RADIO AGE

RESEARCH · MANUFACTURING · COMMUNICATIONS · BROADCASTING

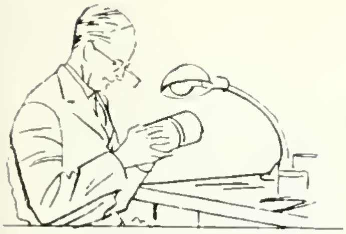
Sir Robert Watson-Watt

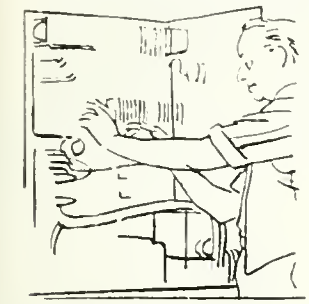
David Sarnoff

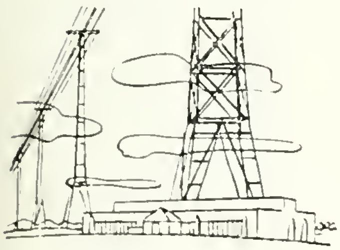
RCA

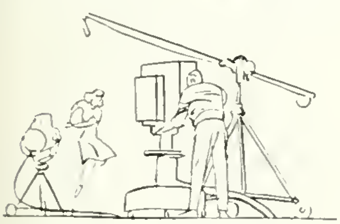
JANUARY

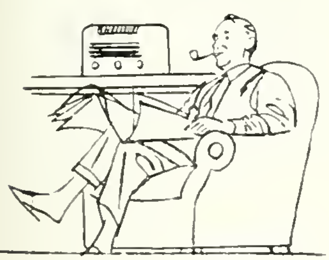
1944











'HE COVER — This excellent 'ull-color photograph of Sir Robert Watson-Watts and Colonel David Sarnoff was nade on November 30, when Colonel Sarnoff was host to a British technical mission and similar group of Americans t luncheon in the RCA Building, New York. (For other ictures and information, see ages 16 and 17)

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VOLUME 3 NUMBER 2
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Radio Age, published quarterly by the Department of Information of the Radio Corporation of America, RCA Building, New York, N. Y., for the RCA services: RCA Laboratories, RCA Victor Division, R.C.A. Communications, Inc., Radiomarine Corporation of America, National Broadcasting Company, Inc., R.C.A. Institutes, Inc., RCA Service Company, Inc.

RCA TELEVISION RECEIVER BRINGS THE RODEO IN MADISON SQUARE GARDEN TO WOUNDED SAILORS IN THE U. S. NAVAL HOSPITAL, ST. ALBANS. (STORY ON PAGE 24)

Sarnoff Looks Ahead

RCA PRESIDENT SEES NEW ELECTRON TUBES OPENING UNLIMITED OPPORTUNITIES—RADIO INDUSTRY NOW BREAKING ALL RECORDS

y David Sarnoff
resident,
adio Corporation of America

RADIO activity in research, engineering, communication and anufacturing during 1943 may be immed up in one objective—win ie war! Although wartime secrecy nposes limitations, the end of the ear affords appropriate opportuty to gauge radio's vital role in ie world today, and to measure the gnificance of wartime developents as they may fit into the pattrn of the future.

Strongly fortified by the ingenuy and skill of American research id industrial enterprise, radio has itered its third year of war in the rvice of the United States. Years suspense—a year of defense and year of offense—have gone into story. As 1944 begins, the United ations are on the road to Victory. year of intensified offensive, such s the world has never known, is iead. Only time can tell, however, hether 1944 is to be the year of ecision—the year of unconditional irrender of the forces which have ought destruction and tragedy pon the world.

Radio's Role Great

Radio's great role in global warire is coordination achieved irough lightning-like communicaon, regardless of distances, natul barriers or the enemy. The oplication of radio-electronics to etecting, ranging and navigation being greatly extended with miaculous results. Thus, the future f radio is an ever-increasing circle within whose orbit new peacetime services are being evolved through wartime research and engineering. As keys to the microwave spectrum, more powerful electron tubes are opening the domain of tiny wavelengths, which possess unlimited possibilities in radio and its related fields of electronics, television, radiothermics, supersonics and electron microscopy.

Today, science marches with the victorious armies. It sails with the fleets and flies with the air armadas. The totalitarian powers intent upon conquest, invaded country after country, and perverted inventions of science to warfare. They have failed.

Today, on the wings of the airplane, Victory soars. On the waves of radio, Freedom sends its heartening message around the world. Science triumphant has given winged Victory indomitable power. There is no direct clue, however, to reveal how long and difficult the march to final Victory will be. Until the goal is reached, there must be no letdown in the all-out effort to win the war.

