Spring 5-1945

Volume 55 - Issue 10 - May, 1945

Rose Technic Staff
Rose-Hulman Institute of Technology

ROSE TECHNIC

MAY, 1945

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Rose Polytechnic Institute has made special plans for the returning veteran. Former students may enter at any time, audit courses for the balance of the term then in progress, and begin regular work at the opening of the next term. New students should enter at the beginning of one of the four 12-week terms scheduled to commence in January, April, July and October. Academic credit will be granted for educational experiences in the armed forces, provided these are equivalent to college courses. For special circular, address the Registrar.

ROSE POLYTECHNIC INSTITUTE

TERRE HAUTE, INDIANA

THE ROSE TECHNIC

VOLUME LV, NO. 10 MAY, 1945

IN THIS ISSUE

STAFF

MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Advertising Representative, Littell-Murray-Burnhill, Inc.
101 Park Avenue, New York

Printed by Moore-Langen Printing and Publishing Co.
140 North Sixth Street, Terre Haute, Ind.

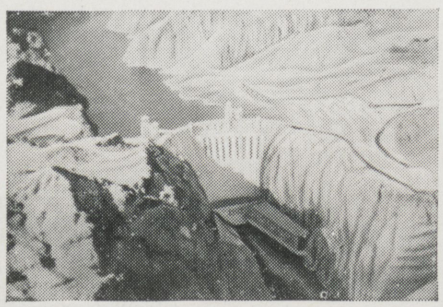
Published Monthly except June and July by the Students and Alumni of Rose Polytechnic Institute. This publishing schedule is subject to change due to war conditions. Subscription $2.00 per 8 issues. Address all communications to the Rose Technic, Rose Polytechnic Institute, Terre Haute, Indiana. Entered in the Post-office at Terre Haute as second-class matter, as a monthly during the school year, under the act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized December 13, 1918. This magazine is not responsible for the opinions expressed by the authors.

COMING YOUR WAY

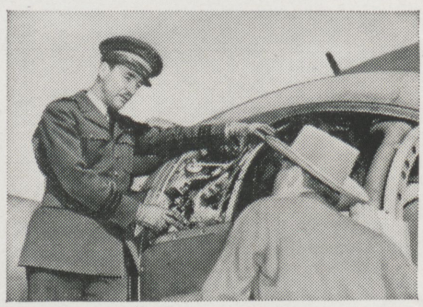
A New Kind of Horsepower is Changing Your World

This is the story of what is likely the biggest thing that has happened in our time . . . of a new kind of power spreading throughout the world . . . of a new force affecting our lives, our outlooks, and our incomes as perhaps only electricity has done since the turn of the century.

1. Under the wing of a giant Lockheed Constellation, in the shadow of one of the big ship's four Wright Cyclones, two men talk. One is a veteran airline pilot who lives and works in a world most people haven't yet begun to know or understand or even to imagine! The other, a man who has seen a whole vast western section of America change in his lifetime as if by magic!



2. The Westerner operates a ranch that was literally made possible by power — electricity and irrigation from the great Boulder Dam harnessing the Colorado River. Power which made possible the conversion of millions of acres of barren wilderness into fertile ranches and farms!



3. No wonder he's eager to hear the pilot tell of a new super-power — such as that of the Wright Cyclone . . . the engine which speeds the great Boeing B-29 Superfortress across the air miles to Tokyo . . . power that makes possible a trans-Atlantic flight every 13 minutes.

4. Most efficient power plant in the world, today's Wright Cyclone packs a horsepower into less than a pound of metal. Four Cyclones develop more power than the mightiest locomotive operating in the Rocky Mountains . . . and already this new power is changing ranches and farms, business and homes . . .

5. These Cyclones help make possible the operation of U. S. transport planes over more than 110,000 miles of global air routes. For example, 1,800 cargo shipments daily leave a single U. S. airport, and millions of miles are daily flown by U. S. airlines and the Air Commands of our armed services.

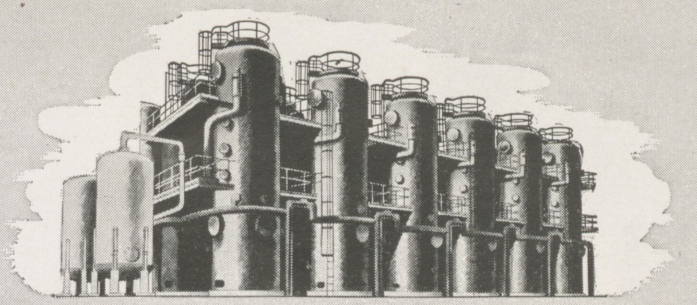
6. Carrying our men, materials, ideals to the corners of the earth — breaking down barriers of distance — the Cyclone power of American aviation is changing the world you live in...right over your head!

LOOK TO THE SKY, AMERICA!

CURTISS WRIGHT

AIRPLANES • ENGINES • PROPELLERS

[AVIATION OFFERS A BRIGHT FUTURE FOR COLLEGE ENGINEERS: WRITE ENGINEERING PERSONNEL BUREAU, CURTISS-WRIGHT CORPORATION, PASSAIC, N. J.]

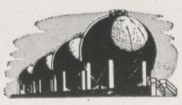


UNION CARBIDE *AGAIN* REPORTS

on the production of

BUTADIENE

for the Government's Synthetic Rubber Program



ONE OF THE MOST IMPORTANT factors in the Government's rubber program is the production of GR-S type synthetic rubber.

The basic chemical in this rubber is Butadiene, which can be made from alcohol or hydrocarbon materials.

The Government's original plan provided that about one third of the required Butadiene would be made by CARBIDE AND CARBON CHEMICALS CORPORATION'S alcohol process.

In 1943, their first year of operation, however, the plants using this process produced over 75 per cent of all Butadiene made for GR-S type synthetic rubber.

In 1944, the second year, these plants produced about 64 per cent of all Butadiene necessary for military and essential civilian rubber. This was true despite the fact that good progress had been made in the production of Butadiene by other processes.

THE RECORD

The first tank-car load of Butadiene was shipped from the Government's Carbide-built, Carbide-operated plant at Institute, West Virginia a little over two years ago.

This was just five months after the famous Baruch Committee Report pointed out this nation's desperate need for rubber—and approved Carbide's butadiene alcohol process, originally selected by Rubber Reserve Company, as one of the solutions.

In its first year the Institute plant, with a rated capacity of 80,000 tons per year, produced enough Butadiene for more than 90,000 long tons of synthetic rubber.

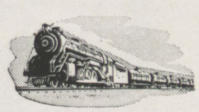
Two more great plants using Carbide's alcohol process—and built from the blueprints of the Institute plant—are in full production. One of these, with an annual rated capacity of 80,000 tons of Butadiene is located at Kobuta, Pennsylvania and is operated for the Government by another important chemical company.

The second, with a rated capacity of 60,000 tons a year, is operated for the Government by Carbide at Louisville, Kentucky—making the total rated capacity of the two huge plants now operated by Carbide 140,000 tons a year.

In 1944, the production of Butadiene from the three plants using the alcohol process totaled 361,000 tons—representing operation at over 164 per cent of rated capacity. An even higher rate is expected in 1945.

* * * * *

Before Pearl Harbor, the United States was a "have not" nation with respect to rubber. Now, thanks to American research, engineering and production skill, our country can take its place as a dominant factor among the great rubber producing nations of the world.



▼

Business men, technicians, teachers, and others are invited to send for the book P5 "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol," which explains what these plants do, and what their place is in the Government's rubber program.

SEPTEMBER 10, 1942

"Of all the critical and strategic materials, rubber is the one which presents the greatest threat to the safety of our nation, and to the Allied Cause.... We find the situation to be so dangerous that unless corrective measures are taken immediately the country will face both a military and a civilian collapse."

—Report of the Rubber Survey Committee (Baruch Committee).

AUGUST 31, 1944

"Undoubtedly the outstanding achievement of your company has been the development of your process for the production of Butadiene from alcohol. With a rather meager background of experimental work, your engineers were able to design and construct commercial units for the production of Butadiene. In an exceedingly short time, the operation of this equipment at capacities up to 200 per cent of rating has been largely responsible for our present safe situation with respect to rubber supplies..."

—Letter from Rubber Director Bradley Dewey to CARBIDE AND CARBON CHEMICALS CORPORATION

The material herein has been reviewed and passed by the Rubber Reserve Company, the Defense Plant Corporation, and the War Department.

BUY UNITED STATES WAR BONDS AND STAMPS

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INDUSTRIAL GASES AND CARBIDE—The Linde Air Products Company, The Oxweld Railroad Service Company, The Prest-O-Lite Company, Inc.

Electron Microscope

by Robert Bannister, soph., ch.e.

The electron microscope, the greatest development in the field of microscopy since the 17th century, has enabled man to view objects which were before considered too minute to be seen by an ordinary microscope. Capable of obtaining a total magnification of 200,000 diameters with the aid of photographic enlargements, the electron microscope has wide applications in industrial research. In this article, Mr. Bannister discusses the evolution of the electron microscope and its industrial applications.

Ever since its invention in the 17th century the microscope has been one of our most useful tools for extending our knowledge of the physical world. It has gradually developed into a powerful and intricate instrument capable of probing deeply into levels invisible to the eye. About 60 years ago, however, optical designers realized that a fundamental limitation of nature blocked the further evolution of the optical microscope. It was found both theoretically and experimentally that the light microscope is incapable of resolving distinct images beyond a certain critical magnification. This limitation precluded the observance by the light microscope of such important objects as viruses, colloids, and the structure of bacteria.

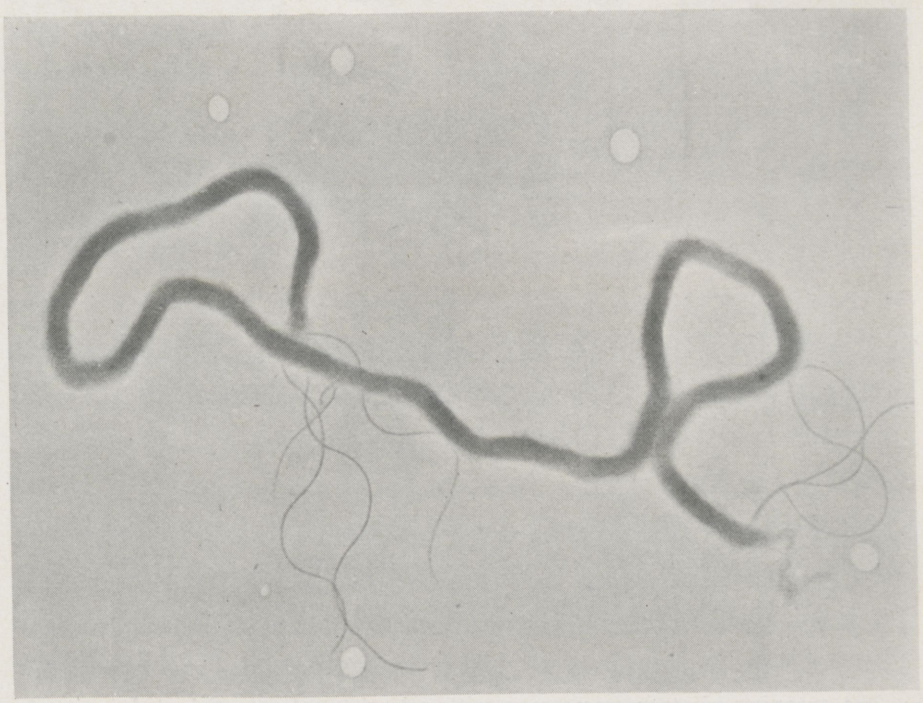
Theoretical considerations show that the limitation is due to the wave nature of light, and that the limit is reached when the diameter of the observed object becomes less than one-third the wave length of the light. Therefore, ordinary light ceases to resolve objects above a magnification of about 2000 (slightly higher for objects showing exceptional contrast). Higher magnifications or photographic enlargements do not reveal more detail, but only blur the image. An obvious solution to this dilemma seems to be the utilization of radiation of shorter wave length. Comparatively small increases in magnifying power have been made through the use of ultraviolet light. Theoretically, an enormous increase in magnifying power can be obtained by the use of X-rays, but lenses suitable for an X-ray microscope have not been found.

Within the past few years the solution to this difficult problem has been found with the introduction of the electron microscope. By the use of this instrument direct magnifications of 30,000 diameters or greater are obtained, and the detail is such that useful photographic enlargements up to total magnifications of 200,000 can be made. The electron microscope also has a much greater depth of focus than the optical microscope. Finally, there is no theoretical limitation to the resolving power of the electron microscope, providing that the necessary voltage may be applied.

The discovery of two important principles made possible the development of the electron microscope. The first was the theoretical prediction by de Broglie that electrons act as waves. This prediction was experimentally demonstrated to be correct by several investigators, who found that very short wave lengths are associated with electrons. The second principle, formulated by Hans Busch in 1926, demonstrated the close analogy between rays of light and beams of electrons. It was shown that electrons can be focused with magnetic or electrical fields, just as light rays are focused with optical lenses. These properties of electrons naturally suggested the development of an instrument utilizing the same principles as the light microscope, but employing the far more powerful electrons.

