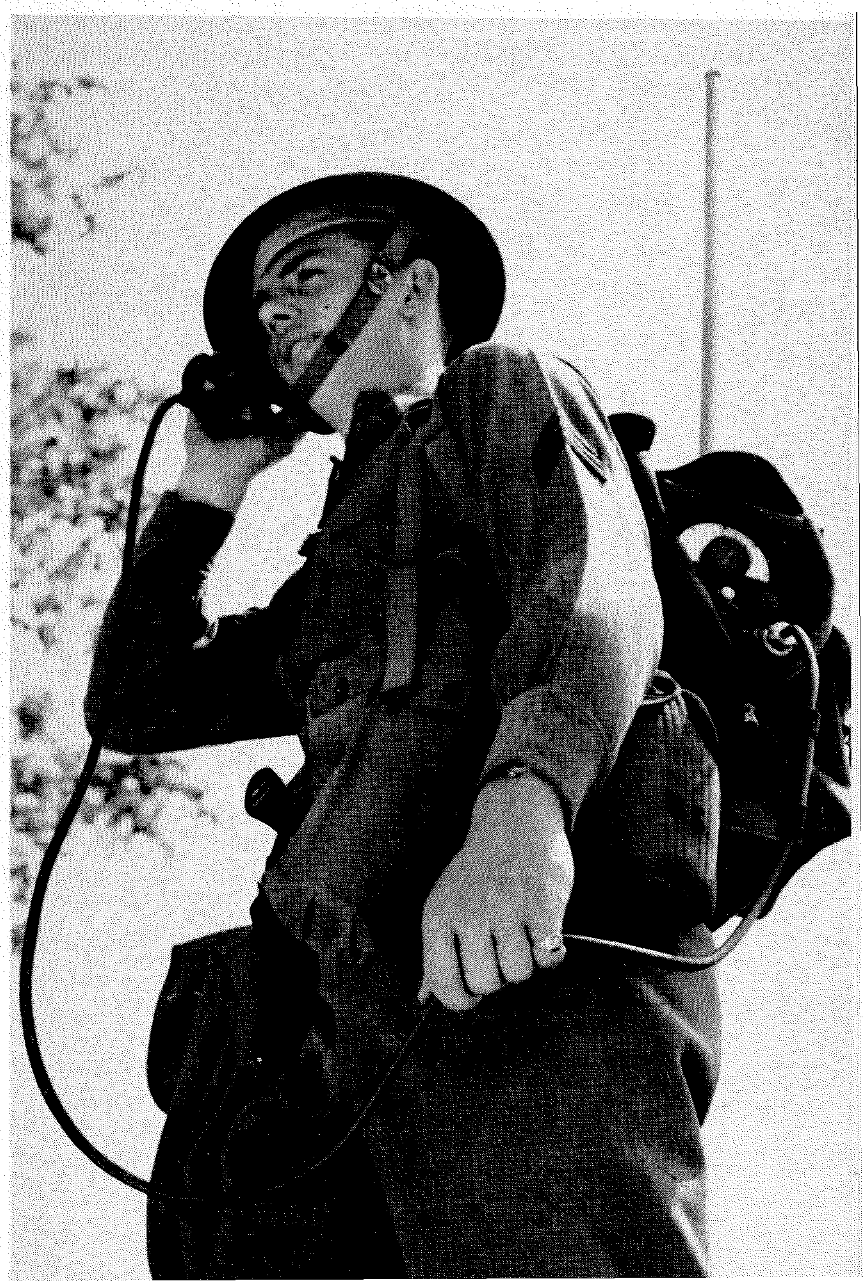
A second development in communication service is the practical production of ultra high frequencies or micro-waves. These are radio waves short enough so that they have many of the properties of light waves, including the useful property that they can be projected in the same manner as a searchlight beam. Accordingly they can be used for short range point-to-point communication with a reasonable degree of secrecy and with low power. Furthermore, a single micro-wave link may carry a very large number of separate telegraph or telephone channels. It would therefore be technically feasible to carry all the communication between two cities on a beam of micro-waves reflected from hill-top to hill-top between cities. The first commercial application of this sort was a telephone service across the English Channel which was set up in 1931. In the postwar period many such services probably will be established.

A wartime development closely allied to the communication field is the detection by radio of distant objects, now known as "radar." Until recently this subject has been surrounded by considerable secrecy in spite of the fact that all the belligerents have some sort of radar equipment. A few months ago, however, a series of articles appearing in the press gave a fairly complete account of what can be accomplished by radar. Basically, the radar equipment sends out a beam of radio waves which strikes the distant object, is reflected back and registered on some receiving equipment. By using a directive antenna system it is possible to obtain the bearing of the object, and by measuring the time taken for the waves to make the round trip, the distance to the object can be calculated. The military uses of this equipment are extensive and the results almost fantastic. In a peaceful world its application also will be most important. Primarily it will be used to aid in the navigation of ships and airplanes through fog and darkness. Particularly in the case of the airplane will it prove a powerful aid to the maintenance of schedules and the safety of travelers.

Industry offers the greatest field for new developments of electronics. These range from the high-power rectifiers and oscillators down through control devices of all kinds to gadgets which measure the vibrations of the smoothest machine, or count the rays emitted by the trace of radium in a piece of granite. Almost any sort of control or measurement problem can be solved by electronic means. In some cases this solution may be a fantastic Rube Goldberg, but in general the electronic solution will be at least as satisfactory as any other, and usually it will have some significant advantages.

Electronic rectifiers for the production of very large amounts of direct current power are now commonplace. Their advantages of quiet operation, ease of control and efficiency, particularly at light loads, are such that probably most new installations in this service will be electronic.

The high-power, high-frequency electronic oscillator is a relative newcomer to industry. These oscillators are used to produce power for two kinds of heating problems, heat treatment of metals where the control must be very accurate or where the heating must be confined to a thin skin, and the heating of non-conductors where heat must be generated uniformly throughout the thickness of the material. The induction furnace has been a useful tool of the metallurgists for many years, but the vacuum tube oscillator has come into the picture because it can provide power at almost any frequency. With rotating machinery, the highest practical frequencies are a few thousand cycles, while the vacuum tube can produce frequencies of millions of cycles per second. Large induction furnaces operating at relatively low frequencies probably will continue to be operated by rotating machinery. Vacuum tube oscillators will be used at high frequencies for special jobs. For example, at frequencies of the order of a megacycle per second, electric currents flow in a metallic skin only a few thousandths of an inch thick. Therefore, an induction furnace operating at this frequency will heat the part to be treated only in the surface layer. Furthermore, the heating will be rapid



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At present the "walkie-talkie," field radio with hand receiver, is used exclusively by the military. Postwar application may be developed for construction jobs, in fire-fighting, railroad service, highway emergencies, to mention only a few of its possible uses.

and accurately controlled. The result is a heat-treating technique which is very precise, yet flexible and adaptable to production processes, particularly with small parts.