The American radio industry is breaking all records in production and communication. As the New Year unfolds, the "ether" pulses with new vigor. Micro-waves accomplish new wonders. Daily, 400,000 radio-electron tubes are manufactured. Every hour of the day and night, all America is informed by up-to-the-minute broadcasts on the progress of the war. At the same time, short-wave broadcasters are reaching every land throughout the world regardless of enemy restrictions. Tons and tons of apparatus are sent into combat every week. Miles and miles of transoceanic radiotelegraph circuits are vibrant with urgent dispatches,

DAVID SARNOFF

news and communiques. Messages are flashed by automatic high-speed machines at the rate of 600 words a minute.

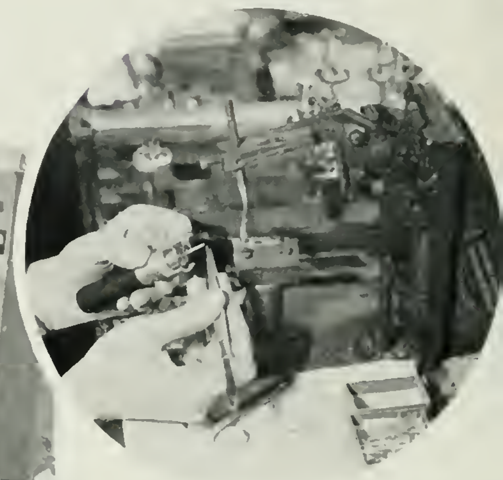
Latest estimates reveal that radio production in the United States is up to $250,000,000 a month against $30,000,000 a month a year ago—all for the armed services. The equipment is the finest and most efficient in the world. America's radio-electronic scientists and engineers have far surpassed Germany's much vaunted super-men of science.

Praises Workers' Record

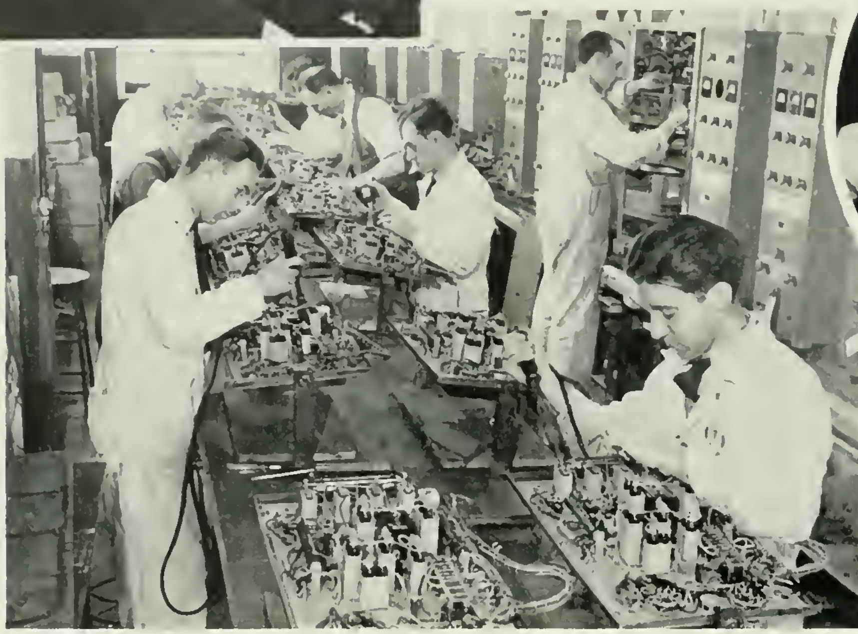
From every theatre of battle, come reports of the outstanding performance of American radio. This speaks high praise for the workers on the production front, who are achieving an unparalleled industrial record. Their patriotic spirit and skill on the assembly lines supplement the courage, initiative and fighting spirit of the men who take radio into battle. A radio flash from a walkie-talkie in a foxhole, or from a handie-talkie on a beachhead, may well be the signal of victory. A radio flash from the cockpit of a fighter plane, or from a rubber liferaft, may turn the tide of a battle, or save the lives of struggling men. Radio's record for 1943 attests the triumphs of the deft fingers that make radio tubes, of the hand that manipulates a

RESULTS OF WAR-TIME RESEARCH IN RCA LABORATORIES POINT TO NEW PEACE-TIME RADIO SERVICES. HERE, EXPERIMENTAL TUBE PARTS ARE BEING REMOVED FROM A HYDROGEN FURNACE.