Details of Electron Microscopes

The simplest electron microscope employs no lenses. It consists of a thin filament or wire which is enclosed by a cylindrical or spherical glass tube evacuated and coated with a fluorescent material on the inside. When the filament or wire is heated and a potential of a few thousand volts is applied at the fluores-



Courtesy RCA

Treponema Pallidum (magnification of 25,000 diameters).

cent screen, the thermionic electrons travel radially towards the screen, where they produce a magnified image. Under special conditions magnifications of as high as 500,000 can be obtained. This microscope is useful in studying such phenomena as the thermionic emission of filaments.

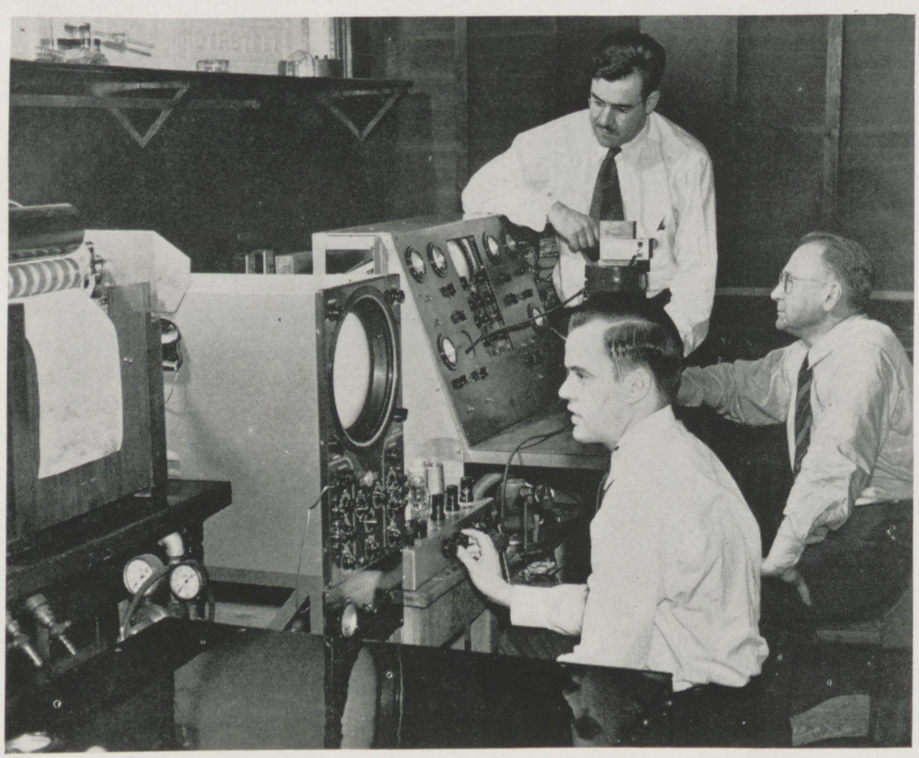
Another type of electron microscope is one employing electrostatic lenses. The cathode (object) is usually a narrow ribbon of metal which emits thermionic electrons when heated. The cathode is surrounded by a ring at the same potential as the cathode. In front of the cathode are spaced two metal sheets, each pierced by a small aperture, and a fluorescent screen. By adjusting the electrostatic potentials on the metal sheets, the thermionic electrons are focused on the fluorescent screen to form a magnified pattern of the object's surface. Although it gives only low magnifications (a few hundred diameters), the electrostatic microscope is advantageous in the study of thermionic emission and the changes in the crystalline structure of substances when the temperature is changed.

The most widely publicized electron microscope—the "super microscope" — employs transmitted electrons and magnetic lenses. In principle, the electron microscope is very much like the light microscope, but it differs in such important details as the source of illumination, the method of focusing, and the manner of observing the image. A great amount of research work has been expended in developing this microscope. Much of the developmental work has been done by von Borries and Ruska in Germany, E. F. Burton, Kohl, and Hall at the University of Toronto, and Zworykin, Hillier, and Vance at the RCA Laboratories.

Courtesy RCA

Zinc oxide smoke particles (magnification of 30,000 diameters).

The source of illumination in the electron microscope is a hot cathode which emits thermionic electrons. These are accelerated through an aperture in an anode to enormous speeds, the accelerating force being about 50 or 60 kilovolts. The beam of electrons is then made parallel by passing it through the condensor lens, which consists of a doughnut-shaped coil of wire. When the beam passes through the object, a density pattern is formed corresponding to the quantity of electrons allowed to pass through each point of the object without being absorbed or scattered. A second electromagnetic coil (the objective lens) focuses this pattern into a highly magnified intermediate image, which lies close to the final coil. This electromagnetic coil (the projector lens) gathers electrons from the central portion of the intermediate image and further magnifies it into the final image. The final image may be observed on a fluorescent screen or



Wide World Photos

The scanning electron microscope with scientists who participated in its development: Dr. James Hillier (foreground), R. L. Snyder (standing), and Dr. V. K. Zworykin.

may be photographed by allowing the electrons to fall directly on a photographic plate.

The electromagnetic coils in the electron microscope have the same arrangement and perform the same function as the corresponding optical lenses in the light microscope. However, it has been found more convenient to focus the electron microscope by varying the current in the coils rather than by moving the lenses as in the optical microscope. Varying the current in the coils varies the intensity of the field acting on the electron beam, which in turn varies the focal length of the lens.

The electron microscope also differs from the optical microscope in the medium in which the illumination travels and in the type of specimen supports. While light can travel through air and glass without appreciable absorption, electrons are almost completely scattered or absorbed by air; therefore, a comparatively high vacuum is maintained over the entire distance traveled by the electrons. In the same way, the conventional glass slides used for mounting the specimen in light microscopy would completely absorb the electron beam. Instead, electron microscope technique employs an extremely fine (about one-millionth of a centimeter thick) collodion film formed by allowing a drop of collodion dissolved in a solvent to spread out over the surface of water. So that the fragile film will not be disintegrated, it is mounted on a very fine wire mesh. The specimen is placed on the film and introduced into the microscope through an air lock.

Variations of the Super-Microscope

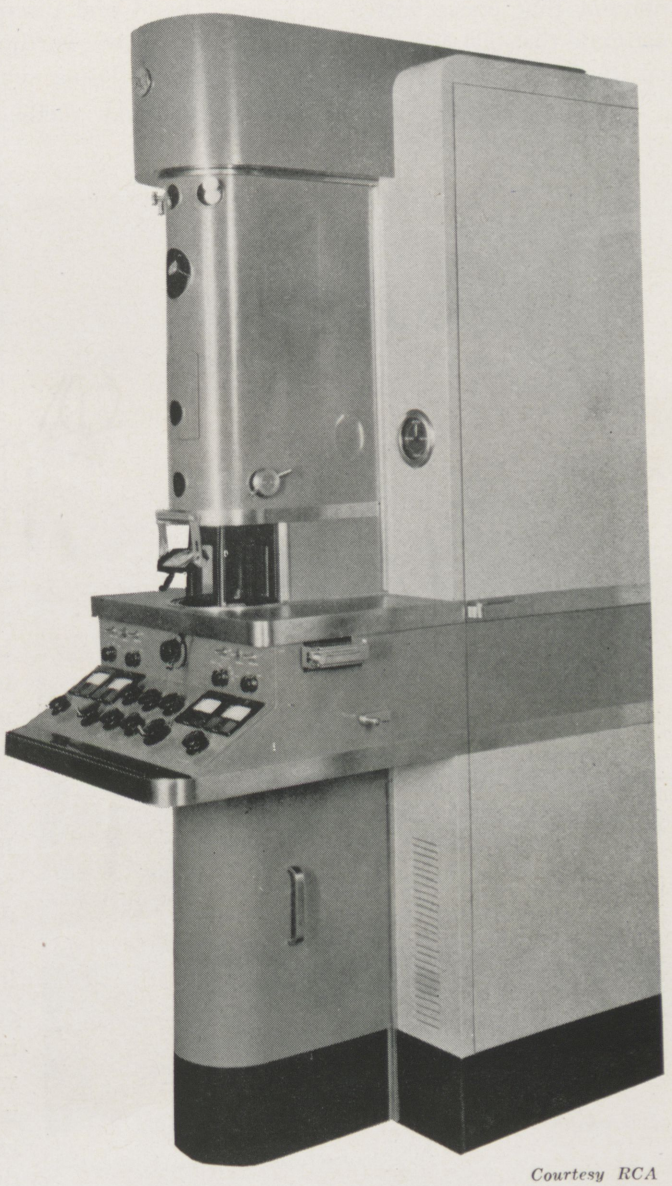
Research has naturally developed different types of electron microscopes for different uses. The powerful electron microscope used widely in industrial research is more than six feet tall, but smaller models have recently been perfected. Both RCA and General Electric have developed simplified portable models which sacrifice extreme magnifications but still perform at much higher magnifications than the optical microscopes. These models are expected to be popular with hospitals, universities, and small laboratories.

An example of a specialized type of instrument is the high-voltage electron microscope. While the regular electron microscopes are ordinarily satisfactory, they are sometimes inadequate for examining the inner structures of substances which scatter or absorb electrons greatly. This is particularly true in the study of certain bacteria and cut sections of organic material, where the thickness of the specimen is such that complete or partial opacity results. For study of such specimens, scientists have developed an electron microscope with an accelerating force of 200 or 300 kilovolts instead of the usual 50 or 60. With the increased velocity, the electrons are capable of resolving considerable detail in substances opaque to the ordinary electron microscope.

For the investigation of entirely opaque surfaces, such as metals, a scanning electron microscope has been devised. This instrument, operating on much the same principle as television, scans the object line by line with an extremely thin pencil of electrons. The resulting secondary electrons are amplified and a magnified image is traced line by line on the fluorescent screen. Opaque surfaces can also be investigated with the regular electron microscope by the use of a replica made from such a material as collodion. A negative replica may be made by flowing collodion over the surface, or a positive replica corresponding exactly to the original surface may be prepared by a more complex two-stage process. The resolution obtained from such artificial surfaces is nearly as good as that obtained in regular electron micrographs.

Several accessories have been provided for the electron microscope. One device built into large models is the electron diffraction camera. Thus, the molecular structure of an

(*Continued on Page* 22)



Courtesy RCA

The Universal model Electron Microscope.

F M -- Radio of The Future

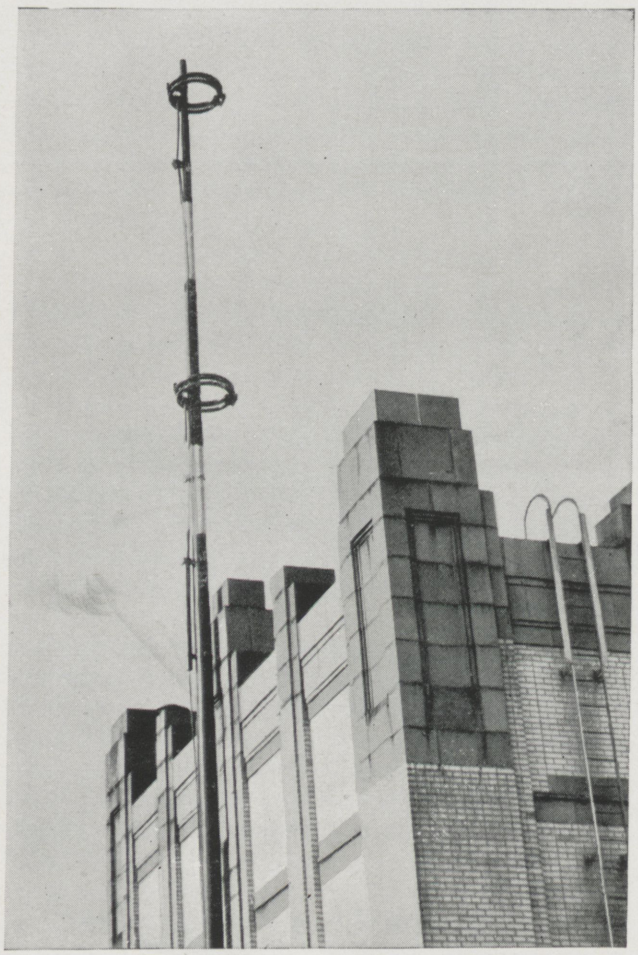
by Brice E. Rumble, soph., e.e.

What is the place of FM in the future of radio? How does it differ from conventional radio? What advantages does it offer? The answers to these and other questions are provided by this discussion of FM.

The radio assumes an important role in our lives. Following the end of the war, radio will play an even greater role in our lives than it does now. Wartime electronic progress will see to that.

Most of the newer radio developments—like radar—are now secret. However one of the greatest advances in radio we can talk about freely because it has not been censored. This new advancement in radio is a new kind of broadcasting called frequency modulation—FM for short. So great is this new development that conservative engineers estimate that 500 FM stations will be on the air 5 years after the war.

FM began to appear on the horizon before the war started and its growth was interrupted by the war. The present interest in frequency modulation indicates a resumption of activities in its behalf and the inauguration of this new system into our broadcasting stations as soon as possible after the war. Postwar plans are now being evolved and so we shall review some of the facilities at hand and discuss the factors which may be worthy of consideration in formulating such plans.



Cut Courtesy General Electric

Two-bay circular antenna of an FM radio station. For another view of this antenna see cover.

What makes FM such a decided improvement over our present type of broadcasting? Well, since the beginning of radio, engineers have tried to improve broadcast transmission and reception so that the programs can come into our homes with the same beauty and realism they have in the broadcasting studio. People have become so accustomed to hearing music on the radio as it is today that they accept what they hear as realism. But if you could listen to a concert in an auditorium one minute, and the next listen to the same concert on the radio in your home, you would realize that what you had accepted as the real thing is only a fair imitation. There is definitely something missing.