An entirely different problem which also is solved with the high frequency oscillator is the problem of heating an insulating material such as plywood. In making large thicknesses of plywood, the problem of heating the wood uniformly in order to bond the sections together is rather difficult. However, if the wood is placed in a high frequency, high voltage electric field, heat will be produced uniformly throughout its thickness and bonding will be completed in much less time than with the usual steam press. Since the heating does not come from outside, there will be a uniform treatment throughout the wood and a more satisfactory product should result. Such "dielectric" heating may be applied to plastics of various sorts, and even, on a mild scale, to the human body. Diathermy machines have proven of considerable value to medicine.

Electronic control and measurement devices are too numerous to attempt to give more than a few general ideas as to their nature. First we might mention the direct control of a current by an electronic switch which is opened and closed automatically at precise instants of time. An example is the control used with resistance welding equipment. Second, the direct control of a motor. Various kinds of devices are available to control the speed and direction of small motors. Third, the use of photoelectric devices to operate relays or other equipment when a light is turned on or off, or two colors are matched. All sorts of counting mechanisms operate photoelectrically. Burglar alarms, smoke alarms are often photoelectric. Fourth, the use of amplifiers to increase a small control-signal up to the point where it can accomplish some desired result. The signal may come from a distant radio station, from a telephone, from the pounding of a fly's footsteps on a microphone, or from any conceivable electrical source. Fifth, electronic means to measure such quantities as time intervals as short as a millionth of a second, dimensional changes as small as a millionth of an inch, or to measure frequency, or count objects at speeds as high as 10,000 per second. Sixth, in a class by itself, the cathode ray oscilloscope, an instrument which can be used to visualize any transient or recurrent electrical phenomena, and which is thus of the utmost value in the analysis of complex electrical circuits. Furthermore, it can be used to great advantage in such diverse applications as the analysis of pressure variations in a gas engine cylinder and the measurement of the speed of rotating machinery, or it can serve as a remote position indicator. In electrical circuits it may be used as voltmeter, ammeter, phasemeter, frequency-meter, and modulation-meter.

As the possibilities of these circuits and gadgets become more widely appreciated, it is reasonable to expect that a great many new applications and devices will appear. When the full story of wartime industrial developments becomes known, it will be found that electronics helped to keep many a production schedule and to break many a production bottleneck.

Among the contributions of the twentieth century to technology, the vacuum tube must surely earn a place near the top of the list. Starting as a scientific curiosity it founded an industry which affected our lives almost as much as the automobile. Now doing its part in winning the war, it will prove useful in peace, not alone in its own field, but as a veritable handmaiden of technology in all its branches.

Nylon

(Continued from Page 8)

made, on an experimental scale, into tire cords, and tests indicate that it is by far the strongest fiber yet found for tire fabrics. In addition it permits the saving of weight and rubber in the manufacture of the tire, and it is particularly suitable where the tire undergoes severe punishment. The strength and adaptability of nylon in various forms—filaments, bristles, "wire" for experimental nylon window screens, sheets and molded plastic articles—indicate that its future should be as brilliant as its past.

One of the most interesting new projects developed in the nylon research laboratory is in connection with the nylon salvage program. This was undertaken because of the urgent need for more nylon for government use. The high-pressure synthesis equipment which makes nylon chemicals from coal, air and water, is already taxed to capacity, and to make additional equipment would require large amounts of strategic metals needed for airplanes, ships and ordnance. The logical alternative was to salvage nylon scrap and make new nylon out of it, and several months ago the Du Pont Company launched such a scrap campaign, offering to buy waste yarn from textile mills and waste dealers. Collection of this material is under government direction.

The waste nylon material is subject to a series of chemical treatments.

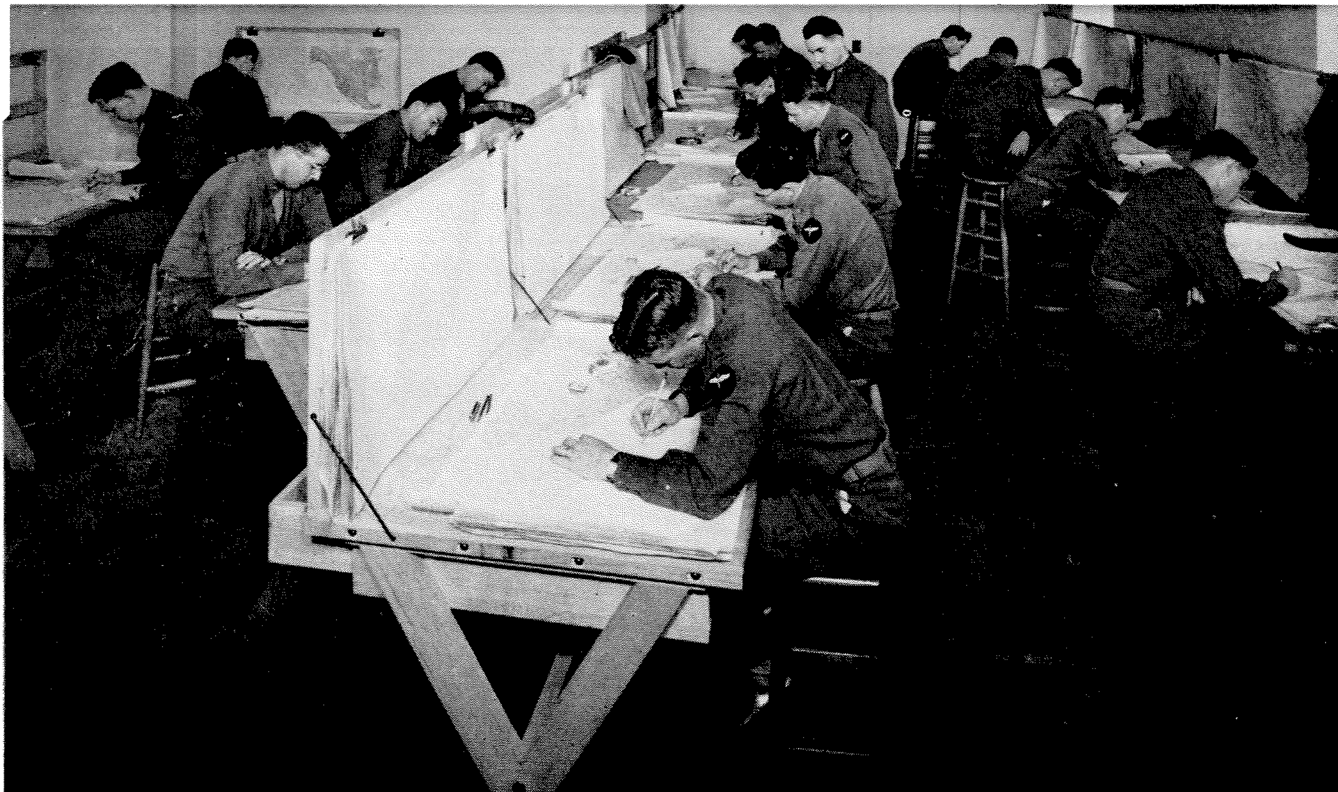
It will be, in effect, chemically "unraveled" until you arrive at the original two starting chemicals from which it was made—adipic acid and hexamethylene diamine.

First step is to boil the nylon scrap in a strong hydrolyzing agent. In the laboratory demonstration this is done in a glass flask, to which is attached a reflux condenser. On a plant scale it is carried out in a lead-lined vessel. By the end of the first hour of boiling the fabric has completely disappeared and the vessel contains only a dark brown solution. A precipitate forms on cooling.