DELICATE FEMININE FINGERS PERFORM INTRICATE TUBE ASSEMBLY JOB (BELOW) IN RCA VICTOR PLANT. THE RADIO INDUSTRY IS PRODUCING ELECTRONIC TUBES AT THE RATE OF 400,000 A DAY.



THE SCENE BELOW IS FROM AN RCA PRODUCTION LINE, WHICH IS CONTRIBUTING TO THE RECORD-BREAKING VOLUME OF RADIO EQUIPMENT BEING SUPPLIED THE ARMED FORCES.



soldering iron on the assembly line, or the skill of the tester who declares the completed apparatus ready to enter the fight.

In fulfilling its unprecedented wartime responsibilities, radio has taken its place among the great industries of America, offering employment to hundreds of thousands of workers. Since the war began in Europe, RCA employees have increased from 23,000 to more than 40,000. Another 6,000 employees are enrolled as officers and enlisted men in the military services. Many of them are in the front-line of communications — they strengthen, maintain and operate the life-line of Victory.

It is a tremendous task to supply radio instruments and installations to our army of 8,000,000 men aligned on a global front; to meet the needs of our allies for radio, and to install radio apparatus in thousands of aircraft, warships, transports, tanks and mechanized units as well as in all airfields and outposts. This task is intensified by new and exacting specifications of war, ruled by all sorts of conditions related to topography, seas, weather, climate, and altitude. Radio apparatus, subject to constant movement, rough handling and assault in the field, on the seas and in the air, must be rugged to be dependable. Our fighting men know and appreciate that the radio research men, engineers and production workers have succeeded in meeting the demands of war. Their craftsmanship keeps faith with science as well as with the Army, Navy and Air Corps.

Serve Home Front

American-built radios have been under fire now for more than two years. Within that period home-radios in the United States have been used as never before as a source of news and entertainment. A home without a radio is out of tune with the world. Americans everywhere have an ear to the battlefronts. There are 60,000,000 receiving sets; 31,000,000 "radio families"; 900 broadcasting stations; 14 American international short-wave transmitters; millions and millions of radio-electron tubes glow in the service of the Nation and its people.

The fact that our civilian radio service is not disrupted during these war years, when all-out effort and materials are directed to winning the war, is high commendation of the quality of American radios as designed for the home. In this country broadcasting has not been distorted by censorship, nor put under absolute government operation and strait-jacketed by stringent rules on listening. Americans listen to enemy broadcasts without danger of death-penalty or imprisonment. All this liberty in wartime is proof of radio's faithful alliance with Democracy and the Freedoms.

Scientifically, the outstanding developments of 1943, as those of 1941-42, are classified as military secrets. It violates no secret, however, to report that outstanding advances have been made in the use of radio sound and sight. Nothing in radio is ever new for long, even in peacetime. War, however, changes the old order of things even more rapidly.

New instruments and new services are in the offing for peace. The wartime pace that science is called upon to maintain is breathtaking. Nevertheless, American radio keeps up with it. Our laboratories are creative beehives of activity; our manufacturing plants are arsenals; our communication waves are lifelines. To reconvert them all to peaceful pursuits will present a great challenge to the radio industry. It will be a most promising field for post-war employment and opportunity.

When the war ends American industry must not be without a chart for the future. The post-war era will bring many challenges and problems to test American leadership and enterprise. Few industries compared to radio hold greater opportunity for the solution of problems relating to industrial progress and employment or the maintenance of the American standard of living. Industry must be prepared to reconvert as quickly as possible from war to peace, yet without the slightest neglect or relaxation in the total war-effort of the present.

Radio as an industry is fortunate to have television as a postwar development of great promise and popular appeal, able to open a new era in service to the public.

New Things to Come

There should be no expectation, however, that when the war ends the air will be transformed overnight to television. It will require from 3 to 6 months to get the machinery in operation to resume the manufacture of civilian broadcast receivers. It may require a year after approval of standards and full authorization of commercialization of television broadcasting by the Federal Communications Commission before television sets are available within the price range from $200 to $300. Production of television receivers is not the only task. Television transmitters must be erected. Interesting programs must be planned. Automatic radio relay stations must be built to link key cities into a network. That is no one-year job.