Before we go farther in explaining how frequency modulation broadcasting comes very close to the ideal of giving you a seat in the broadcasting studio without leaving your home, let us see if we can understand what sound is, and some of its applications to broadcasting.

Plucking the string on a musical instrument causes it to vibrate. These vibrations set up air waves which travel outward in all directions, as the ripples caused by dropping a stone in a pond. When these air waves reach your ears, you hear the sound.

Now a musical tone is characterized by (1) pitch (2) loudness (3) timbre or quality.

The number of times per second the string vibrates determines the pitch of the sound heard. For example, the string of middle "C" on a piano vibrates 256 times a second no matter how hard it is struck. So when you hear middle "C", it means that air waves vibrating 256 times a second are striking the diaphragm of your ear. When you hear notes below or above middle "C" it simply means that the air waves striking the diaphragm of your ear are vibrating at rates less or more than 256 times per second. The harder you strike middle "C", the greater the energy of the air waves and the louder the sound. But no matter how loud or soft, middle "C" keeps a constant pitch of 256 vibrations per second.

Now let us see what is meant by the timbre or quality of sound. Middle "C"—or any other note on a musical instrument—is actually composed of a "fundamental" tone which is its chief characteristic plus a series of "overtones", which sound in harmony with it. The presence of these "overtones" in proper proportion makes a note pleasing to hear and gives realism to reproduced music.

Middle "C" of such instruments as the violin and clarinet have the fundamental 256 vibrations per second but their characteristic quality results from a different combination of overtones, or harmonics as they are also called. These overtones of middle "C" are vibrating at the rate of two, three, four, five or more times than 256 vibrations per second. The organ, the most versatile musical instrument, is capable of a wide range of effects due to the fact that these overtones can be introduced at will and to a very great extent and variety.

The normal human ear can hear sound ranging from 16 to 16,000 vibrations per second. This is usually referred to as the Audio range or the "frequency" range of sound waves.

Perhaps now we can see that to bring true realism, the radio must bring you all of the tones and overtones that you can hear. But because of limitations in broadcasting as it exists today, even the best conventional radio brings you less than half the range of tones you are able to hear.

Cut Courtesy General Electric

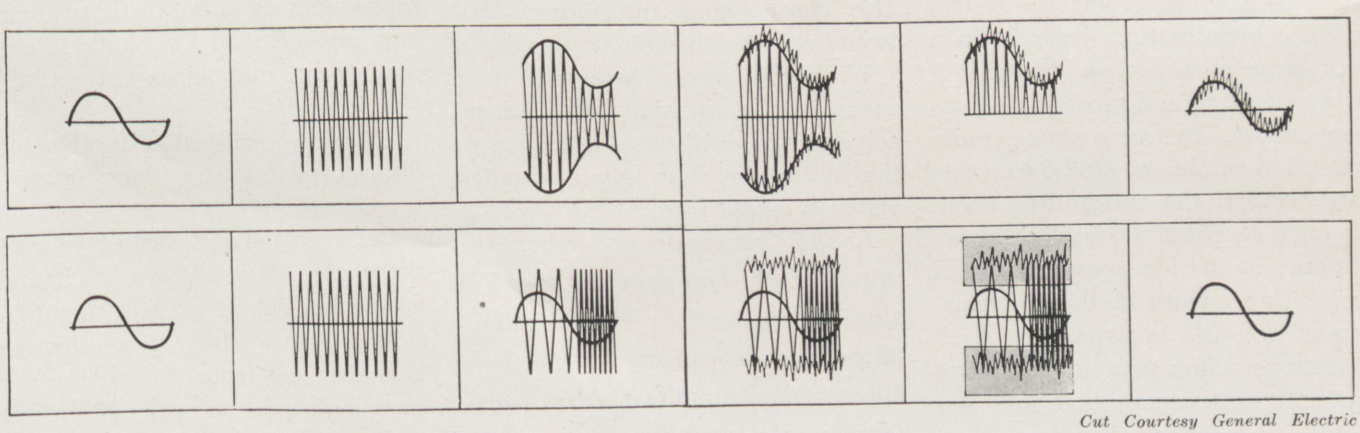
Not a crackle of static came from this FM receiver which was being operated near a discharge of artificial lighting at the New York World's Fair.

Radio is a system of wireless communication in which sound waves created in the studio are changed into electrical waves by the broadcasting transmitter. These electrical waves are radiated into space and picked up by the receiver of your radio which changes the waves back to sound.

The studio microphone is analogous to the diaphragm of your ear. When sound waves strike the microphone they are changed into electrical currents. These electrical currents, if it were possible to see them, would have exactly the same wave form as the sound waves from which they were created. However, these electrical waves cannot be radiated directly through space. It is necessary to have some vehicle to carry these electrical sound wave currents to your receiver. This vehicle is called the "carrier" wave, and it is an electrical radiation of much higher frequency.

When you tune in a station, say "810", on your dial, you are adjusting your radio set to receive a carrier wave having a frequency of 810,000 vibrations per second — usually called 810 kilocycles.

The carrier wave by itself does not transmit any music or speech. The broadcast transmitter varies or controls the characteristic of this



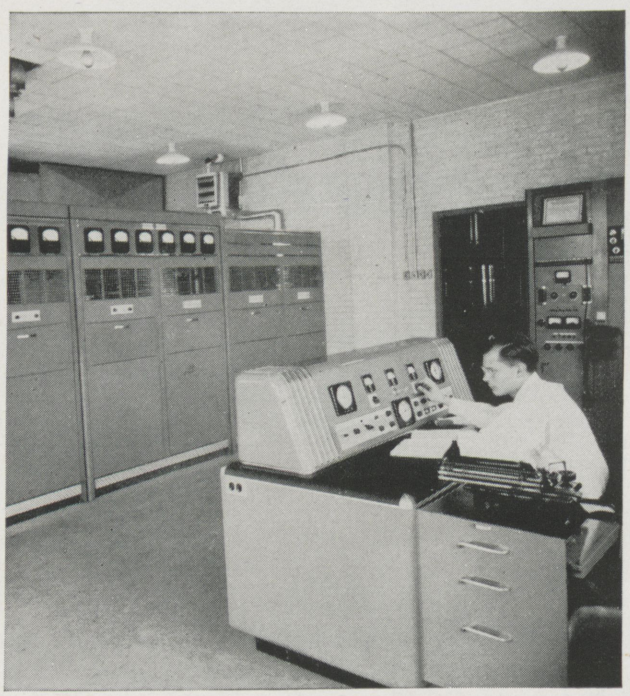
Cut Courtesy General Electric

How FM reduces static to the vanishing point. Sketch showing Sound, Carrier, Sound on Carrier, Sound and Static on Carrier, What the Receiver Does, and How Sound Looks at Loudspeaker.

carrier wave. Now this is called modulation, and means that the carrier wave is molded or shaped to conform with the sound.

Your radio receiver discards the carrier which has served its purpose and admits only the electrical equivalent of the sound wave. This electrical sound wave causes the loudspeaker cone to vibrate and reproduces sound which should correspond to those which entered the microphone. I say "should correspond" because certain limitations of our conventional radio make true realism impossible.

For instance, the quality of reception which comes from any system of radio broadcasting depends, in a very large measure, on the quality of broadcasting and receiving equipment in use. The microphone, radio and sound amplifiers, studio to transmitter wires, the transmitter itself, the radio receiver, the public address amplifier or the loudspeaker may all be limiting factors in the transmission of a sound to your ears. Each of these is a link in a chain. If any one link is deficient, that may account for poor quality reception. Most of us are not aware of these limitations but are acutely aware of two others: static and station interference.



Cut Courtesy General Electric

50,000-watt FM amplifier installed for tests.

There are two kinds of static which cause noise in radio reception—nature made static such as that produced by lightning and sun spots, and man made static, such as may be produced by electric razors, neon signs, dial telephones and other electrical devices. Even with the best of our common radios, it is impossible to enjoy a radio program during a thunderstorm. The annoyances and irritations of man-made static are all too familiar.

You wonder why static is so troublesome. Simply because various sources of static are actually small broadcasting stations that transmit undesired sounds. They send out waves similar enough to those broadcast to be reproduced by your receiver.

With our conventional radio, the only way to reduce static interference to the vanishing point is to increase the power of the broadcasting station to a point where it will deliver a signal to your receiver many times stronger than the static signal. Such a power increase would not only be too expensive, but would also cause more interference between stations that already exist.

With FM radio, however, it is necessary for the signal at your receiver to be only twice as strong as the static signal to give reception virtually static free.

As in conventional radio, the sound of the program in the FM studio is picked up by the microphone and reproduced in electrical currents and amplified. Also a high frequency carrier wave is used. Its frequency, however, may be nearly a 100 times as high as in conventional broadcasting.

Thus it is the combining of these two factors, the amplified microphone current and the carrier frequency, that the two methods of broadcasting AM and FM fundamentally differ.

In conventional radio, the carrier wave increases and decreases in amplitude or height in accordance with the microphone currents, while the frequency of the carrier in FM remains essentially unchanged.

The microphone current modulates the FM carrier wave in an entirely different manner. Instead of causing the carrier wave to increase and decrease in height, the height remains the same and the frequency of the carrier changes in accordance with the sound. The modulated FM carrier wave bunches together in places and stretches out in others like an accordian.

Our conventional radios pick from the air not only the desired signal, but also the other electrical effects called static. The desired and undesired signals are so similar in electrical characteristics that they cannot be separated. Thus both are produced by the loudspeaker. This is not the case in FM. The receiver is designed to translate into sound only variations in the constant amplitude rhythmic frequency of the carrier, and rejects the spasmodic and high amplitude characteristics of static.

After the conventional radio discards the carrier wave, the sound which the loudspeaker supposedly reproduces is a mixture of music and noise. But in FM, static is eliminated and only clean-cut sound is reproduced.

There are still other fundamental differences in the two forms of broadcasting.

Between 550 and 1600 on your dial there are 105 roadways or channels available. Yet at present about 900 stations are using these channels. You can see from this that a very crowded condition exists. Stations on the same frequency or channel, al-

(*Continued on Page* 24)

Research and Development

Plastic Foam Grows by Itself

The new type of foam plastics developed by chemists initially is resin resembling molasses. Within two to five minutes after it is mixed, it begins to foam and grow. And in practically no time it develops into a coarse-textured mass that is lighter than rock wool, glass, or cork, and lower in heat conductivity than any of the three.

Equally astonishing is the fact that the resin is also self-curing. What little heat is needed is generated by the mixture itself. As soon as the foam stops growing it is ready for use. The plastics weighs less than two pounds per cubic foot.

Wartime uses of the plastic foam are secret. But after the war, the material promises to have many applications, especially where insulation is required.

Weathering Heights

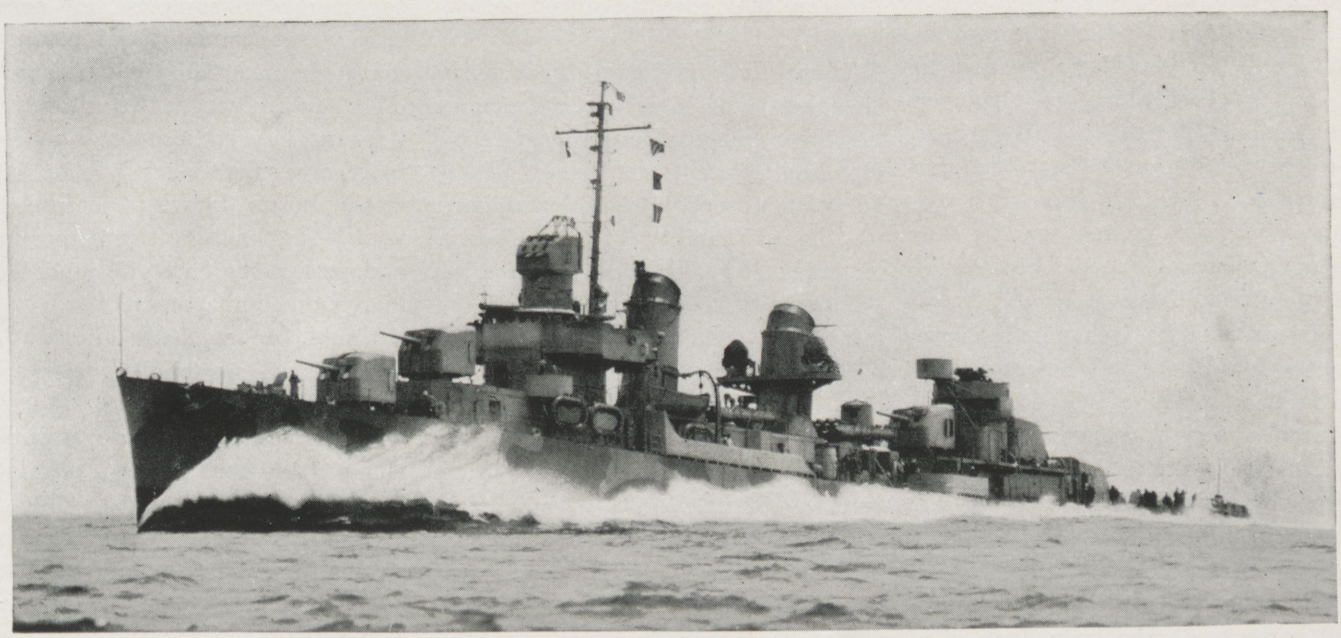
The elements are in for some startling competition when the weather-predicting and combatting devices now used by the military are released to the public. Rain, snow and sleet will fall on cities prepared for the worst; ships will navigate in the densest fog; planes will fly safely through clouds that load them with ice.