Filtering through a glass fabric separates the precipitate, which contains the adipic acid, from the filtrate, which contains the diamine.

Each of the two components is now purified. The adipic acid, which is a powder and in the unpurified form may be any color depending on the amount of impurities present, is redissolved and recrystallized and is then treated with decolorizing agents. These steps yield a pure final product. The diamine solution is neutralized by addition of lime, which produces a precipitate of calcium sulfate. The mother liquor is drawn off and the water distilled off to leave the diamine. The diamine, which has a higher boiling point than water, is now distilled and it condenses as a colorless liquid, which becomes crystalline on cooling. The "reverse synthesis" of nylon into its chemical components is now complete.

As mentioned previously, the future is expected to find an ever increasing number of uses for this interesting product. For the present, however, all efforts of those concerned with the production and improvement of nylon are centered on making its contribution to the winning of the war as full and complete as possible.



Colleges are Learning from the War

By WILLIAM B. MUNRO*

OUR colleges are learning a good deal from their present war experience. Perhaps one might put it more accurately by saying that they are re-learning things which they were assumed to have learned from previous war emergencies. The older universities and colleges of the United States have had plenty of opportunity to learn what war means to them. At Harvard, for example, the facilities of the university have been taken over by the armed forces on four occasions—in the Revolutionary War, the Civil War, and the two World Wars. Under such conditions the impact of war on higher education becomes an old story.

Universities and colleges are in general rather conservative. They dislike to have their normal routine upset. Even those institutions that call themselves progressive do not make changes very often or very fast. The ordinary course of social or economic progress is likely to find some colleges lagging behind, and even at the onset of war there is an effort to keep on doing business as usual. But of course that can't be done; modifications have to be made at accelerating speed as the months go by. So one of the lessons that the colleges are now learning anew is that war inexorably demands not only a shift of emphasis in the curriculum but great readjustments in the social and athletic activities of the student body.

Members of the faculty are set to the teaching of new courses, or even new subjects—in some cases requiring a considerable display of versatility. Many of them are detached from teaching to handle research projects of military importance or are called into some branch of the public service. Civilian students, those of them that remain, are turned out of the dormitories and dining halls to make room for the boys in uniform. Intercollegiate games—at any rate the great commercialized spectacles—go into eclipse. Students in uniform find little time for social distractions after the heavy schedule of studies, drills, and physical training is finished.

The impact of war on the colleges has been greatly altered by the new methods of conducting warfare. Wars are no longer fought by volunteers, as were all the wars in which the United States participated prior to 1917. An army of eight or 10 million men cannot be raised by voluntary enlistment. Some sort of selective service system is essential to the raising of so large a force, and when drafting begins it cuts deeply into the college enrollments. Yet the public authorities realize that a general exodus of college students into the armed forces would be little short of disastrous in the event of a prolonged conflict. It would exhaust our principal reservoir of material from which a continuing supply of young officer-candidates must be drawn.

One does not need to argue the point that the highly specialized technique of modern warfare has now come to demand, as never before, a measure of training in mathematics and in the natural sciences which is far beyond what the average citizen realizes. There is hardly a single branch of either the military or naval service which does not now require, even on the part of its most junior officers, a considerable degree of proficiency in some one or more of the fields which come within the range of the college curriculum. So the Army and Navy turn to the colleges because these institutions are the

*An address at the 1943 Commencement Dinner of the California Institute Alumni Association.

only ones which have personnel and facilities to give the instruction that is needed. Their action in filling the colleges with uniformed youngsters during the past few months is not, as some people have supposed, a measure designed to save the colleges from bankruptcy. It is a plan of mobilization, not of deferment.

One of the surprises which the colleges are encountering in this connection is the considerable emphasis which both the Army and Navy (the Navy especially) have placed on the desirability of training these young men in the humanities and in the social sciences, as well as in the more specialized fields. The Navy V-12 program, in fact, gives almost as much recognition to the study of literature, history, and economics as has been regularly given in the peacetime curriculum of the California Institute of Technology. The result is that only a relatively slight adaptation of the regular academic program has been required here. Some other institutions have not been so fortunate. In any event the colleges all over the country have learned that they possess considerable resiliency, and on the whole they have made the adjustment to the new conditions with surprisingly little difficulty.

Incidentally they have learned that great advantages to a student body can be derived from a well-organized and all-inclusive program of daily physical training. The Army and Navy are demonstrating to the colleges what physical training really means. It means vigorous exercise for everybody at regular hours every day under skilled supervision. The colleges are also learning from their experience with Army and Navy trainees that healthy young men can live and thrive under more Spartan conditions than civilian undergraduates have been asked to do. Reveille at 6 A.M., when these trainees tumble out of their two-decker beds, seems a far cry from the days (only a few months ago) when students grumbled at having to attend an eight o'clock class. Let us venture a hope that the standards of punctuality and diligence which the colleges are now enabled to maintain may be perpetuated after the war is over. It would be excellent training for the students concerned.

In some quarters fear has been expressed that what is commonly termed "a liberal education" may suffer an enduring setback as a result of this wartime experience, with its strong emphasis on those academic studies which are assumed to have direct military value. And if by a liberal education one means what undergraduate students have been getting at many American colleges in peacetime by taking a conglomerate of miscellaneous, unrelated courses, this fear may have some foundation. But such an education has been "liberal" only in the sense of not being intellectually exacting. If we have less of it after the war the loss will not be irreparable. Meanwhile the emergency is bringing home to thousands of young Americans the value of mathematics and other too-much-neglected studies in the curriculum of liberal arts colleges. Some of us have viewed with misgivings the steady decline in the popularity of mathematics as an elective subject during the pre-war years. This grand old channel of rigid intellectual discipline is now having its renaissance, and the momentum is likely to continue after the emergency is past. When college officials say, as some have done, that liberal education is being adjourned for the war period, they are giving a rather strained interpretation to this term.

Just as statesmen are beginning to think about what problems will arise when the "duration" is past, so educators are wondering about their own transition back to peacetime routine. Will the Washington authorities continue to send young men to the colleges, at the public expense, after the war is over? Already there has been announcement from highly authoritative sources that young men whose education has been interrupted by service in the armed forces will be given an opportunity to complete it, without cost to themselves, after they are demobilized. It has even been seriously proposed that federal funds be appropriated after the war to provide a college education for deserving youth irrespective of their war service and purely as a means of affording equal opportunities to all. That idea will doubtless gain considerable public support, some of it from people who care very little about higher education but merely like to see governmental funds passed out broadly and on a generous scale.

There is danger, of course, that the colleges themselves will look with favor on some such plan of governmental subsidizing. They may feel, some of them, that it would enable them to expand their enrollments and increase their tuition income without any sacrifice of their standards or impairment of their academic independence. But the chances are all against their being able to do anything of the sort. Federal subsidies will mean some degree of control over the way in which the funds are spent—they always do. Such tutelage might be very mild at the outset, but it would not forever remain so. Perhaps a plan can be devised whereby deserving young men and women can be helped through college with federal funds, yet without placing any constraint either upon them or on the colleges which they attend; but it will not be easy to do this. The attitude of the colleges in this matter will be determined to some extent by their present experience in dealing with the Army and Navy authorities. If this proves irksome they will not be very keen to continue anything of the sort in peacetime.