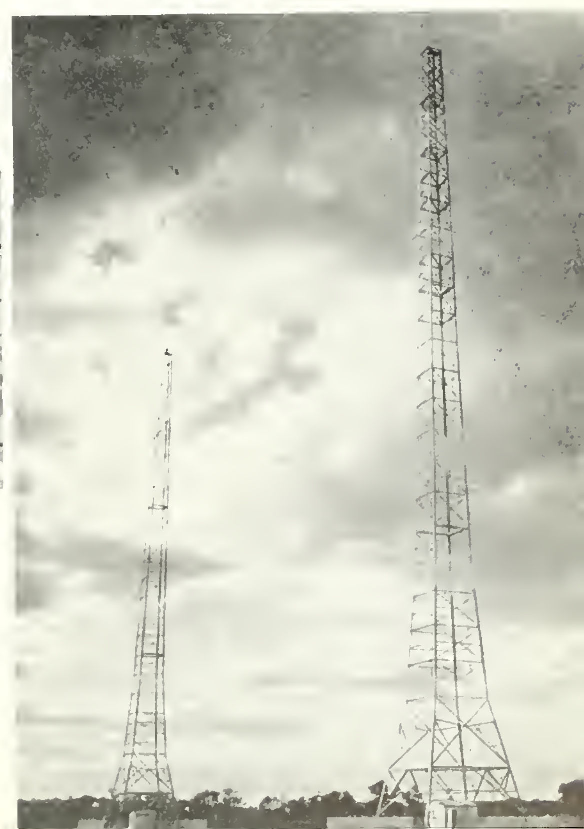
Alongside of television, "FM," or frequency modulation on ultra-short waves, holds great promise of becoming an added feature in broadcasting. Even now "FM" carries the sound part of television. In both television and "FM," much scientific progress has been made in connection with the application of radio to the war. The home-radio instrument of the future will be a combination television and sound-broadcast receiver incorporating "FM" and a phonograph.

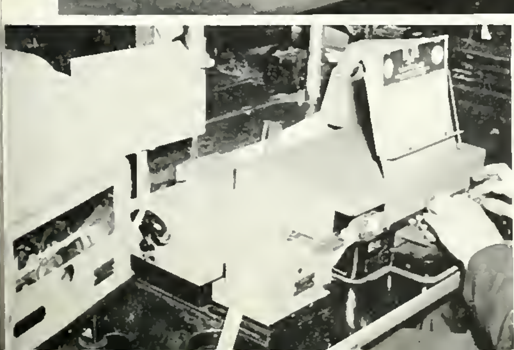
Outside the realm of radio communication, the application of radio-thermics, or radio heating, is finding widely extended use in industry. The use of high-frequency waves for heating is a wartime development of no small achievement. It is accelerating and increasing the efficiency of numerous industrial processes.

The electron microscope, now produced under a high wartime priority rating, will be made available over a vast field of usefulness after the war. It will be compact

SPECIAL RADIO COMMUNICATION UNITS, DESIGNED BY ENGINEERS OF RADIOMARINE FOR LIFEBOATS, ARE PROTECTING LIVES OF THOUSANDS OF AMERICAN SEAMEN.

THESE TOWERS OF WEAF, KEY STATION OF THE NBC NETWORK, SERVE THE HOME FRONT WITH UP-TO-THE-MINUTE NEWS AND ENTERTAINMENT.





HIGH-SPEED MULTIPLEX RADIO-TELEGRAPH PRINTERS AT RCA COMMUNICATIONS TRANSMIT WAR-VITAL MESSAGES ACROSS THE SEAS AT THE RATE OF HUNDREDS OF WORDS A MINUTE.

and portable, and its service will be greatly increased. In addition, RCA Laboratories has succeeded in developing an electron micro-analyzer, which, incorporating an electron microscope, enables atomic identification of the chemical elements comprising submicroscopic particles of matter. For example, if there is iron in the nucleus of a bacterium, the micro-analyzer detects it.

Because of spectacular wartime developments, radio apparatus will be adapted for collision prevention to aircraft, ships, railroads and possibly automobiles. All this will be part of the new service of radio in an era of sight control made possible by the development of electron tubes in the field of microwaves.

New Tubes Foreseen

As new electron tubes always serve as keys to major advances, so in broadcast reception, new and tiny tubes—smaller than acorns—may introduce "personalized" radio. Small, compact receivers, and even transmitters may be built in a little case that will slip into a pocket. The uses to which such "stations" may be put gives the imagination much to play upon.

All these new developments will not be realized in 1944, but with 1944 as the year of expected decision in the European war, they will date from it, as radio broadcasting dated from 1919.

The new ideas, tools and instruments of progress that emerge from the war may well give us 1960 radio in 1950. War shrinks the lapse of time between invention and its practical use. The merit of a discovery is quickly appraised and harnessed.

While we can see all these signs of progress, we must not lose sight of the losses suffered to the world through the casualties of battle. The boy who fell in the jungles of Guadalcanal, on the sands of Africa, on the road to Rome, who vanished in the Atlantic or Pacific or parachuted into the realm of missing warriors, may well have carried with him a revolutionary idea. When we review a year of war we wonder what might have been the fate of wireless had war taken the lives of such men as Maxwell, Hertz, Marconi, deForest, Alexanderson, Armstrong and Zworykin, in their youth.