Glancing into the sky now is an eye many times larger than the human one, although constructed on the same principles. This is part of a device called the ceilometer which, by measuring the angle of light reflected from the clouds, enables engineers to get sky-information they never before had access to. And with data on the heights and range of cloud banks, they are able to construct three-dimensional weather maps.

Contributing considerably to this new era of weather predicting is another device for getting information from above the clouds—the radio sonde. The principles upon which the sonde operates cannot be divulged, but the regulation ones used by the Signal Corps and Weather Bureau (now going full tilt to turn out key military information) operate this way: A radio transmitter and instruments for measuring temperature, humidity and air pressure are sent up in a balloon to 50,000 or 70,000 feet. During its rise, at regular intervals the radio transmits instrument readings back to earth.

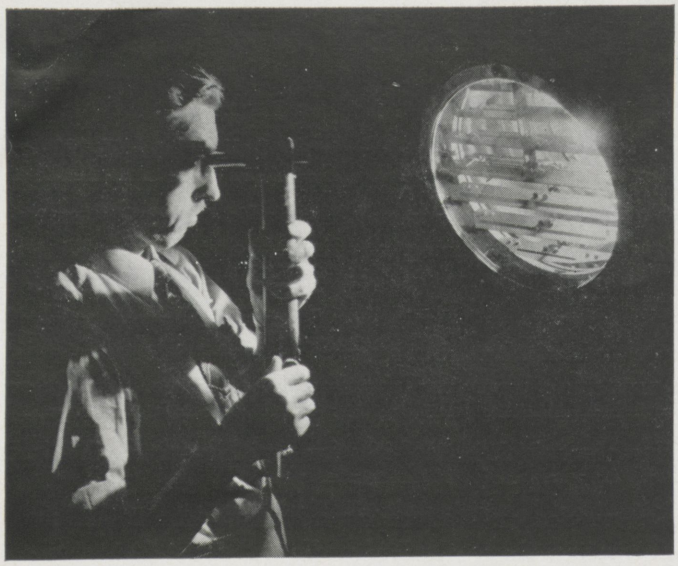
On the basis of these and other devices still censored, weather predicting can be done more accurately and further in advance than ever was hoped for prior to the war. Particularly for aerial warfare, this has assumed real importance. One of the advantages held by the RAF over the Luftwaffe is the fact that weather moves eastward and England knows what German's weather will be before it gets there.

Similarly, the weather will be an important factor in commercial postwar aviation. Business uses of weather information are becoming so important financially that many companies are hiring their own weather observers. Many diverse organizations are using weather predictions for profit, for example: an electric company, which uses air pressure data in turbine tests; a roofing company that kept track of a hurricane in Texas and rushed roofs where they would be needed; and an engineering company which held a demonstra-



Cut Courtesy General Electric

This new high-speed naval destroyer is typical of the ships being repaired by the mammoth floating dry docks constructed for the Navy during the war.



Cut Courtesy General Electric

Designed by engineers to stand the pounding of heavy waves and the shock of big guns fired close by, this signaling searchlight—which is visible for 17 miles on a clear night—will soon be aboard the Navy's battleships, cruisers and destroyers.

tion of a smoke-generator in a valley where air currents showed it to best advantage.

Tough Searchlight Ready for Signal Duty Aboard Navy Ships

Tough enough to stand the pounding of heavy waves and the shock of big guns fired close by, a signaling searchlight has been developed and is now ready for duty aboard Uncle Sam's warships.

Already in production the searchlight will enable Navy vessels to "talk" to other ships, to airplanes and to shore patrols. It will play its most useful role as a "stand-in" for radio communication when such signals might be picked up by the enemy or are ineffective because of weather conditions.

The searchlight flashes its message in code by projecting a beam of light through a series of Venetian-blind shutters that are opened and closed by hand to simulate dots and dashes. On a clear night the beam is visible for many miles.

Few shipboard lights are required to take the beating this searchlight will undergo on the open deck of a warship. In battle it must stand up under the recoil of giant guns fired nearby. When the ship is plowing through heavy seas, the searchlight must be able to take the heavy battering and be ready to light at any time.

A special heat-resisting glass, ten times stronger than plate glass, enables the searchlight to resist sudden changes in temperature.

Icy cold waves lashing against the lens of the searchlight while it is still hot would instantly shatter ordinary glass. To prevent this a special glass has been used which can be heated to a very high temperature and then plunged into icy water without showing the slightest strain.

Floating Factories Repair Warships in Battle Areas

Enough electric equipment to furnish a good-sized factory plus a small hotel is installed on each floating drydock the Navy is using to make emergency repairs of warships far from their most advanced permanent bases.

These floating factories, recently revealed to be in action, are changing the concept of naval warfare by enabling strategists to plan ocean-going operations without dependence on the availability of fixed bases. Whereas the old static concept of sea strategy required ships to operate within an approximate range of 2,000 miles from a permanent repair base, floating drydocks make it possible to establish bases as they are needed and as near the fighting zone as desired.

In operation these mobile drydocks prepare a warship for repair by literally lifting the damaged vessel out of the water, thus giving workmen access to any part of the hull or deck, the same as if the ship were being overhauled on land. This is achieved by admitting water to sealed compartments so that the drydock submerges. When this is accomplished, the damaged vessel is floated over the dock or the dock is submerged under the vessel. Then water is pumped out of the compartments, and the drydock, with the ship under repair now nestling on it in a rack, arises to the surface. In this position, the damaged ship is completely out of the water, with its hull exposed, and examination or repair is made possible.

Though several different models of floating drydocks are presently in operation, the newest and most radical of these is the advanced base sectional type, in which 10 separate units, or barges, are joined together to form a repair dock that can accommodate a battleship. When this type dock is assembled, the separate barges form a surface nearly as long as three footbball fields and with side walls rising higher than a five-story building. Each of the sections has a lifting capacity of 10,000 long tons, equivalent to a fleet of 7,500 average automobiles. An assembly composed of 7 such sections joined together is large enough to accommodate a cruiser.

Because each barge is a complete unit in itself, as well as a "hotel" for the men who comprise the service crew, great amounts of electricity are consumed. This is generated by diesel-driven generators on each section and is used to operate machine tools, cranes, welders, anchor windlasses, hoists, blowers, compressors, ventilating and refrigerating units and pumps for emptying and filling buoyancy compartments.

Unable to navigate under their own power, sectional drydocks are towed by other vessels to a protected location and there assembled and put into operation. Their latest repair equipment enables them to overhaul huge warships in short order and either send them back to permanent bases under their power or put them back in the fight.

Absolute Altimeter

An absolute altimeter in mass

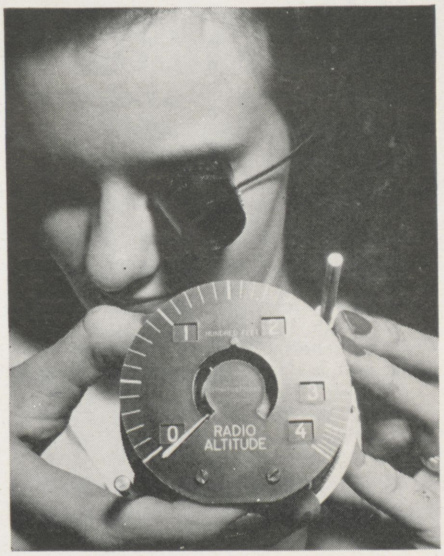
production and in successful use, now tells the pilot how high his plane is above a mountainside or other unseen obstacle at night, during fog, or in storms.

The absolute altimeter, based on radio principles, is a development of engineers of several organizations. The system requires a special instrument, which is a highly accurate d-c milliammeter of the circular-scale type and is fully temperature-compensated to operate at temperatures from minus 67 to plus 18 degrees F. Over the normal range of temperature, the accuracy is within one per cent. The instrument has two scales, 0 to 400 feet and 0 to 4000 feet, selected by turning an external switch. Only one scale shows at a time behind the windows in the dial face, thus eliminating any possibility of error by the pilot reading the wrong scale. The instrument, necessarily made as light as possible because of its use in planes, also combines the master control switch for the entire absolute-altimeter system.

Unlike previous altimeters, which gave only an indication of altitude above sea level, the absolute altimeter provides information as to the distance to the nearest solid object, whether flat ground, a hillside, or a mountain. Furthermore, for distances within the all-important region of 10 to 400 feet, this indication is accurate to within five feet of the actual distance. The radio system and the instrument are so accurate that they have enabled many a pilot to land his plane on a runway he could not see.

Invisible Light "Pinch-hits" for Chemicals

The uncanny ability of invisible rays to take the place of chemicals in compounding processes has been described as an inexpensive shortcut having far-reaching industrial possibilities. Strange new foods, new plastics, new rubber products and new chemicals may emerge from the chemical laboratory in the future as a result of irradiation by electric lamps producing invisible ultraviolet.



Cut Courtesy Westinghouse

Assembling one of the absolute altimeters at the Newark plant of the Westinghouse Electric and Manufacturing Company.

As examples of the possibilities ahead, light rays can furnish foods with hydrogen, a process called hydrogenation, can polymerize chemicals into dense, gummy substances such as plastics and rubber by uniting the molecules, and can make possile many new chemical compounds by invisible chlorination, a process commonly associated with water purification.

Already ultraviolet radiations have been employed to improve the taste and odor of cacao oil and to vulcanize rubber. The reason that ultraviolet is the radiation most useful to photochemistry is because these unseen rays are vibrations of a high frequency and distort the electron structure of the atoms and molecules more effectively than the longer rays of visible light. Nevertheless visible light has a photochemical effect to a lesser degree.

The photochemistry which abounds in nature is the most extensive chemical action in the world. Plants absorb the radiant energy of the sun, both visible and invisible, and through that energy create the matter of which plants are made. Radiant energy, in fact, sustains all forms of life on this earth. It is so plentiful that the radiant energy produced by the sun in a 12 mile square of West Virginia at noon on a clear day in June is equal to the energy of 100 Niagara Falls.

Illustrating the possible role of light in the explosives industry, a beaker containing toluene and chlorine in solution, used in the manufacture of TNT, was irradiated, with rays from an ultraviolet lamp. The beaker was first covered with a clear wafer of specially treated gelatin which filtered out the ultraviolet but passed the visible light rays. After five minutes irradiation, a thin, colorless layer formed on the top of the yellow solution, evidence that the visible light emitted from the lamp and only a slight photochemical effect.

Next, the gelatin wafer was removed and the entire yellow solution turned crystal clear after one minute's exposure to the ultraviolet rays. This was visible evidence that chlorination, the first step in many chemical processes in industry, had been accomplished primarily by ultraviolet.

New Featherweight Bazooka

A featherweight bazooka with a heavyweight punch and a new "eye" sight, 42 per cent lighter than the standard model, that may be handled as easily as a regular Army rifle, has been developed by engineers for the Army and is now in production.

The little heavyweight, far more accurate than its older brothers and weighing 10½ pounds, now has a barrel made from aluminum, which represents several years of research by the War Department. The standard model now in use by the Army's ground forces is made from steel, but the wall thickness of the aluminum bazooka is greater than the steel one.

This is the seventh basic design of the weapon, forerunner of all combat rocket-launchers in this war, since original plans were submitted to the company by the Army in the spring of 1942. At that time one of the fastest production jobs in the history of industry marked the com-

(*Continued on Page* 20)

Hypnotism

by Albert Silverman, soph., ch.e.

adapted by Ted Blickwedel, soph., ch.e.

Did Hitler hypnotize the German people? This thought is typical of the sensationalism which is associated with hypnotism. Actually, this phenomenon has several practical uses and offers an interesting field of study for the psychiatrist. This article was first written as a term paper and is printed here by special demand of the student body.

The working of the mind has always been intriguing. There are a great many mysteries remaining, which scientists have been struggling to solve for ages. In most instances, the phenomena have been accurately observed, studied, and recorded, but the processes involved are still to be learned.

Take, for instance, hypnotism. It has been satisfactorily proved that there really is such an occurrence. In brief, it is the exercising of a powerful influence over the mind of one person by that of another. This influence is so great that the hypnotised person cannot resist the impulse to obey the operator.

The most generally believed theory regarding hypnotism is that of suggestion; i.e., an order given by the hypnotist is taken as a suggestion by the subject, who immediately performs the act, not knowing why, but seemingly on his own impulse.

The act of hypnosis was practiced long ago, the first great exponent probably being Anton Mesmer, who was expelled from Vienna because of his unorthodox theories. From his name we get the term Mesmerism, which is an older title for hypnotism. A great number of people today look upon hypnotism as being shameful because of the uses to which it has been put in the past. The commonest use has been in vaudeville. In the last few years a typical vaudeville act might have been one in which the subject was put into a trance and then given a raw potato. Upon being informed that this potato was a delicious apple, the subject would eat it with relish. Although the majority of these acts were meant to be funny, great harm was often done to the subject.