PLASTICS STANDARDS

THE first edition of a new compilation of new standards on plastics has been published containing 71 specifications. More than 20 of the items included in the publication are in the field of electrical insulating materials. Covered also are the following materials; several kinds of molding compounds — phenolic, polystyrene, melamine-formaldehyde, urea-formaldehyde, cellulose acetate, cellulose acetate butyrate; also sheets, rods, etc., of cellulose nitrate, and cast methacrylate; also, vinyl chloride-acetate resin sheets; phenolic laminated sheet and phenolic laminated tubing for rabio applications are covered.

The large number of standard test procedures essential in determining various properties of plastics which are included in the compilation cover the following: arc resistance, resistance to chemical reagents, colorfastness, compressive strength, relative humidity, deformation, distortion, dielectric constant, diffusion of light, flammability, flexural strength, flow temperatures, haze, impact resistance, mar resistance, punching quality, refractive index, surface irregularities, shrinkage, softening point, tensile properties, tear resistance, thermal conductivities, water absorption, etc.

C. I. T. NEWS

Photo courtesy U. S. Signal Corps

MAJOR M. M. BOWER

RETURNS FROM SERVICE IN NORTH AFRICA

MAJOR M. M. BOWER has recently returned to the United States from North Africa. He has visited Casablanca, Rabat, Oran, Algiers, Philippeville and Tebourba. He has been in places which were bombed shortly before he arrived and again shortly after he left, but at no time did he experience any actual action. Following is an excerpt from a recent letter to Harry K. Farrar, '27:

"I was attached to Allied Headquarters in Africa from February to June of this year. Since I was there to assist in the introduction of new types of signal equipment, my duties carried me over the entire area and gave me an unusual opportunity to see everything that was going on during an interesting period.

"I was tremendously impressed by North Africa itself, which is so much like California in its geography, climate, and vegetation that I could have imagined I was 'at home' as far as those factors are concerned. They raise oranges, lemons, grapes, wheat, etc., on as beautiful farms as you could see anywhere. A trip from San Diego to L. A. and then to San Bernardino, Needles, Phoenix, and Albuquerque would offer countless opportunities to take pictures of scenes which have their counterpart in North Africa. The length of the trip would be of interest in this regard too, because it was over a thousand miles from Casablanca to the front in Tunisia. I find that few people here have any conception of the distances we were wrestling with in a battle which seems such a small part of a global war.

"I traveled both ways by boat and the Navy took such good care of me that both trips were entirely without incident as far as I was concerned. We did have to run a heavy gantlet of submarines both ways, and did seem to be crossing at two relative peaks in submarine activity, but that was the captain's worry and not mine, luckily."

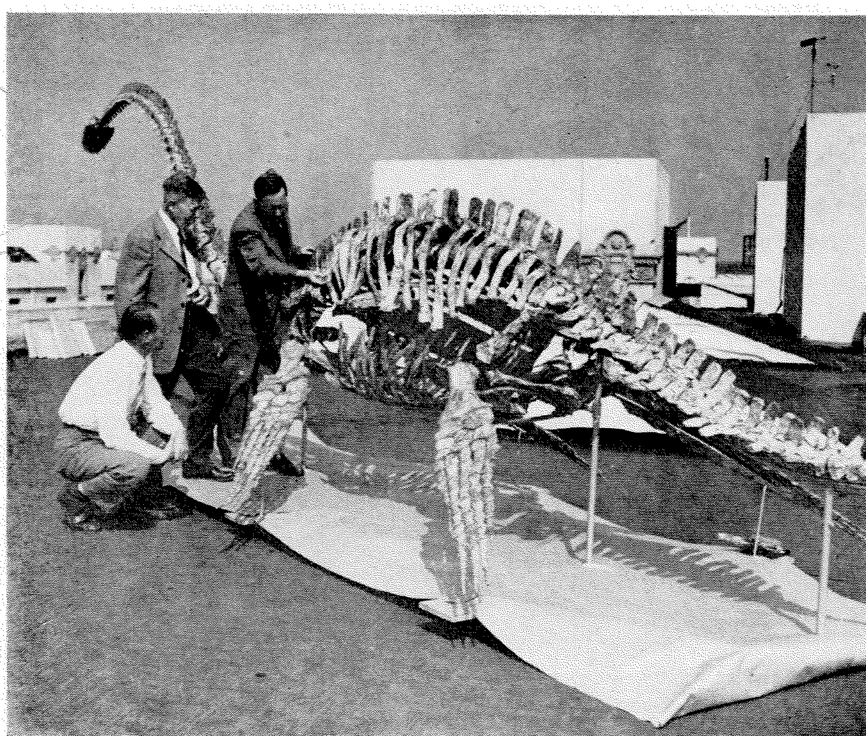
ARMY AND NAVY GRADUATION

A TOTAL of 154 Naval Reserve Officers, detailed to Caltech for special courses in aeronautical engineering and aerology, were graduated in ceremonies held at Tournament Park on Saturday, September 4. Before the graduation, the officers were inspected by Rear Admiral Ernest L. Gunther, U. S. N. 11th Naval District Air Officer, Dr. Robert A. Millikan, and James R. Page, president of Caltech's board of trustees. The program included a report on the Naval Training School by the officers in charge, and addresses by Admiral Gunther and Dr. Millikan.

In afternoon ceremonies of the same day 180 United States Army Air Corps cadets received certificates of master of science degrees in meteorology from Dr. Robert A. Millikan. Dr. William B. Munro told of the value of history in being able to get the true value of current happenings. Dr. Millikan spoke on postwar responsibilities of the graduates. After receiving their commissions, the cadets received orders assigning them to their posts as weather observers.

AT RIGHT:

Inspection of graduates before ceremonies at Tournament Park, Pasadena, on Saturday, September 4, 1943.



AT LEFT:

Dr. Chester Stock and his associates, E. L. Furlong, curator, and Wm. Otto, sculptor, complete the mounting of *Morenosaurus stocki,* marine reptile 30 feet long whose skeleton is one of the very few which are complete enough for an open mount.

NEWLY DISCOVERED PLESIOSAUR

By CHESTER STOCK*

FULFILLING the cartoonist's dream of what paleontologists can reconstruct from fossil bones is this huge extinct sea serpent, discovered by members of the Division of the Geological Sciences. The specimen was uncovered by California Institute field parties in the organic shales of the Moreno formation, exposed along the flanks of the middle Coast Ranges in western Fresno County, California. Coming from the Cretaceous or the last period in the great Age of Reptiles, it is about 100 million years old.

This animal, whose scientific name is *Morenosaurus stocki,* is a marine reptile 30 feet long, with heavy body, extremely long neck, very short tail, small skull, minute brain, and four large paddles. The latter were powerful propelling organs in water, the animal using them as oars. The skull has a vicious battery of long, slender, sharp teeth for catching slippery prey like fish. Found with the skeleton was a nest of highly polished pebbles that are unquestionably gastroliths or gizzard stones. These aided the digestion of hard foods like fish skeletons.