But the young men, lost to the world and to science in this war, have, in their supreme sacrifice, made it possible for the civilized world to progress; they have contributed far more than invention. They have made future invention possible by the defense of a civilization in which men can think, study, work and achieve for the welfare of mankind under freedom and justice.

We may look forward to 1944 with high hopes, bulwarked by a determination never to break faith with those who have fallen, or with those who are marching with the Stars and Stripes, on the bomb-infested road to Victory.

RADIO-ELECTRONIC DEVICES, SUCH AS THE RIVET DETONATOR (RIGHT), HAVE GREATLY SPEEDED UP PRODUCTION FOR WAR IN NUMEROUS BRANCHES OF INDUSTRY.

TWO TYPES OF THE ELECTRON MICROSCOPE (LOWER LEFT) HAVE BEEN DEVELOPED IN RCA LABORATORIES BY DRS. JAMES HILLIER, LEFT, AND V. K. ZWORYKIN. THE LARGER, STANDARD, MODEL IS SERVING WAR-TIME RESEARCH.

LARGE-SCREEN TELEVISION RECEIVERS FOR THE HOME (LOWER RIGHT) HAVE BEEN DEVELOPED EXPERIMENTALLY BY RCA, AND ARE PART OF TELEVISION'S POST-WAR PROMISE.

Radio Vital to Victory

HARBORD SAYS SCIENCE OF RADIO-ELECTRONICS IS IMPORTANT FACTOR IN WINNING THE WAR—REVIEWS MILITARY USES

LIEUT. GEN. JAMES G. HARBORD

By Lieut. Gen. James G. Harbord

Chairman of the Board, Radio Corporation of America

THE Second World War has been called a "radio war," because the science of radio-electronics is an all-powerful factor in the formula for Victory. The nations which make the most efficient and strategic use of the radio spectrum in this war possess an outstanding advantage. There is every indication that the United Nations, unsurpassed in scientific resources, have gained the initiative in offensive on the highway to Victory. I have every confidence that the advance will continue. When the war will end no man can predict; there are too many imponderables. They cannot be figured mathematically. Unpredictable human behavior and morale are not accurate factors in mathematical calculation or in formulas of world-destiny.

Helps Time Attack

Global warfare on the vast scale and at the high tempo at which this war is being conducted could not be waged successfully without radio-electronics. The infantry, mechanized units, warships, transports, bombers and fighter planes would be tremendously handicapped without radio communications.

Radio helps to time the attack; to locate the enemy and aid the artillery in accurately placing its shots. Radio is the voice of the commanders on the beachheads and at the bridgeheads, of troops in foxholes and of sailors in lifeboats or on rafts. Radio coordinates military and naval operations; it saves lives, time and materiel. The split-second precision of the mighty air squadrons flying over Berlin would be impossible without radio instructions, coordination and navigation. Radio at the same time is used to confuse the enemy, to prevent concentration of intercepter forces, and to draw enemy fighter planes to another city distant from the target. There were no such radio tactics in the First World War. Radio then was used chiefly for exchange or delivery of messages, but on a greatly limited scale compared to its modern uses.

Every war sheds light on new military and scientific developments. The flintlock rifle was a radically new weapon in the Revolutionary War. The telegraph, transatlantic cable, photography and armored vessels were innovations of the Civil War. During the Spanish-American War, magazine rifles came into action. In the First World War, we had automobiles, trucks and tanks for the first time; the airplane found a comparatively limited use; the electron tube, the radiophone and short-wave radio gained new prestige.

Now, in the Second World War we are witnessing the greatest of revolutions in military operations. It marks a summit of all the Ages in use of scientific weapons—radio, aircraft, mechanized units, and more accurate and long range artillery. The world has never seen armies hauled around so quickly over such vast areas. Even within our own country, before the soldier completes his training and goes overseas, I am told that the average man makes at least six railroad trips. When he arrives on foreign shores, he can hear broadcasts of news and entertainment from America. He can have a piece of apple pie and go back for seconds in the African desert, or he can eat ice cream in India! No war has ever witnessed the transport of men and supplies as in World War II. Military leaders fly from outpost to outpost, from battlefront to battlefront in a matter of hours while 25 years ago the same journey would have consumed weeks, perhaps months of dangerous travel across mine and torpedo infested seas. Warfare in a quarter century has been revolutionized by science—by radio, the airplane and mechanized units but soldiers with rifles are still necessary to win a war!