People also react violently against hypnotism because of many misunderstandings and false ideas concerning it. Contrary to popular belief, one cannot be hypnotized against his will. There have been many movies and comic strips in which the villain happened to be a hypnotist who would freeze the victim in his tracts by staring at him with a pair of piercing, supernormal eyes. This feat cannot be accomplished if the subject does not desire it, and furthermore, one needn't have a pair of supernatural eyes to be a hypnotist. Also a person in a trance cannot be made to do anything against his moral principles or to do anything that he knows is wrong. This explodes the belief that a person can be hypnotised, given a gun, and then told to murder a certain person. There still remains the possibility, however, that by deception a subject can be made to kill someone. For instance, he might be told that his intended victim is a wild animal and that he must kill it in self-defense. A college professor once hypnotized a girl in front of the class and ordered her to undress. She immediately awoke in a rage but didn't know why she was angry. This is a good illustration of the fact that one cannot be made to do anything against his morals. If a hypnotist should hypnotize a person and then die, the person would sooner or later awaken from the trance of his own accord. The length of time anyone would remain in a trance under these circumstances varies with the individual, but it is usually from six to ten hours. Another false concept is that one will suffer harmful mental or physical after effects from repeated hypnotic trances. No one yet on record has gone insane or been made feeble-minded from hypnotism, as many would have one believe. Also, feeble-minded individuals cannot be hypnotized more readily than intelligent ones, and in fact, most of them cannot be hypnotized at all. The lower animals and young children cannot be hypnotized, but it has been found that children between the ages of five and fifteen make the best subjects.

There are many peculiarities of hypnotism, most of which as yet have not been explained. Subjects seem to acquire some abnormal power of distinguishing objects very accurately, a power which vanishes upon awakening. Also baffling to the investigator is the fact that stutterers almost always speak normally under hypnosis, but revert to stuttering as soon as they awaken. Hypnotized subjects can be regressed to any age desirable. They will believe exactly as they did at that certain age, they will be able to do the same things that they could at that age, but they can do nothing which they learned to do at an older age; e.g., subjects who are regressed to the age of two are unable to read or write. If they are then told that they are eight years old, they will be able to write exactly as they did at that age, but they will not know the meaning of words added to their vocabulary after the age of eight. Psychologists have offered a logical explanation for this latter phenomenum. Everyone has two minds, the conscious mind and the subconscious mind. The conscious mind remembers only recent happenings, while everything that occurs from the day one is born is indelibly impressed upon the subconscious mind, never to be erased. When one is hypnotized, the operator may reach

into the subconscious mind of the subject, who can thus recall any incident in his past life very distinctly. When the person awakens, his conscious mind takes control, and the subconscious is shoved passively into the background. In one case of this sort, a hypnotized girl described in detail everything that had happened on her past birthdays. In a peculiar case of a different nature, the blood sugar content of one person was actually decreased by telling him that he was eating sugar. The insulin in his body went to work on the actual sugar in his blood, thereby decreasing its sugar content. This is proof that hypnotism can be used to alter one's physical condition through mental suggestion. In experiments conducted by Dr. Leslie H. Farber and Dr. Charles Fisher of Washington, D. C., college students were able to make sense out of the supposedly unintelligible speech of insane persons. They were also able to interpret dreams. Dr. Ralph Slater, a high-speed hypnotist, believes that Hitler had hypnotized the German people over the radio with his high-pitched voice and microphone technique. In order to prove that people could be hypnotized over the radio, Dr. Slater broadcast to a group in a radio studio. They were hypnotized as easily as if they had been sitting directly in front of him.

The methods of bringing about hypnotic sleep vary with different hypnotists. Some use bright objects to tire the subject's eyes. This was Mesmer's method. Most modern hypnotists tell their subjects to relax, that they are getting sleepier, etc. Typical of many in inducing sleep are the following words: "Now your eyes are becoming tired, very very tired. Your head is heavier and heavier and your eyes are weighted with lead and it is so hard to keep them open as you get sleepy all over and heavy and sleepy. Your eyes are blinking now and now faster and your eyes are closing and pulling downward and closing and closing." From these words one can see that piercing eyes are unnecessary.

A person in a hypnotic trance is conscious and may even have his eyes open. He can hear distinctly only the voice of his hypnotizer and will obey no one else.

An important phase of hypnotism is post-hypnotic suggestion, or the reacting after awakening to suggestions given in the trance. Dr. Franz Polgar illustrates this by telling a hypnotized boy that after awakening, he should take off his left shoe as soon as Dr. Polgar touched his tie. A few minutes later, after the boy has awakened, Dr. Polgar nonchalantly adjusts his tie. The boy immediately bends over and begins removing his left shoe. When asked why he did it, the boy is usually dumbfounded and can think of no reason. The situation is the same with all post-hypnotic suggestions. The subject acts upon an impulse from his subconscious mind, which was contacted while he was in the trance.

After all this discussion on hypnotism, one may ask, "what good is it? What practical use does it have?" It would take hours to answer this question, for hypnotism has a myriad uses. In the field of psychology and psychiatry, it has extensive application. In many large institutions where psychiatry is properly used and taught, hypnotism has been found useful in the diagnosis and cure of certain psychological disorders. Emotional disorders can be cured by finding the underlying cause. The patient's past life is probed while he is under hypnosis by delving into his subconscious mind. An example is a case in which a young scientist developed strangling throat spasms when in contact with water. He was hypnotized, his subconscious mind was probed, and it was discovered that he almost drowned in a river when he was young. The hypnotist informed him that he would remember all that had taken place when he awoke. Realizing the cause of his spasms and how silly they were, the young man promptly recovered.

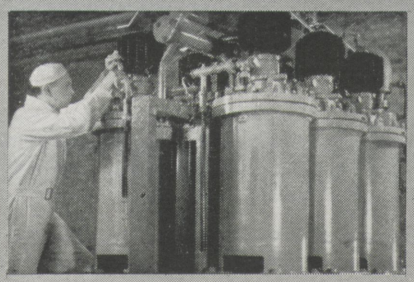
Hypnotism is also useful in the practice of psychotherapy. Suggestions are implanted in the subconscious mind of the patient. Because the subconscious mind has an immense influence over the conscious mind, the suggestions impressed upon the patient's subconscious mind are carried out when he is awake. To the patient, the impulse to do certain things seems to originate in his own mind, but the hypnotist has really ordered that this act be performed. Entering here is the effective treating of alcoholism. The horrors of alcoholism are described to the hypnotized patient and it is suggested to him that he has lost his craving for liquor. Four or five treatments are usually required before the patient is totally cured. Another case of this sort is the reducing of fat people by suggesting to them while under hypnosis that they despise fattening foods.

The Reverend Lewis O. Heck, pastor of the Episcopal Church of the Messiah, Baltimore, Maryland, has his own uses for hypnotism. A postman, about to take an examination on the names of two thousand streets, was rather concerned over his chances of passing. The pastor hypnotized him and read to him the names of all the streets. The postman passed with a grade of one hundred percent.

Dr. George H. Estabrooks, professor of psychology at the University of Chicago, proposes several uses to which hypnotism might be put to further victory. *First,* psychologists, masquerading as physicians, could hypnotize prisoners of war and obtain information from them, under hypnosis. *Second,* give prisoners of war, while hypnotized, false military information. Then awaken them and allow them to escape back to their own lines with the false information. *Third,* give one man a vital message while he is hypnotized. Tell him that only one person (the intended receiver) has the right to hypnotize him and learn the message. Since the message would exist in the carrier's subconscious mind, he would have no conscious recollection of it, and

(*Continued on Page* 28)

Helped Hatch 89,000



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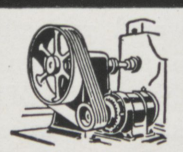
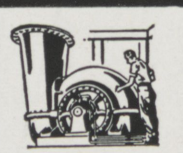
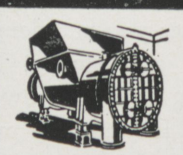


MOTORS & TEXROPE V-BELT DRIVES



BLOWERS AND COMPRESSORS



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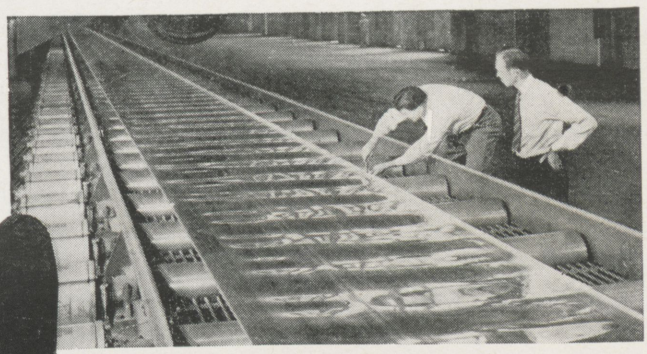
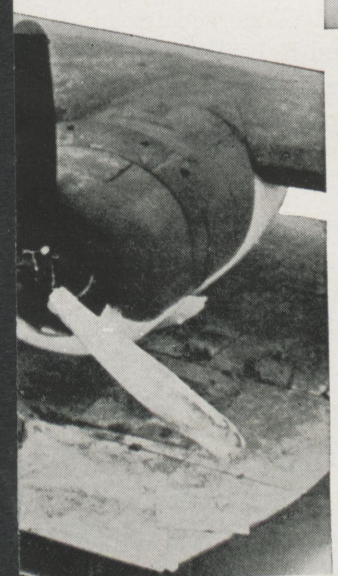
"Rivers" of aluminum, → magnesium, other vital war metals flow off U. S. production lines speeded by Allis-Chalmers Mercury Arc Rectifiers. Big boost for U. S. airpower!



Wave after Wave → of U.S. warplanes now attack our enemies—thanks to a plentiful aluminum supply!



Amazing story of a "laboratory curiosity" that became an Industrial Giant!

ONE OF THE GREAT miracles of this war—the rapid expansion of U.S. airpower—was performed with the help of a huge electronic device—the *Allis-Chalmers Mercury Arc Rectifier!*

First introduced to America in practicable form by Allis-Chalmers, the Mercury Arc Rectifier provided—in the nick of time—a fast, easy way to convert alternating to direct current for mass production of aluminum and magnesium for warplanes.

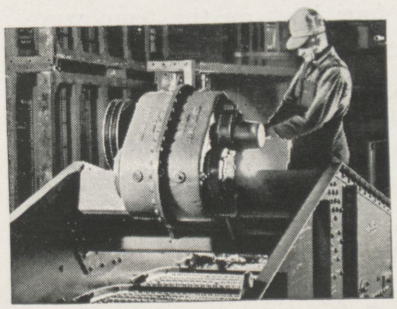
After war, the Mercury Arc Rectifier—*plus the other 1600 Allis-Chalmers products*—will help speed production of many things America needs and wants . . . will work for better peace-time living!

VICTORY NEWS

Better Pulpwood, More of It—With Less Manpower! Important help in reducing serious manpower shortages in the nation's pulp and paper industry is Allis-Chalmers' new Streambarker...a machine which removes bark from pulpwood logs quickly, thoroughly, economically by means of water under high pressure.

Streambarker does away with hand cleaning of wood, eliminates pulp loss from "brooming" of log ends, produces cleaner wood for pulp than is possible with older type barkers.

More Help for "Sink-Float" Plants: To facilitate wet screening and dewatering, Allis-Chalmers has designed a new End-Tension Deck for Low-Head Vibrating Screens.



New deck construction assures uniform depth of product and maximum use of screen surface for more efficient operation. Write for Bulletin B-6321.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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Allis-Chalmers' coast-to-coast radio program dedicated to the men and women of American Industry!

Hear the World's Finest Music by the World's Finest Concert Orchestra with Serge Koussevitzky conducting. Over the Blue Network, every Saturday, 8:30—9:30 P.M. (E.W.T.)

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INDUSTRIAL TRACTORS & ROAD MACHINERY

Campus Survey

by Keith Sutton, soph., m.e.

Track

On March 24, the Rose Poly Track Team, composed of four men and a coach made the trip to Purdue to take part in the annual Purdue Relays.

The four man team ran as a relay team and succeeded in taking third place in the college mile relay. This was worth four points and enabled Rose Poly to finish fourth in the college division of the meet.

The four boys on the team were Charles Kessler, Jack Matthews, Keith Sutton, and Arnold Hannum. Arnold has since departed for the service, leaving not even enough men for a relay team.

This is the only meet the team has participated in this season. However, Coach Brown says he hopes to get enough men out to be able to take a team to the Little State Meet at Earlham on May 19.

New Class I

In accordance with the anticipations of everyone in school, registrations for a new class, Class I, which is scheduled to begin studies on July 9, have begun coming in already.

Most of the boys are from towns not in the immediate vicinity of Terre Haute. Of the 26, who have registered thus far, the majority are from Indiana, although a few Illinois boys are present on the list.

Miss Mary Gilbert, registrar, says she expects 50 in the new class. She also states that she expects local registrations to start rolling in soon.

Glee Club

On March 22, the glee club sounded its last note of the season and closed its book until next fall. A friendly session of singing was held and officers for next season were chosen.

Keith Sutton was elected president and Paul Lawrence was elected business manager.

Although lack of numbers and other difficulties which were encountered permitted only one concert to be given, this concert was considered a success and therefore the season, a success.

The club lost the services of it's only two veterans of more than one season. They were Lubo Chelich and Bob Manhart. Both boys graduated at the end of the winter term.

R.O.T.C.