More than a year was required in the preparation and mounting of the specimen by curator E. L. Furlong and sculptor Wm. Otto of the Division staff. The skeleton was assembled on the roof of the Mudd Geology Building for photographing, and our readers may recall that an illustration of the specimen was the picture of the week in a recent issue of Life Magazine.

Plesiosaurs are known the world over. However, those with very long necks have been discovered in California and Colorado. The Institute specimen is one of very few that are complete enough to prepare as an open mount.

Occurring in the same geological formation with the plesiosaur are other great extinct reptiles, like duckbill dinosaurs and sea lizards or mosasaurs. Never before have these been found west of the Rocky Mountains. In the popular mind the plesiosaurs are perhaps remembered best by Disney's animated restorations shown in his film Fantasia. The extinction of the plesiosaurs came at the close of the reptilian age, when the dinosaurs became extinct on the land. Probably their disappearance in the seas of that day was hastened by the coming of more intelligent animals like the ancient whales.

*For biographical note see September, 1943, issue of ENGINEERING AND SCIENCE.

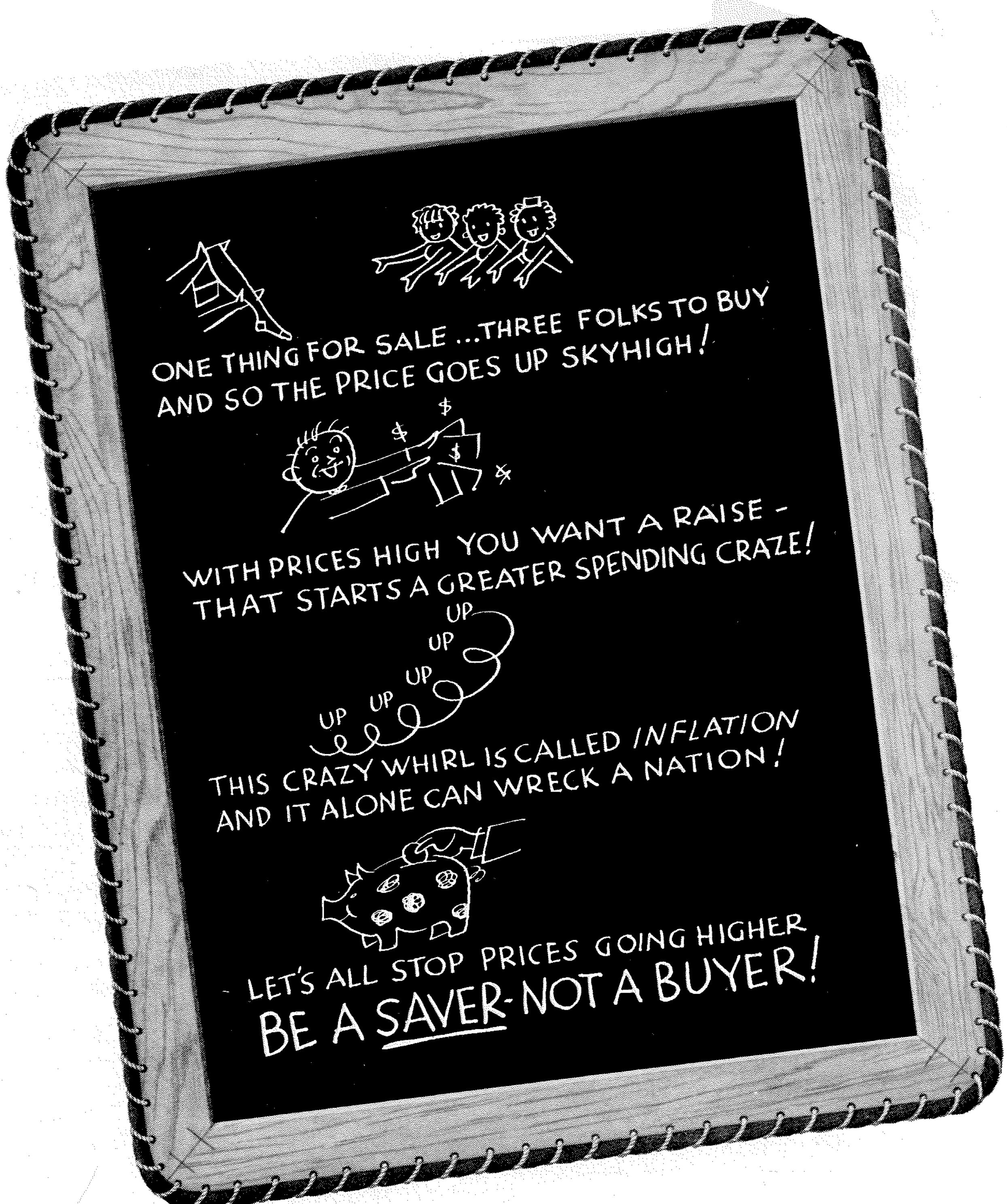
NEW YORK CHAPTER DINNER

AN INFORMAL alumni dinner was arranged for September 7, 1943, upon short notice at the Hotel Holley, on Washington Square, New York City. Arrangements were made by Harry P. St. Clair and Clifford C. Burton, President and Secretary-Treasurer, respectively, of the New York Chapter.

The immediate occasion for the gathering was the presence in New York of three members of the faculty: L. Winchester Jones, associate dean of upper classmen and registrar, R. E. Untereiner, associate professor of economics, on leave during the current year to serve as economic adviser for the National Association of Manufacturers, and Franklin Thomas, professor of civil engineering. Professors Jones and Thomas were attending a conference at Columbia University called by the Navy and attended by representatives of colleges in which Naval V-12 training programs are in operation.

The following alumni were in attendance:

W. G. Abraham	'41	C. R. Keith	'22
Paul R. Ames	'22	George S. Lufkin	'29
C. C. Burton	'40	J. R. Pierce	'33
C. F. Carlson	'30	R. K. Pond	'39
N. O. Cox	'40	Harry P. St. Clair	'20
W. G. Cox	'35	R. M. Watson	'27
Sydney K. Gold	'42	W. H. Wise	'26



Seven things you should do:

1. Buy only what you really need	2. Pay no more than ceiling prices... buy rationed goods only with stamps	3. Pay off old debts and avoid making new ones	4. Support higher taxes ...pay them willingly	5. Provide for the future with adequate life insurance and savings	6. Don't ask more money for goods you sell or work you do	7. Buy all the War Bonds you can afford – and keep them

Keep prices down... use it up, wear it out, make it do, or do without

This advertisement, prepared by the War Advertising Council, is contributed by this magazine in cooperation with the Magazine Publishers of America.

Rear Adm. Ralston S. Holmes, USN, (ret.), is shown being presented with the Medal of Group America by General de Division Juan Felipe Rico, commander of Mexico's Second Military Zone. Admiral Holmes now serves as the Navy Department Liaison Officer with the National Defense Research Committee at California Institute of Technology. On the extreme right is Capitan Manuel Fontes, aide to General Rico.

GIVEN GROUP AMERICA MEDAL

REAR Admiral Ralston S. Holmes, U.S.N. (ret.), former commandant of the 11th Naval District, and now serving as Navy Department liaison officer with the National Research Committee at the California Institute of Technology, has been awarded the Medal of Group America. This medal was awarded for "devotion to this country and the benefits of the Americas" by General de Division Juan Felipe Rico, commander of Mexico's second military zone.