New Fields Listed

When the full story of the Second World War is written there will be amazing revelations of radio's participation through every phase of its activity. New developments in radio-electronics will come to light. New uses will be disclosed in the application of radio as a navigational aid, in averting collisions, in "blind" flying, and in development of many devices such as tiny, lip microphones, new electron tubes, metal locators, automatic direction finders for planes and ships, all of which will be converted to peacetime pursuits.

Tubes Key to Progress

ULTRA-HIGH FREQUENCY, MICROWAVE FIELDS ARE LIKENED BY THOMPSON TO UNDEVELOPED LANDS OF WEST 80 YEARS AGO

By B. J. Thompson
Associate Research Director
*RCA Laboratories,
Princeton, N. J.*

ONE hears a great deal about electronics these days. It is promised that electronics will do almost everything to make life easier and more enjoyable after the war. The scientists and engineers who have been engaged in vacuum-tube research and development find themselves a little bewildered and perhaps a little resentful of all the talk about electronics for two reasons. First, they have called their own field of specialization "electronics": the name of their profession is being stolen before their eyes. Second, they feel that electronics (in its present broad meaning) is not new, and they wonder at the sudden shouting and excitement.

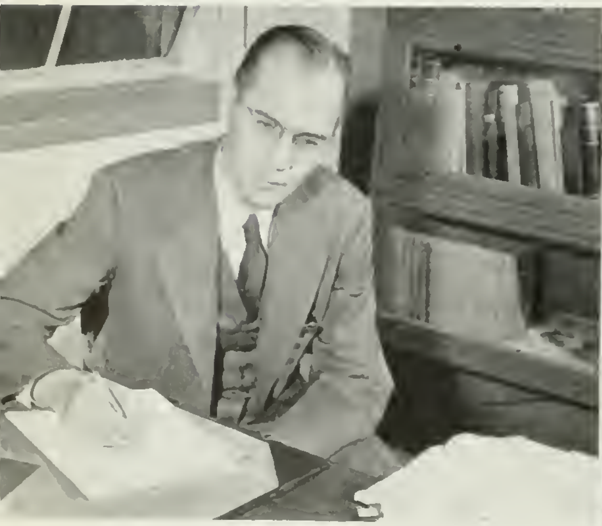
Those who have time these busy days to philosophize briefly over the matter may readily reconcile themselves to the situation, however. The theft of the name of their profession is a tribute to the importance of the work which these men and their predecessors have done. And the sudden excitement may be justified by the remarkable wartime accomplishments of electronics and the reasonable expectations for peacetime contributions to come.

Normally, it is not for the scientist to blow his own horn. But the men who have been devising new kinds of vacuum tubes have heard so often that "the tube is the heart of radio" and, more recently, that "the tube is the heart of electronics" that they may be forgiven for believing it. The engineers and scientists who create new radio transmitters and receivers, television equipment of all sorts, and the electronic devices used in war and in industry seem almost invariably to start their work by coming to the vacuum-tube engineers and saying "we need a new tube to meet our requirements; without it we cannot do our job." The tube engineer is convinced that his work is either the keystone of electronics progress or the chief obstacle to progress, depending on its success or failure. In any event, he knows that he personally is one of the principal bottlenecks in the war effort. That is why he looks even a little more haggard than his fellow technical workers. Nothing can be said publicly of his wartime accomplishments to cheer him up, but it might not be inappropriate to look at some of his past work.

RCA Laboratories is one of a number of important American laboratories in which the full technical effort of the staff is devoted to developing new military applications of radio and electronics—developments which have contributed and will contribute to shortening the war and to assuring victory to the United Nations. The engineers and physicists of RCA Laboratories who are engaged in developing new vacuum tubes were fortunate in being able to turn as a team from their peace-time pursuits to an all-out war effort with little change in the nature of their work.

In the days before the war, the

IN RCA LABORATORIES, DR. D. O. NORTH (LEFT) COMPUTES THE PERFORMANCE TO BE EXPECTED OF A NEW TUBE, ONE OF THE EARLY STEPS IN A RESEARCH PROJECT; B. KULLEY (CENTER), USING JEWELER'S LATHE AND MAGNIFYING SPECTACLES, MAKES A SMALL PRECISION PART, AND DR. R. TRUELL (RIGHT) OPERATES A HYDROGEN-FILLED, QUICK-HEATING BRAZING UNIT.



electron tube research of RCA Laboratories was largely concentrated in two fields, ultra-high frequencies and television. Years before, these men had helped to produce the great variety of tubes required for modern radio receivers and transmitters and for industrial and scientific applications of electronics.