The farther advanced group of students in R.O.T.C., Class G, have been deeply engrossed in studying the Army's various forms, reports, and records. The course is called Administration and really shows what holds the vast organization of the Army together.

Class H, the lower group, have been drilling and practicing in the performance of the manual of arms. S/Sgt. Carl Lutz, commander of the unit, and members of Class G have been instructing Class H.

The whole unit is looking forward to and preparing for inspection day, the time when officers from the Service Command come to inspect the Rose R. O. T. C. unit. The date has been set as May 21. The whole day will be spent in drilling, manual of arms, and testing of other operations and knowledge which the students have learned.

Dr. Donald B. Prentice, president of the Institute, received a letter from General of the Army Arnold, Chief of Staff, stating that, contrary to rumors which have been circulated recently, R.O.T.C. will be continued in colleges and universities both now and after the war.

Debate Club

The Rose Tech Debate Club has decided to close its season and not to have any more intercollegiate debates.

Debate Club Keys will be awarded to four men. They are Joe Durra, Fred Maienschein, Jack Ice and Charles Stringfellow. In order to be eligible for a key, two years of active membership in the club must have been completed.

A.I.Ch.E.

The Rose Student branch of the American Institute of Chemical Engineers recently held an election to choose officers and committees for the next year.

The officers are:

Chairman .....Fred Maienschein
Vice-Chairman .....Joe Durra
Secy.-Treas. .....Ted Blickwedel
Sgt.-at-Arms ....Warren Haverkamp

The program committee is composed of Bill McGlone, chairman; Robert Tiefel, and Robert Bannister.

Bill Dedert heads the Professional Development committee. He is assisted by Herbert Bailey and Albert Silverman.

A banquet was held at Deming Hall on Monday evening, April 9. Dr. Hickock was the principal speaker and his topic was "Dielectric Heating."

Lambda Chi Alpha

Theta Kappa Zeta of Lambda Chi Alpha is honored to announce the pledging of Felix Grohovsky. Grohovsky's formal pledge ceremony was held Friday evening, April 27th.

Theta Kappa's rush party for the members of class H was held Sunday, April 22nd. The party was held in the lounge at the dormitory. Guests were entertained with various games, and punch and cookies were served as refreshments.

Recent visitors of the chapter include Brothers Bashe and Kylander,

(*Continued on Page* 22)

U. S. Marine Corps Photo

Combat wire moving up in a hurry!

Every unit ties in by telephone to report on contact between companies, and to discuss the next move. That means combat telephone wires must be laid down with every forward push. And communications crews must work continuously repairing breaks in lines torn by tanks and amphibians and blasted by artillery and mortars. Our Armed Forces still have urgent need for huge quantities of communications equipment of all kinds. That's why there is a wait for home telephone service.

BELL TELEPHONE SYSTEM

"Service to the Nation in Peace and War"

Alumni News

by David Templeton, freshman

The Grads Advance

'16 Richard D. Leitch, ch.e., is now Principal Chemical Engineer and Chief of Explosives of the Control Division of the U. S. Bureau of Mines. In January of this year he received an Award of Merit from the Department of the Interior for "an outstanding suggestion" of benefit to the Department. He has also been designated Vice Chairman of the Technical Subcommittee which passes on suggestions submitted for improvement of the Department.

'29 John C. Cooley, c.e., is now President of Res-N-Cem Company, Inc., makers of adhesives and lacquers, Hawthorne, New Jersey.

'35 Harold Reintjes, ch.e., with high honors, has been elected to the American Institute of Chemical Engineers.

'42 Edwin E. Gaston, e.e., is working for the War Department, Special Staff, New Developments Division, Washington, D. C.

'44 Charles W. Stringfellow, ch.e., who is with Commercial Solvents has been sent to Agnew, California, for eight weeks training.

In The Service

'41 John G. Appel, ch.e., who is now in England has achieved the rank of Major in the U. S. Army.

'43 Gene A. Coltrin, c.e., has received an honorable discharge from the U. S. Army and taken a position at Mill Hall, Pennsylvania, with the Unit Engineer of Sylvania Electric Products Company.

William C. Soudriette, ch.e.., is now at Norfolk, Virginia in Destroyer School.

Marriages

James Sidney March, m.e., '43, was married to Miss Marjorie Jane Nattall, April 9, at Champaign, Illinois.

Lt. James Robert Mercer, x-'45, was married to Miss Millicent Keeble Mosely of Fort Worth, Texas. The wedding was held in Victoria, Texas, where the groom is stationed at the Aloe Army Air Field.

Births

John A. Straw, e.e., with high honors, '35, has announced the birth of a son. Mr. Straw is now an instructor of mathematics here at Rose Poly.

Mr. Gene F. McCorrel, m.e., '42, has a girl. Carolyn Jean, born April 14, 1945.

Death

The death of William D. Eldir, m.e., '10, occurred at his home in Ypsilanti, Michigan, in October of 1944. Mr. Eldir had retired from his position as Assisting Engineer, New York Central System in 1938 but had returned in 1943 for the duration of the war.

Visitors

'16 Leinberger, e.e.
'27 J. B. Wilson, c.e.
'33 Bradfield, m.e.
'36 Creal, ch.e.
'37 Garzolini, c.e.
'42 Sutphin, ch.e.
'42 O'Dell, ch.e.
'44 Shaw,
'44 Mitchell
x-'45 Marchall, Bashe, Murdock, W. G. White.

RESEARCH & DEVEL.

(*Continued from Page* 13)

pletion of the first few thousand bazookas. It took engineers only a few weeks, from the time the Army gave them the plans, to put the weapon in production and ship the first lot to the North African front.

The first model bazooka had a single-piece barrel with a permanent rear sight, similar to an ordinary gun's.

Next came a streamlined take-apart model, commonly known as the folding bazooka, and designed for use by paratroopers and infantrymen fighting in jungles and thick underbrush. The advantage here was easier handling, less chance of snagging the weapon on vines and impeding the progress of an attack. This model had no sights on the barrel. It was equipped with a collapsible, single-element bar sight mounted on the side of the bazooka. When not in use the sight was folded against the side of the barrel.

The latest design has an optical sight on a folding mount. The design and construction of the sight provides unrestricted vision when leading fast-moving targets such as tanks. An elevation adjustment eliminates the conventional sights used on Army rifles. This sight has increased the accuracy of the bazooka to such an extent that now an infantryman may qualify as a "bazooka sharpshooter," for which he is awarded a sharpshooter's medal upon which is mounted a replica of the weapon.

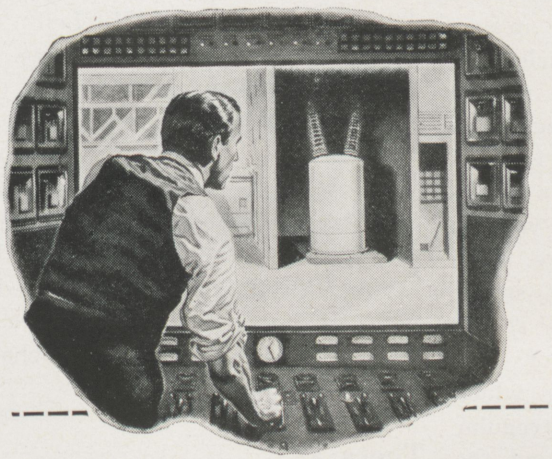
Optical sights are not a new development. But their application on the bazooka required special study and unique application on the part of engineers. The sight consists of a highgrade glass lens in which are concentric lines and a bull's-eye center, similar to gun targets, enabling a bazookaman to pinpoint the vulnerable part of an enemy tank or pillbox.

The standard shoulder stock in use today for the launcher is also an improvement over the old model.

(*Continued on Page* 26)

In a field hospital, a SURGEON uses a new x-ray machine that marks the exact location of the bullet, speeds life-saving behind the battle line.

. . . the name on the X-RAY MACHINE is Westinghouse.



In a laboratory an ENGINEER uses the instantaneous power of 75,000 thunderbolts to test giant circuit breakers that protect America's power systems.

. . . the name on the CIRCUIT BREAKER is Westinghouse.

In his tent a SOLDIER uses a bug bomb to destroy insect life – safeguarding health and increasing comfort in tropical jungles.

. . . the name on the BUG BOMB is Westinghouse.

In a war plant a WORKER uses an electro-magnetic device to detect flaws in heat-treated bearing races – keeping our combat vehicles rolling on to victory.

. . . the name on the ELECTROMAGNETIC DEVICE is Westinghouse.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

TODAY—Westinghouse products are serving in every battle, on every front, in the war against aggression.

TOMORROW—New processes and new materials...created under the stress of war . . . will mean better and longer-lasting Westinghouse products for a world at peace.

Tune in: JOHN CHARLES THOMAS—Sunday 2:30 pm, EWT, NBC. TED MALONE—Mon. Tues. Wed. Evening, Blue Network

ELECTRON MICROSCOPE

(*Continued from Page* 7)

object may be studied from its diffraction pattern while other physical data, such as particle size and shape, are obtained from the micrograph. Another device which may be included in the microscope makes possible the taking of three-dimensional pictures. A tilting mechanism allows the object to be shifted at a slight angle to the normal in either direction. A pair of photographs taken at these angles and viewed stereoscopically seems to have depth. The great depth of focus of the electron microscope often produces remarkable effects in such photographs.

Uses of the Electron Microscope

The electron microscope appears to have wide application in industrial research. It has been found that electron micrographs of a substance frequently reveal clearly the reason for its peculiar physical or chemical properties. For example, the unusual activity of a substance may be found to be due to porosity or large surface area. Many surprises have already been found in examining common substances, and research has hardly yet begun in this direction.

Under the electron microscope, many smoke particles are found to be regular in shape. Magnesium oxide smoke is found to be made up of perfect cubes varying greatly in size, while zinc oxide smoke particles are shown to consist of four thin particles which are very irregular and rough, and the edge of a razor blade seems to have a topography as irregular as a mountain range. Silver grains in photographic film are found to resemble loose balls of thread rather than compact particles.

Biology and medicine are benefiting greatly by the introduction of the electron microscope. Viruses, the cause of many diseases, are being seen for the first time. Even though many disease germs could be seen with the light microscope, their structure could not be determined. Now microbiologists are enabled to study their details closely. Thus, many types of bacteria, including streptococci, pneumococci, and typhoid bacilli, have been found to possess rigid outer membranes or shells to protect their inner structures. Wide variations in size and shape were found to exist between various bacteria of the same types.

Since there is no theoretical limit to the magnifying power of the electron microscope, it may be possible at some future time to see atoms and molecules. At present there are many technical difficulties which stand in the way of such an event. Some of the things needed are better focusing apparatus, extremely accurate current regulators and voltage regulators, and other technical equipment. There is little doubt that extensive progress will be made in these directions.

CAMPUS SURVEY

(*Continued from Page* 18)

both x-'45, and Bill Mitchell, '44. While Brother Kylander was in town, the active members of the chapter were guests at a party given by Bob and his sister, Joyce, and held at the Kylander home. Other guests were Mary Joan Greger and "Libby" Bashe of St. Mary of the Woods College, and Marianna Dede, Joan Harris, Eleanor Johnson, and Bill Lutz of Indiana State Teachers College.

Theta Xi

Kappa chapter installed its newly elected officers on March 19, 1945. The officers elected were as follows: Stephan Liddle, president; Donald Kersten, vice president; Albert Silverman, treasurer; Brice Rumble, house manager; William Dedert, assistant house manager; Jack Doerffler, corresponding secretary.

All of the brothers spent a pleasant vacation at their respective homes during the first week of April.

In addition to the actives of last term, all of whom returned to register for the spring term, was brother Robert Penno who has been out of school because of illness. The chapter welcomes Bob back, and wishes him the best of luck.

The past few weeks have been busy ones for Kappa chapter, with preparations being made for rush week. Also, the spring house cleaning has kept all of the brothers busy in their spare time.

RCA Laboratories model with an 18 by 24-inch screen showing how Bob Hope may appear on future home television.

New Projection Television - Bob Hope's face "big as life"

Can you picture Bob Hope on television . . . seeing his face *big as life*—right in your own living room?

Well, you will—for now, thanks to RCA research, all limitations on the size of home television screens have been removed.

RCA Projection Television sets can have 18 by 24-inch pictures, or for that matter, pictures as large as the screen in a "movie" theater!

When you tune in an NBC television broadcast you'll almost think the actors are in the same room with you—and trust NBC, America's No. 1 network in sound broadcasting, to bring you the best in television entertainment.

This revolutionary improvement was achieved in RCA Laboratories by development of an entirely new reflector and lens, shown in phantom above. This lens, of inexpensive plastic, is 8 times as efficient for the purpose as the finest optical lens.

When you buy an RCA radio, phonograph or television receiver—or any other RCA product—you receive the benefit of the latest research development of RCA Laboratories. It is this *plus value* which is your assurance of lasting satisfaction.

The widespread public recognition of this plus value has given to RCA world leadership in the radio, phonograph, television and electronic art.

Dr. D. W. Epstein with a projection television tube, reflector and lens unit. Here the image on the end of the tube hits the reflector, is corrected by the lens, projected to the screen, then enlarged . . . making possible larger and clearer television than ever before.

RADIO CORPORATION of AMERICA

PIONEERS IN PROGRESS

F-M RADIO

(*Continued from Page* 10)

though many miles apart, tend to interefere with eath other, producing hum, whistle, or crosstalk.