In accepting the medal, Admiral Holmes described Group America as an organization "which stands for the unity, friendship, and comradeship which are so vital in these times." The organization was originally formed in South America and now has members in every country of this continent.

The presentation was made at military headquarters in Ensenada with Mexican troops and representatives of the U. S. Army and Navy attending.

PITZER RECEIVES AWARD

Dr. Kenneth S. Pitzer, graduate of the California Institute of Technology and now professor in chemistry at the University of California, received the $1000 American Chemical Society Award in Pure Chemistry at the Society's 106th meeting in Pittsburgh in September. Dr. Pitzer, picked as one of the most brilliant young chemists in North America, was cited for his work in chemical thermodynamics.

"The importance and high quality of the many contributions to our science already made by this young man justify the confident prediction that he will be one of the leaders in American chemistry during the coming decades," said a Society statement summarizing Dr. Pitzer's achievements.

Dr. Pitzer received his B.S. degree from Caltech in 1935 and his Ph.D. degree from the University of California in 1937. His researches, published in more than 40 papers, include studies of some of the fundamental facts of the structure of chemical molecules and their reactions, and basic facts of chemical reactions in solutions. Like most chemists, Dr. Pitzer is now busy with problems connected with the war.

The American Chemical Society Prize, provided by Alpha Chi Sigma, national scientific fraternity, was founded in 1931 by the late A. G. Langnuir to encourage fundamental research by young chemists working in North America.

ON SIGNAL ROUND TABLE

EVERY Sunday afternoon at 4:30 p.m., Columbia arranges time for a trio of news experts to gather at the "Signal Round Table" and discuss the three most pertinent topics of the day. The three gentlemen are Harry W. Flannery, John B. Hughes, and Dr. Wallace Sterling, professor of modern history at the California Institute of Technology.

DR. WALLACE STERLING

Dr. Sterling, who had gained a large listening audience before joining the Round Table show by virtue of his own ten o'clock news analysis program, has expanded that same audience with his continued crisp and generally correct comments on news of the day. When the talk gets round to Russia, Sterling's words carry even more weight, for he has been a student of that country and its people for several years. He has written scores of magazine articles on Russia and her policies, and has been co-editor of a number of books on the same subject.

The show is completely unrehearsed, and Sterling's authoritative and easy flow of conversation on almost any subject relative to the war today has made him an exceedingly valued member. He has lived in this country since 1930, but he is a native of Canada.

Petroleum

(Continued from Page 2)

tinued his education at California Institute of Technology. He became an American citizen in 1928. Since 1931 he has been a member of the staff of the Research and Development Division of General Laboratories of Socony-Vacuum Oil Company in Paulsboro, where he is general supervisor of the Development Section. He is the inventor of processes in petroleum refining and has written several books on petroleum technology.

Social Security

(Continued from Page 10)

between investment and savings. To provide a constant balance in the flow of investment, public funds and management, we are told, must take up the recurring slacks of private investment. To one not yet fully adjusted to the great state nor completely confident in its beneficence and competence, this proposal for so great and so sudden an extension of its power seems both perilous and ultimately illusory. The provision of a floor of social security may, we may well believe, ease the impact of trade depression, but if it needs such props as only so large a transformation of our economic structure can give, then, it may be argued, we had better pause for fuller consideration. It is, however, open to question whether Sir William has not raised a needless stumbling block in making his social security plan dependent on attempts by government officials to apply an inadequately proved formula for control of the whole economic system.

In fact, despite all studies thus far made by economists and statisticians, we are a long way yet from a comprehension of the complex causes of these successive swings, both short and long, in the modern industrial and credit economies. Some of the results may be appraised and measured; it is more difficult to isolate and weigh the causes, social and psychological as well as economic. Speculations about "marginal propensities to consume" and the like may lead only to seductive fallacies. We cannot yet scientifically assess man's propensity to optimism, or the effect of mass suggestion in cumulative spasms of hope and fear. Lord Keynes, in his most recent book, stresses the inherent stability of our existing economic system. It oscillates about a middle position, "avoiding the gravest extremes of fluctuation in employment and in prices in both directions." He says that "full, or even approximately full employmen is of rare and short-lived occurrence." It is permissible, therefore, to suggest that, before adopting any wide extension of social security, we wait until the elasticities of our richly productive economy become less tensely stretched, and our enterprise less weighted with restrictionism. In time, without pursuing the mirage of "full employment," we shall be able to take an additional measure of social security in our stride.

Security is a natural and necessary aim for the individual and for the nation, but, as experience has shown, like all good things, it may be sought too exclusively and thereby become self-defeating. The limiting rule of social insurance, "the floor and nothing more," applies also to security in the wide sense. It is indispensable as a necessary environment and starting point, but only so far as to make possible daring initiative and risk-taking. Aggression, not merely in warfare, is ordinarily the best defense. The principles of true liberalism, more deeply and understandingly applied, are still potent. The individual's welfare is still the yardstick, but an individual more aware of his social responsibilities. Competition remains an effective spur to progress, but experience has shown that there are areas that it does not automatically serve, such as those public services where there can be no adequate reward, or where a single regulated supplier can give more general satisfaction with greater economy. And the lesson has been emphasized that the unbridled pursuit of gain may lead to unbalanced power or other socially noxious consequences. But the point has not yet been reached where the flow of energy and initiative is so limited that the government must build and guard a whole system of dams and reservoirs. The mighty stream needs only embankments and occasional catch basins to guide its flow into socially productive channels.

Our civilization has not exhausted its possibilities for free enterprise and the spirit of adventure. The frontier has not vanished, least of all for the sciences, pure and applied.

WINS A.I.E.E. PRIZE

DR. G. D. McCANN has been awarded the American Institute of Electrical Engineers' 1942 national best paper prize in theory and research as co-author of the paper, "Shielding of Substations."

DR. G. D. McCANN

Dr. McCann received his bachelor of science degree from California Institute of Technology in 1934, his master of science degree in 1935, and his doctor of philosophy degree in 1939. He is now employed as transmission engineer at Westinghouse Electric and Manufacturing Company, East Pittsburgh, Penn.

ALUMNI NEWS

1921

LAWRENCE F. CHANDLER died early in June. He had been with the Glendale school system for several years, teaching science in the high school.

MAJOR SMITH LEE is located in the Los Angeles area, having been transferred from duties at Camp Callan.

ROBERT J. HARE has returned to work at the Southern California Telephone Company, after having undergone an operation recently.

1922

E. T. GROAT and Mrs. Groat are parents of a second daughter, Mary Frances, born in October of last year. Their older son, Leonard, is in the Navy V-12 College Training Program at the University of Wisconsin.

LINNE C. LARSON has been on active duty since July 20, 1942, in the Corps of Engineers, United States Army, assigned to the District Engineer, U. S. Engineer Office in Los Angeles, as camouflage officer in charge of all camouflage accomplished by the Los Angeles Engineer District.

1925

LIEUTENANT THOMAS M. HOTCHKISS is with the U. S. Naval Reserve, attached temporarily to Harbor Defense School, San Pedro, California.