The story of the beginning of applied electronics has often been told. The Fleming valve and the DeForest audion, in 1903 and 1906, greatly improved the sensitivity and reliability of "wireless" receivers. These were the first "vacuum tubes," and all later developments in electronics stem from them. About 1912, the triode oscillator and the amplifier were developed. These notable contributions were not tube developments, but were exclusively circuit accomplishments. Engineers had suddenly learned how to use tubes in their two most important applications. Tubes could be used to generate high-frequency oscillations and to amplify very weak radio signals. The importance of tubes was greatly increased, leading to intensive effort in several large research laboratories directed toward understanding and improving vacuum tubes. Developments came rapidly. The scientific effort devoted to tubes has increased continuously ever since, and the results in new accomplishments have not diminished.

The early vacuum tubes were small affairs and were used entirely for radio reception. The high-frequency oscillations required for transmitters were generated by sparks, the Poulsen arc, or by great, high-speed rotating alternators not very different, superficially, from the "dynamos" one sees in electric power stations. Each of these sources had serious limitations. If high-power tubes could be constructed, vacuum-tube oscillators could be used as generators for radio transmission. By 1915, the first practical transmitting tubes had been demonstrated. The vacuum-tube oscillator proved to be so greatly superior to other generators for radio transmission that, by the early 1920's, there was no further development or manufacture of any other type of generator.

Early Tube Developments

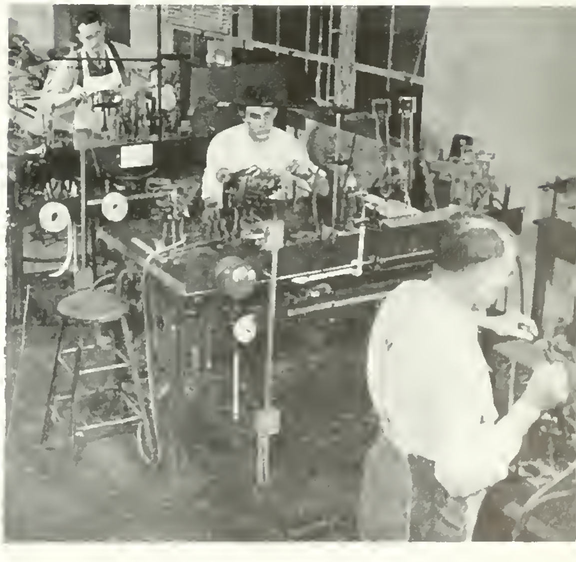
When radio telephony came along about 1915, high-power tubes were essential as modulators to impose the voice signal upon the radio waves. Without these large tubes, radio would have been confined to telegraphy. Our modern radio broadcasting, begun in 1920, is simply an outgrowth of the radio telephone.

The first World War contributed much to the development of vacuum tubes. There was intensive effort devoted to the development of radio for military communications. As usual, the tube was the bottleneck. This resulted in many important developments in the way of tube design and manufacture, which later facilitated the great expansion of radio that began with broadcasting.

From the end of the war until 1927, the most noteworthy tube developments were in the direction of producing more powerful and more efficient transmitting tubes and more reliable and more economical receiving tubes. The high-vacuum receiving tube for use in radio-frequency amplifiers made its appearance. Tubes which took little power to heat the filament were produced, making possible receivers operated by dry batteries. These developments may seem modest in looking back, but they were of almost as much interest to millions of radio "fans" of that day as the latest models of automobiles were to motorists in the days when there were new models. A man knew and took pride in the fact that his receiver was a Radiola and contained six UV199's.

In 1927, the home radio receiver ceased to be a plaything requiring much attention and became simply an instrument for receiving radio programs which could otherwise be ignored. This change came about through alternating-current operation, made possible by the development of tubes in which the cathodes or filaments could be heated by

FRANCES KAWALEK (LEFT) OPERATES AN ELECTRONICALLY-CONTROLLED WELDER IN EXPERIMENTAL TUBE ASSEMBLY; ADELE RZESUTEK (CENTER) USES A SPECIAL ALIGNMENT JIG UNDER A TOOL-MAKER'S MICROSCOPE FOR FINAL ADJUSTMENTS OF A TUBE ASSEMBLY; AND A SECTION (RIGHT) OF THE GLASS-BLOWING ROOM, WHERE HIGH SKILL IS ESSENTIAL.



alternating current, thus eliminating the "A" battery. The "B" battery was eliminated by the use of new rectifier tubes. This development was promptly followed by the screen-grid tube, which was noteworthy because it represented the first revolutionary improvement in tube design since DeForest added a grid to the Fleming valve.