On the other hand, when two FM stations broadcast on the same frequency, your FM radio will select the stronger of the two and reject the weaker one—as if it did not exist. There is no intereference between two FM stations on the same frequency, provided the stronger signal is more than twice as strong as the weaker one. But with conventional radio, you will get station interference unless the desired signal is at least 20 to 50 times as strong as the weaker one.

Station interference occurs in conventional radio because there is not sufficient clearance between channels. One station's program overlaps its neighbors. It could be compared to a narrow two-lane highway where there is not enough clearance between opposing streams of traffic to prevent collisions.

FM is broadcast at much higher frequencies than our conventional radio (42000 to 50,000 kilocycles as compared with 550 to 1600 kilocycles). FM provides wide enough channels so that only 75 per cent of their width is used for the program. This leaves a safety zone between adjacent channels wide enough to guard against overlapping.

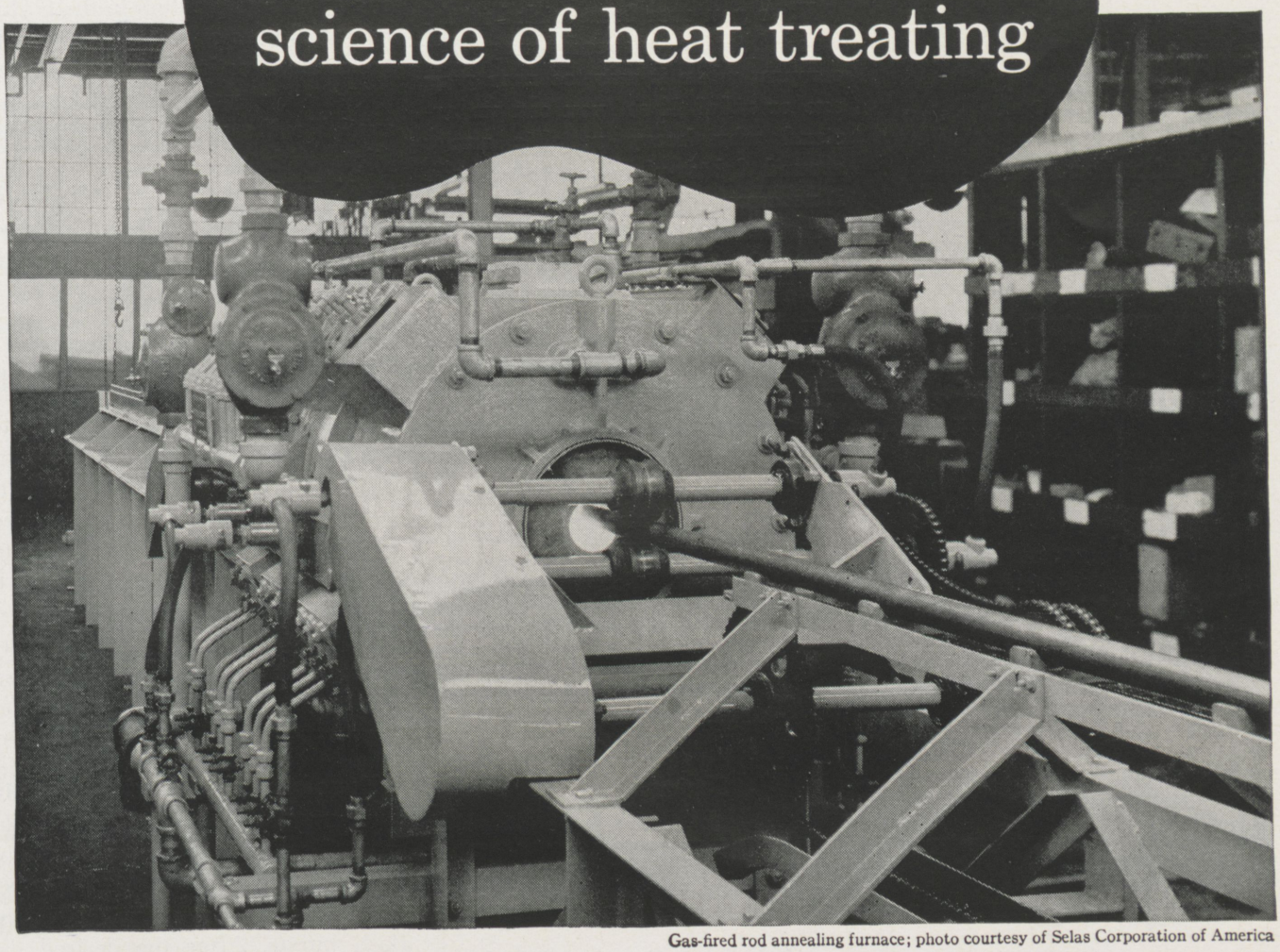
Perhaps it can now be seen why FM by virtually eliminating static and station interference, creates the velvety soft background of silence so necessary for true reproduction.

Back in the early 30's, radio was still a novelty. If you think back to crystal set days, the present day system known as amplitude modulation (AM) seemed perfect. But the engineers and scientists knew better. And one of them, Major Edwin H. Armstrong, who developed the superheterodyne and other important radio circuits, came up with the answer. In 1935, three years after he had applied for patents, he presented frequency modulation (FM) as an accomplished fact.

Today, 53 stations and more than 150 concerns have filed applications with the Federal Communications Commission for permits to build FM

(*Continued from Page* 26)

How Gas advances the science of heat treating



Gas-fired rod annealing furnace; photo courtesy of Selas Corporation of America

Research in Gas application, through the ceaseless study and experiment of equipment manufacturers, independent laboratories and the facilities of the American Gas Association, is constantly producing improvements and new departures in the application of heat, industrially.

For example, heat treating of metal rods in batch furnaces has certain disadvantages, particularly that of uneven heating throughout the bundle of rods. A group of engineers recently perfected a continuous-flow type Gas-fired furnace with a ceramic heating unit capable of intense, focussed heat, and closely fitted to the shape of the work in progress.

There are many advantages to this new Gas technique for annealing. For instance, one inch rod stock passing through a six foot furnace of the new type can be heated and quenched at a rate of 12 feet per minute, no section of the metal remaining under heat more than thirty seconds—against 2½ hours in a batch furnace. Furthermore, better uniformity of heating is achieved; scaling, distortion, decarburization are minimized. Floor space of the new furnace is 24 square feet against several hundred feet for the older type. Over-all costs are also considerably reduced.

Local Gas Companies help make these new benefits of Gas and Gas Equipment available to industry through the services of skilled Industrial Gas Engineers, who are available for consultation without obligation.

BUY WAR BONDS—HELP SPEED VICTORY!

AMERICAN GAS ASSOCIATION
INDUSTRIAL AND COMMERCIAL GAS SECTION
420 LEXINGTON AVENUE, NEW YORK 17, N.Y.

THE TREND IS TO **GAS**

FOR ALL
INDUSTRIAL HEATING

RESEARCH & DEVEL.

(*Continued from Page 20*)

The present model is equipped with a two-position stock for firing when standing or kneeling, and lying down.

New Type Compass

Have you ever been misled in the woods because you read your pocket compass when it was too near your axe or rifle? If so, you can understand why heavy metallic armor around fighter-plane cockpits made it necessary to adopt a kind of compass that could be located in a wing tip, or the tail, but read in the cockpit. Such a remote-indicating compass is now being manufactured it was revealed with the permission of the War Department.

Such compasses offer other advantages in that one compass unit may have several remote indicating dials so the navigator or other members of the crew on large planes can have the same information as the pilot.

Alnico permanent magnets in the compass unit, placed in a wing tip or the tail of the plane far from the plane's disturbing magnetic effects, line themselves up with the earth's magnetic field. These magnets affect the electrical voltages in a wire coil so that corresponding coils in the one or more indicators in the cockpit move pointers over a dial in exactly the same directions as the compass.

Until this type of compass became available the problem of providing pilots with a compass dial which could be located where they could read it, and still be depended upon to guide them, seemed to be growing beyond practical solution.

Robot Cameraman Permits Aerial Photography at Night

An electronic control that automatically synchronizes a new type shutter for aircraft cameras with the bursting of a flash bomb, thus enabling military observers to photograph from high altitudes and at night the destruction caused by their explosives, has been developed through the collaboration of General Electric and The Folmer Graflex Corporation.

Use of this unique control permits the camera to take advantage of the peak illumination of the bomb by beginning an exposure in approximately 1/100 of a second after the flash bursts. After the desired exposure time has elapsed, the control closes the shutter of its own accord. At the same time the camera automatically rewinds the film and gets ready for another picture, thereby

(*Continued on Page 28*)

How many lives is a glass bulb worth?

NO, it isn't a gun or a new-style bomb. It's just about all we can show you of a special glass radio bulb that is a part of our secret military apparatus.

At one stage in the war a high-ranking officer stated that a bulb of this type was so valuable and effective that he would risk the lives of five soldiers to keep it in operation. That's something to think about. And it's one reason why you find Corning men and women today striving to surpass quality standards that are already exacting.

This bulb is made of a special glass to very strict requirements. And so are most of the articles Corning is making for the Army and Navy and other services. They cover a wide range—from airplane wing-tip lights to giant field marking beacon lenses. From laboratory ware for hospitals to optical glass for gunsights. From tough glass messware to thimblesize tubes for field radios.

And these are but a few of hundreds of items that Corning is making for the military services in addition to glassware for industries that supply chemicals and clothing, food, powder, rubber, and gasoline! In these fields and in many others Corning's deep knowledge of glass and glassmaking has made it possible to put this fairly plentiful material to work, not merely as a substitute, but as a new material capable of standing on its own feet and delivering better service in many instances than the one it replaces. Keep this in mind when the peacetime developments you will be working on, reach the blueprint stage—glass is amazingly versatile in the hands of people who know glass. And Corning has spent nearly a century getting acquainted with it. So, when you get to those blueprints, write us. Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

RESEARCH & DEVEL.

(*Continued from Page 26*)

saving the observer precious minutes and permitting another picture to be taken automatically as soon as the next bomb explodes.

Brains of this robot control is a sensitive photoelectric cell that acts on the light impulse coming from the bomb. When the flash explodes, the photoelectric cell picks up a light impulse, amplifies it and transforms it into a current to which the shutter responds in less than 1/500 of a second. By using this ingenious combination, an aerial camera, otherwise of use for daylight photography only, can be converted into a camera capable of taking night photographs of the ground in great enough detail to permit the closest military study.

Small enough to fit into a hat bag and weighing only nine pounds, this robot device was designed especially for use on reconnaissance planes and bombers. Both photoelectric cell control and shutter are shock-proof in construction. When in use, the control operates on three-billionths of a watt—about the equivalent of the energy spent when a human hair falls 1/10 of an inch.

Adapting Radar to Civil Aviation Use

First steps to apply the great safety benefits of wartime radar developments to civil air transport operations have been taken by the Civil Aeronautics Administration experimental engineers.

The "magic" radio detection device moved into civilian radio channels for the first time in March when engineers at CAA's Indianapolis experimental station began work on its use in airway traffic control, airport instrument or "blind" landing procedures and other air transport operations.

Wartime radar has enabled pilots to "sight" unseen enemies in pitch-black darkness and to bomb accurately through heavy cloud layers. Engineers feel that its civilian use may hold the key to the "all-weather" postwar air transport, with possible 100 percent completion of flight schedules through rain and fog.

Cigaratte Temperature

Smokers may not realize it, but the lighted end of a cigarette is so hot its temperature is slightly above the melting point of aluminum or magnesium.

Using a thermocouple, made of extremely thin wires 5/1000ths of an inch in diameter, research engineers have found that the lighted cigarette end is between 1200 and 1325 degrees Fahrenheit. A thermocouple is an electrical device that measures temperature.

Despite the proximity of this terrific heat to the lips, no burns result, because fibrous materials containing air spaces—such as the tobacco in a cigarette—are inherently good insulators. Consequently, the temperature drops off very rapidly from the hot end.

Shutters Get Workout

The shutters of the searchlight, which must open and close hundreds of times during the sending of a single message, were also designed to take severe punishment. A single metal part or fitting that did not survive this pounding might put the searchlight out of commission at a critical moment.

Engineers put the shutters through their "baptism of fire" by rigging up an electric motor with a mechanical arm attached. The arm opened and closed the shutter a total of two million times—the equivalent, engineers estimated, of sending out a 100-word message every day for a period of three years.

HYPNOTISM

(*Continued from Page 15*)

couldn't divulge the secret if captured and tortured by the enemy. Only the intended receiver could receive the message.

James Grippo, fight manager, uses post-hypnosis to make his charge more pugnacious. Hypnotism has various miscellaneous applications, such as treating hysterical paralysis, curing amnesia, confining sleep-walkers to their beds, treating shell shock, stopping the pain of child-birth, and making good students out of bad ones.