1926

DAN G. DINSMORE is secretary-treasurer of McColpin-Christie Corporation, manufacturers of battery chargers, electrical rectifiers, and electrical water testing devices.

DIMITRI MELNIKOV visited the campus in September after having worked under a Navy contract in Puerto Rico for the past 13 months.

1927

MAJOR JOHN H. MAXSON, of the Army Air Forces, visited the Institute in August. He has a second daughter, nine months old, born in Harrisburg, Pennsylvania. Major Maxson recently addressed a section of the National Research Council on the work of geologists in the Intelligence Branch of the A. A. F.

CHAPLAIN (LIEUTENANT COLONEL) VERNON P. JAEGER was selected by the Army to attend the Command and General Staff School, Fort Leavenworth, Kansas, during the months of September, October, and November. This is considered a special privilege for any Army officer, but especially for a chaplain.

VAINO A. HOOVER is now engaged as the president and chief engineer of the Electrical Engineering and Manufacturing Corporation in Los Angeles, a firm building D.C. and A.C. motors and generators for aircraft, shipboard, and Army Signal Corps use. Many interesting applications on multiple gear turrets, radar generators, and submersible bilge pumps have been developed.

C. HEWITT DIX is vice-president of the United Geophysical Company in Pasadena. Prior to this position he had been a chief seismologist and a geophysicist in New York, Venezuela, and Texas.

M. M. BOWER, a major in the Signal Corps, recently arrived in the United States after having been in Africa.

1930

FRANCIS D. BODE is on leave of absence from his position of assistant professor of geology at Caltech, to assist the Texas Company search for petroleum. He works under the supervision of Dr. Hampton Smith, '28, who is chief geologist for the Texas Company in California.

WILLIAM B. HATCH, JR., is field engineer for Twentynine Palms Air Academy, an Army Air Corps primary training school.

1931

BENJAMIN HOLZMAN is a major in the Army Air Forces with his headquarters in Washington, D. C.

LUCAS A. ALDEN is employed by the War Production Board in Washington. He is now in the hospital from a broken leg received when a plane he was entering was picked up and destroyed by a violent squall passing over the field where the plane was parked.

1932

W. L. KENT is with Union Oil Company at Wilmington, California, as research chemist. He was formerly with General Chemical Company at El Segundo and Marcus Hook, Pennsylvania.

1933

DR. MAURICE DONNELLY and Mrs. Donnelly are the parents of a daughter born April 14 in Riverside, California.

BOB FLETCHER is now supervising forecaster with the United States Weather Bureau District Forecast Center, Burbank, California. He is also a research associate on the Physics-Meteorology staff at U. C. L. A. He recently completed an interesting flight around the country and met several Tech friends while on the tour. The Fletchers are parents of two sons, Bob, Jr., six, and Johnny, one.

GREGORY K. HARTMANN, a Rhodes Scholar, is now a civilian employee of the Navy Bureau of Ordnance in Washington.

FERD STRAUSS is industrial control engineer for the G. E. Aviation Equipment office in San Francisco.

1934

ANATOL A. FOMILYANT was married to Virginia Henger of San Marino, California, on May 24 at Santa Barbara. They are living in Long Beach and he is employed as service engineer at Merco Nordstrom Valve Company in Los Angeles.

GLEN WOODWARD is the father of a daughter, Susan Helen, born September 5, 1943.

1935

Mr. and Mrs. LIND DAVENPORT are the parents of a daughter, Doreen Marie, born June 11. Their first child is Roy, now 20 months old. Lind has been chief engineer for the Air Conditioning Company of Southern California since December, 1941.

HOWARD P. GLUCKMAN is now plant engineer with the American Screw Products in Los Angeles.

WALLACE J. S. JOHNSON is assistant general manager of the Pomona Pump Company.

CLYDE CHIVENS is the father of a son, Don, born May 31.

1936

Mr. and Mrs. T. E. BROWNE, JR., are parents of a third son, Charles Edwin, who was born May 20.

WILSON H. BUCKNELL is chief electrical engineer at O'Keefe and Merritt Company, now producing engine-driven generators for the Army Signal Corps, Ordnance Department, and for the Navy. Mr. and Mrs. Bucknell are parents of their first son, who was born in February.

MERAL W. HINSHAW is assistant general manager and works manager of the Felker Manufacturing Company in Torrance, California, manufacturers of diamond abrasive tools. The Hinshaws have two daughters, two and four years old.

ROBERT L. JERAULD is general sales manager of Felker Manufacturing Company. He has a three-year-old son and a seven-months-old daughter.

CHARLES A. MORSE and Jane Addams Linn, an ensign in the Waves, were married at Kansas City, Missouri, on August 6.

ROBERT P. DILWORTH, who has been instructor in mathematics at Yale, is now teaching mathematics at Caltech.

1938

LIEUTENANT A. F. DuFRESNE is stationed somewhere in England with the Signal Corps.

JACK JOHANNESSEN is now superintendent of generation of the Imperial Irrigation District.

Mr. and Mrs. PAUL A. DENNIS are the parents of a son, John Eric Dennis, who was born August 11.

1939

HERBERT STRONG has been employed at Ingersoll Rand Company in New York, but is now in the A. V. S. EN program at Caltech.

CAPTAIN PAUL ENGELDER and Miss Alice Coolidge of Long Beach, California, were married at Camp Murphy, West Palm Beach, Florida, on Saturday, August 7. He held a commission in the U. S. Marine Reserves when he was called to active duty early in 1941.

W. A. DIEHM is field service engineer for General Electric Aviation Equipment being used in the bay area.

1940

FORREST H. HALL is the father of a daughter, Janet Kylene, born August 16. For the past two years he has been in ship work, being employed at the present as hull technician of the Marinship Corporation in Sausalito, California. When this yard was started a little over a year ago he was sent up from the California Shiphuilding Corporation in Wilmington, California, to be in charge of all design in connection with launching and supporting the ship while under construction on the building ways. He personally performed all of the launching calculations.

SHERWIN AVANN is instructor in mathematics at Yale, replacing Robert P. Dilworth.

CYNDOR BIDDISON is a civilian with the camouflage branch of the Engineering Board at Ft. Belvoir, Virginia.

1941

WILLIS E. DOBBINS is a first lieutenant in the Signal Corps and is stationed in England, where he is in charge of a mobile installation crew connected with the air force.

OLIVER K. JONES is a major with the U. S. Army Air Corps and is stationed overseas, where he has been assigned to duty as a weather officer.

1942

VICTOR BRUCE is employed as a staff member at the M. I. T. Radiation Laboratory. Other members of the Class of 1942 who are working there are WARREN PROCTOR, FRED ASHBROOK, JACK IRVING, and DWAIN BOWEN.

LIEUTENANT FRANK FLECK visited the campus in September. He is stationed at San Marcos, Texas.

AL LANDAU is attending Ordnance Officer Candidate School at the Aberdeen Proving Grounds.

CAROL VERONDA is with General Electric at Bridgeport, Connecticut.

CARL SAVIT is employed as teaching fellow in the mathematics department at Caltech.

1943

ROBERT BRAGG and JAMES BLAYNEY are in Army Air Corps Special Training and are stationed at Boca Raton, Florida.

BOB BASHOR is on the U. S. S. Prairie State at New York City.

BILL FAIR is with Sperry Gyroscope, Garden City, New York.

LeROY WELLER, who is with Ingersoll Rand in New York City, visited the campus early in September.

JOHN MILES and Herberta Blight were married on June 19. He is employed as instructor at the Institute.

SHELTON STEINLE is with the Shell Development Laboratory in Berkeley. He visited the campus recently.

RAY TEDRICK is with Pan American Airways System in San Francisco. He recently visited the campus.

ROLFE LaFORGE is a statistician on a war project at the Institute.

ROBERT BENTON is employed as a teaching fellow in the mathematics department at the Institute.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

of ENGINEERING AND SCIENCE MONTHLY, California Institute of Technology, published monthly at Pasadena, California, for October, 1943.
State of California,
County of Los Angeles, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared the editor of the ENGINEERING AND SCIENCE MONTHLY, California Institute of Technology, DONALD S. CLARK, who having been duly sworn according to law, deposes and says that he is the editor of the ENGINEERING AND SCIENCE MONTHLY, California Institute of Technology, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation) etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Alumni Association, Inc., 1201 E. California St., Pasadena, California; Editor, Donald S. Clark, 1201 E. California St., Pasadena, California; Managing Editor, R. C. Colling, 124 West Fourth St., Los Angeles, Califirnia; Business Management, Colling Publishing Co., 124 West Fourth St., Los Angeles, California.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Alumni Association, Inc., California Institute of Technology, 1201 East California St., Pasadena, California; no stock, a non-profit corporation.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is . . . . (This information is required from daily publications only.)

DONALD S. CLARK, Editor.

Sworn to and subscribed before me this 7th day of October, 1943.
(Seal) Ida A. Ritchie.

(My commission expires April 8, 1945.)

OCTOBER ISSUE

The October issue of E. S. M. was not published due to problems connected with the editorial and production schedule in starting the new publication. These difficulties have now been taken care of and the December issue will come from the press on December 5.

ANOTHER LESSON FROM HISTORY

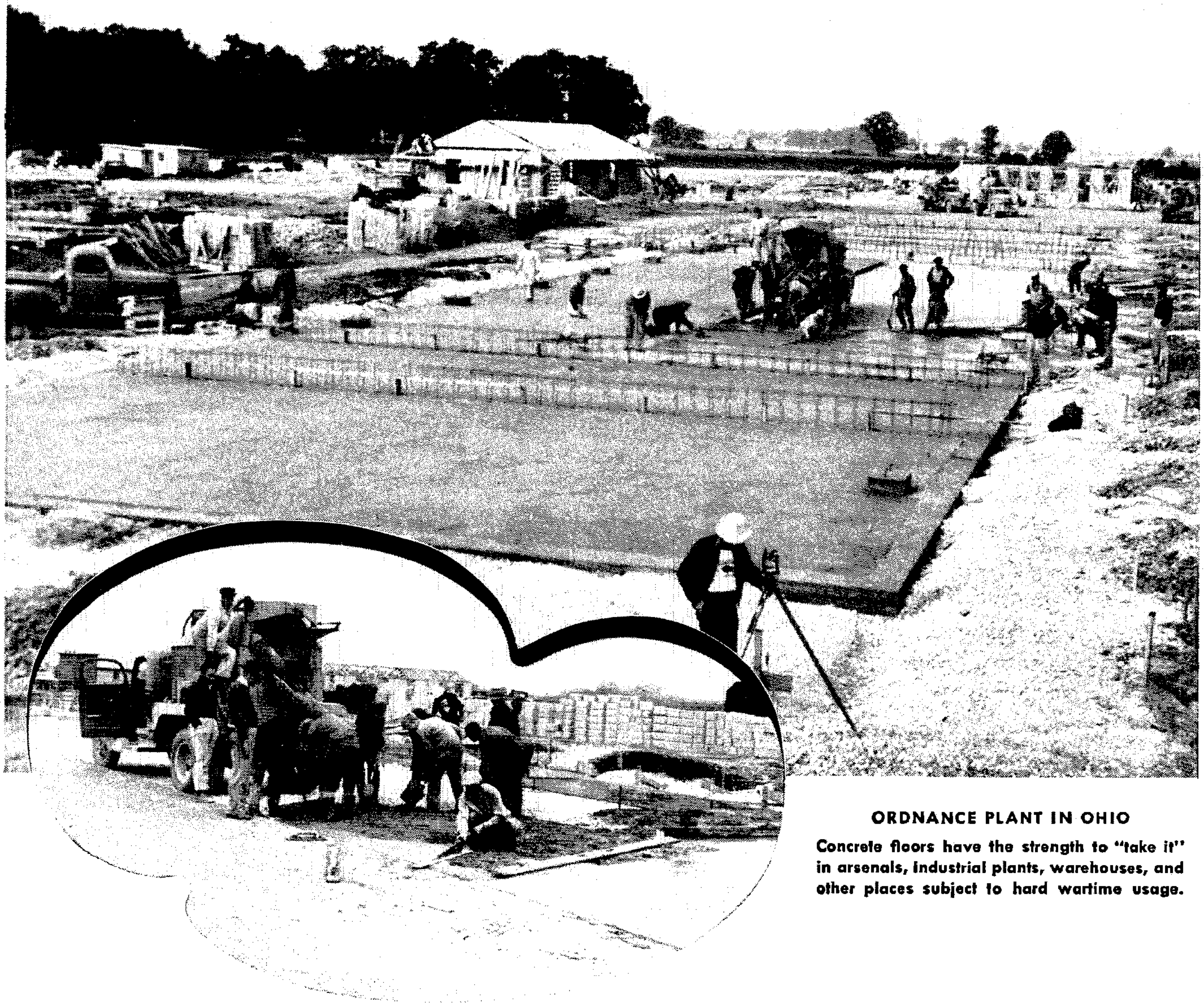
(Continued from Page 4)

ment been more strikingly or more beneficently applied."

Now, having listened to the spirit of Montesquieu supported by the teachings of history, let me try to apply the foregoing to the critical problems of the ensuing peace.

For the sake of winning the war, as we are going to do, we have had to become very largely, for the time being, a totalitarian state. We knew that in war this was inevitable, but if we retain in peace this now highly centralized totalitarian government, if we do not combat at every opportunity this insidious, this terrible centralizing tendency, and restore, insofar as present conditions make possible, the principle of local self government, then if history means anything we shall quickly be destroyed by the inner vice of all totalitarian states, a governmental patronage system, instead of a government of laws, and our sons will have died in vain.

The greatest and most insidious danger lies in my own field, the field of education, which must be kept practically completely free from the influence of the central government. Look at what within the last two decades the control of education by central governments has done in Europe! It has substituted for education the *indoctrination* of whole peoples in the ideologies of the group in power and in the interests of their retention of that power. It is that kind of indoctrination for world conquest that has destroyed the souls of great peoples and made two world wars. Your votes alone, and your influence, American citizens, can prevent that kind of a catastrophe from happening in the United States. Remember this when you come back from the victory.



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Please send me free information sheets checked:

☐ *"Concrete Floors on Ground,"* covering subgrade, slab design, jointing, placement, finishing, curing.

☐ *"White Cement Floors,"* giving construction data.

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