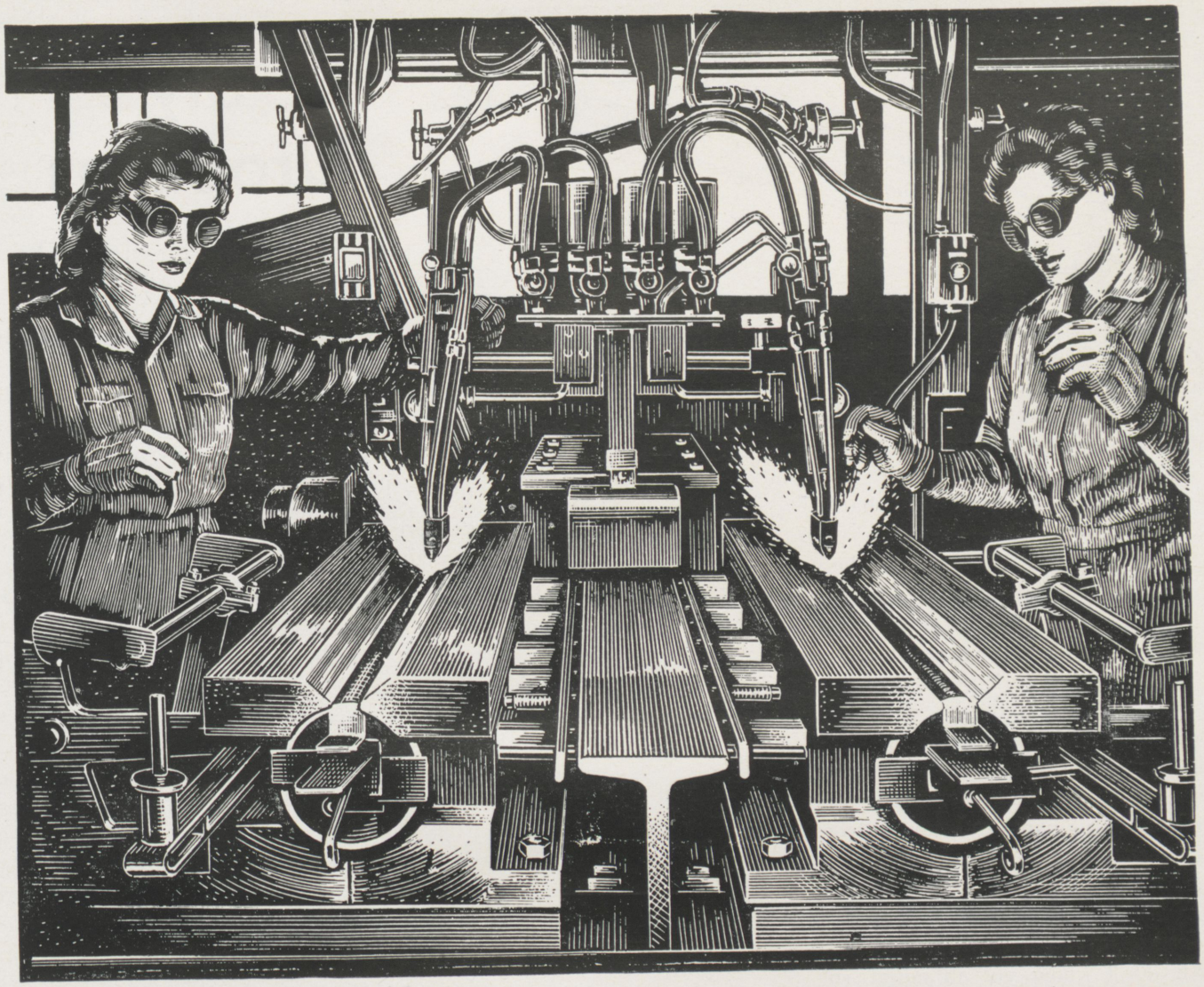
The last important phase of hypnotism is auto-hypnosis, a condition in which the subject is his own hypnotist; i.e., puts himself to sleep, gives himself suggestions, etc. Andrew Slater, an exponent of this type of hypnotism, suggests that by auto-hypnosis, soldiers could go on long hikes without becoming fatigued, and that they could go to sleep in trenches with bombs falling about them.

F-M RADIO

(*Continued from Page 24*)

stations—and the number is steadily increasing week by week.

In 1938, in collaboration with Major Armstrong, General Electric radio engineers proved the superior qualities of FM reception in the home. Today the whole of the radio industry, including both manufacturers and broadcastors, admit that the trend is FM. FM is in because the public likes it.



Courtesy Wheeling Steel Corporation

FLAME STITCHING COVERALLS FOR ARTILLERY SHELLS

SHELLS need protection against corrosion and other surface damage during their long journey to our global firing lines. Each shell is encased in a metal container—a "coverall" that preserves the lethal traveler on the long trip from arsenal to artillery post.

Automatic oxyacetylene flame welding machines perform the main tailoring operation in producing these metal shell-containers. Open seam tubes that have been formed from flat metal sheets are placed into each of ten identical welding machines, two of which are shown above. Then at the push of a button, all ten torches move as one, automatically stitching up the open seams. The operation takes only a minute . . . and the seams are tight and permanent.

This mechanical welding operation—developed in wartime by Airco Engineers—presents interesting opportunities for postwar manufacturing. It combines unusual speed with a high degree of weld uniformity, features that make for increased economy and reduced rejects

For additional information on Airco oxyacetylene flame and electric arc processes, write for a free copy of the interesting publication "Airco in the News". Address your request to Dept. CP, Air Reduction, 60 East 42nd Street, New York 17, N. Y.

★BUY UNITED STATES WAR BONDS★

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NATIONAL CARBIDE CORPORATION
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OXYGEN, ACETYLENE AND OTHER ATMOSPHERIC GASES • GAS WELDING AND CUTTING APPARATUS • CALCIUM CARBIDE
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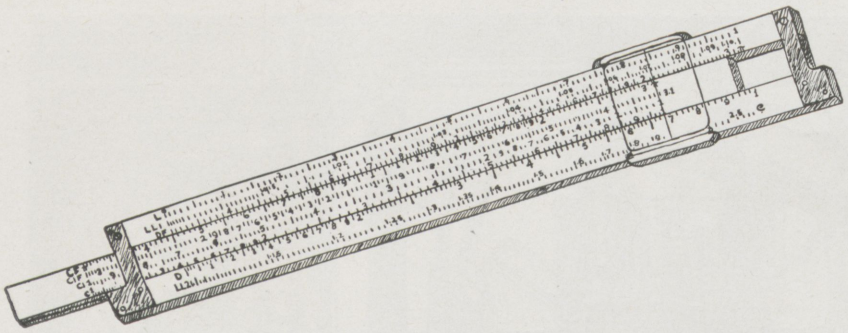


Sly Droolings

by Charles W. Kessler, soph.

The man had just saved the little boy from drowning and was being questioned by the boy's father.

"Are you the man who saved little Johnnie from drowning?"

"Yes, I am."

"Well, where the hell is his hat?"

1st Freshman: "Where in hell have I seen you before?"

2nd Freshman: "I don't know. What part of hell are you from?"

A colored Yankee soldier in England was engaged in a poker game with some British Tommies. He picked up his hand and saw that he held four aces. Anxiously awaiting his turn to bet, he heard someone say, "I'll bet one pound." When the colored boy's turn came, he said, "Ah don't know yo' all count yo' money, but Ah'll raise one ton."

The little old lady bent over the cherub in the cradle.

"O-o-o-o. You look so sweet, I could eat you."

Baby: "The hell you could, you haven't any teeth."

The mad engineer's latest research deals with a speedometer that will play "Nearer My God To Thee" when the pointer hits the 90 mile an hour mark.

Sutton: "What's Professor Straw talking about?"

Silverman: "Integration, you halfwit."

Sutton: "Is he for it or against it?"

DEFINITION

Wisdom—Knowing what to do next.

Skill—Knowing how to do it.

Virtue—Not doing it.

A group of local college boys were coming home from a party one night plastered to the gills. They stood in front of the house of one of their number and called for the father. "Will you please do us a favor?" said one.

"What do you want?" replied the father.

"Will you please come out and pick out Johnnie so the rest of us can go home?"

Newton's thirty-third law: The dimmer the porch light, the greater the scandal power.

Last Sunday that girl was standing in my uncle's corn field and the birds took her for a scarecrow. She frightened the crows so much they brought back the corn they had stolen three days before.

First Lawyer: "As soon as I realized it was a crooked business I got out of it."

Second Lawyer: "How much?"

I never kiss, I never neck,
I never say hell, I never say heck;
I'm always good, I'm always nice,
I play no poker, I roll no dice.
I never drink, I never flirt,
I never gossip or spread the dirt;
I have no line or funny tricks,
But what the hell, I'm only six!

God made a machine; the machine made men:

Doctors, lawyers, priests, and then,

The devil got in and stripped the gears,

And turned out the first batch of engineers.

He: "Do you believe kissing is unhealthy?"

She: "I couldn't say—I've never—

He: "You never been kissed?"

She: "I've never been sick."

Joe: "Have you got a picture of yourself?"

Roommate: "Yeh."

Joe: "Then let me use that mirror. I want to shave."

Little Johnnie had torn his trousers twice in the course of one morning, and when he came in with his pants torn again his mother said: "You go right upstairs, remove your pants, and mend them yourself."

Sometime later, she thought of him and went upstairs to see how he was getting on. The torn pants were lying on a chair, but there was no sign of Johnnie. Returning downstairs, she heard a noise in the cellar and decided that he was down there playing. "Are you down there running around without your pants on?" she called loudly.

"No, madam, I'm just reading the gas meter," a deep voice replied.

By the way is your name Cleophus Petrovich?

No.

Aren't you glad?

Faith of the Engineer

I am an Engineer. In my profession I take deep pride, but without vainglory; to it I owe solemn obligations that I am eager to fulfill.

As an Engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity.

When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies.

Jealous of the high repute of my calling, I will strive to protect the interests and the good name of any engineer that I know to be deserving; but I will not shrink, should duty dictate, from disclosing the truth regarding anyone that, by unscrupulous act, has shown himself unworthy of the profession.

Since the Age of Stone, human progress has been conditioned by the genius of my professional forbears. By them have been rendered usable to mankind Nature's vast resources of material and energy. By them have been vitalized and turned to practical account the principles of science and the revelations of technology. Except for this heritage of accumulated experience, my efforts would be feeble. I dedicate myself to the dissemination of engineering knowledge, and, especially, to the instruction of younger members of my profession in all its arts and traditions.

To my fellows I pledge, in the same full measure I ask of them, integrity and fair dealing, tolerance and respect, and devotion to the standards and the dignity of our profession; with the consciousness, always, that our special expertness carries with it the obligation to serve humanity with complete sincerity.

Campus News

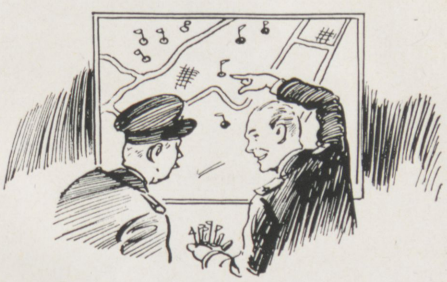
RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

HOSPITAL ON WHEELS

SOME PEOPLE—perhaps when they're very young—have a touch of tuberculosis. It may be just a spot on their lungs, which hardens and never causes any trouble. On the other hand, thirteen people out of a thousand, when examined by X ray, show evidence of reinfection tuberculosis. This does cause trouble unless it's treated at once.

G-E photo-roentgen units make it possible for public health and welfare organizations to reach and examine, not only thousands of persons in large cities, but in rural areas and thinly settled sections as well.

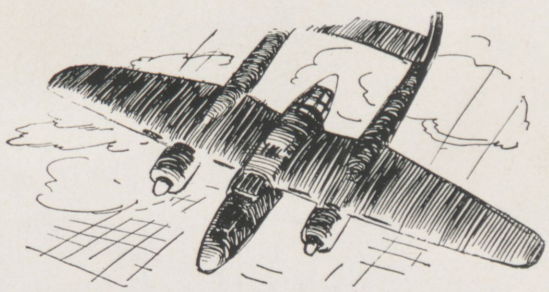
Forty-five to sixty chest X rays an hour is the record of mobile units designed and built by the G-E X-Ray Corporation. As each person takes his turn in the bus-like vehicle, a small fast-lens camera transfers his chest image from the standard size fluorescent screen onto a supersensitive 4 x 5 inch X-ray film.



MAGNETIC MAP MARKERS

LOCATING an enemy position or tracing the course of our own convoy is a war job of the alnico magnet. Both Army and Navy use G-E sintered alnico as magnetic map markers—with its aid keep abreast of vital information.

Alnico is an alloy—of aluminum, nickel, cobalt, and iron—with greater magnetic power than any other known material. To make sintered magnets G.E. begins by pressing powders of all these metals. After heating and wet grinding, one surge of current makes alnico a permanent magnet. And with a piece of steel behind the wall map, the markers can move around but won't fall off.



DEATH FROM A P-61

SOMEWHERE in the European theater of operations there is a squadron group called the Green Bats, whose Northrop P-61 Black Widow planes carry as their insigne a green bat against a yellow moon.

These Widows fight by night—with G-E remote-control gunfire. Once they let loose, the four electrically-operated .50 calibre guns can swing a deadly barrage on their target. Each plane has two sighting stations. A gunner at either of them—or the pilot himself—can take a turn at building up the high score of enemy planes downed. In the two months following D-Day it totaled 400 for the Bats—and groups like them.

General Electric Company, Schenectady 5, N. Y.

Hear the G-E radio programs: "The G-E All-girl Orchestra," 10:00 p.m. EWT, NBC—"The World Today" news, 6:45 p.m. EWT, CBS—"The G-E House Party," 4:00 p.m. EWT, CBS.

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