The screen-grid tube had simply another grid but the fact that a second grid would be any better than a second steering wheel on an automobile had not been obvious. The technical results obtained by the use of the second grid were of major importance. Perhaps of even greater importance was the fact that the way was opened for a great diversification in tube design through the use of additional grids and other electrodes, making a tube a specialized item designed for a particular purpose. The tube engineer was now under pressure to produce a tube tailor-made to fit a given job. As a result, the number of tube types available commercially increased from a dozen or so to several hundreds within ten years.

In the past fifteen years, much effort has been devoted to the study and development of the ultra-high radio frequencies. If tube engineers could have turned out promptly tubes which would meet the specifications of other engineers who were impatient to develop this virgin territory, the problems would have been solved long ago. Instead, they have moved haltingly, at first taking small, unsure steps. But they have moved forward and with increasing pace. It is certain now that after the war we shall see the development of the extremely high radio frequencies in a manner almost undreamed of ten years ago. These developments will include such things as the radio relay and navigation aids which will prevent collisions of ships at sea and will enable planes to navigate and to land under any conditions of visibility.

The ultra-high frequencies have been—and still are—the great field for expansion in radio. They are to radio what the undeveloped lands of the West were to American agriculture eighty years ago. Radio transmission for any purpose uses a portion of the radio-frequency spectrum. At the lower frequencies, its use for one purpose prevents its use for any other purpose, at least in that geographical vicinity and perhaps in the whole world. New developments in radio, in general, are possible only by turning to unused portions of the spectrum. These unused portions, by the very nature of things, can be found only by going to higher frequencies. This situation has long been recognized. There have been many proposals and much experimental work directed toward development of the ultra-high frequencies. But always progress has awaited the development of suitable tubes.

One of the very attractive possibilities involving the use of the ultra-high frequencies is the radio relay system. Ralph R. Beal has recently discussed (*Radio Age*, October, 1943) this system as it may be developed after the war. It is no secret that RCA Laboratories engineers were actively engaged on this development before the war. As they envisaged the system, television, facsimile, voice, and telegraph signals could all be transmitted simultaneously across the country from one "light-house" tower to another on narrow beams of ultra-short waves, or microwaves. When they laid their plans they knew the radio frequencies they would need to use. The serious difficulty they faced was that there were no suitable tubes for their purpose. They then turned to their co-workers, the tube engineers, and explained their needs.

Working in co-operation with the engineers developing the complicated radio equipment for the relay towers, the tube engineers produced several new kinds of tubes meeting the requirements of the relay system. One of these was the inductive-output tube, embodying entirely new principles especially suitable for ultra-high-frequency amplification. In this tube, the energy is taken from the electron stream directly through the glass walls of the tube without wire connections.

With the coming of the war, the radio relay system had to wait while more urgent matters were taken care of. After the war it seems certain that the system will be developed commercially and that

LIQUID AIR, TEMPERATURE 313 DEGREES BELOW ZERO, FAHRENHEIT, IS USED BY J. BURNETT TO IMPROVE THE VACUUM IN A TUBE WHEN IT IS COMPLETED. BELOW, H. A. FINKE TAKES PERFORMANCE DATA ON A RESEARCH TUBE AS IT IS PUT THROUGH ITS PACES IN AN ELABORATE SERIES OF ELECTRICAL TESTS.

it will prove to be of great value. One cannot say now whether the post-war relay system will use the tubes developed for it before the war or whether, instead, some of the great wartime developments will be used. In any case, the success of the radio relay depends on the new tubes which are made available in the ultra-high frequency or microwave region of the spectrum.

What has been said of the intimate relationship between tube developments and the application of microwaves to the relay system applies to almost all other applications of microwaves. For new applications, new tubes are required.

Outstanding RCA Record

In the field of television, the record of RCA Laboratories physicists and engineers is outstanding. Television became an electronic art—and a practical possibility—through their development of the Iconoscope and the Kinescope. The Iconoscope receives the optical image of the scene to be transmitted, stores it, analyzes it into its elements, and converts it into electrical impulses for transmission. The Kinescope converts the electrical impulses at the receiver back into an image for viewing.

Remarkable as was the performance of the Iconoscope and the Kinescope, further progress was demanded. The Iconoscope required too much light for the transmission of a satisfactory picture. In the studio, the performers complained of the glare and the heat. Outdoors, the last quarter of a football game on a rainy November afternoon, when viewed on a television receiver, might become lost in the "snowstorm" of background disturbances, similar to "noise" or static in the case of sound broadcast programs when the signal is weak. An increase of tenfold in sensitivity of the Iconoscope was demanded. To the Iconoscope experts, this was an almost impossible demand—but only almost.

The first step for a research man in solving a problem is to analyze it. The Iconoscope stores electrical charges produced by photoemission and then converts these charges into signal current. For many years, research has been conducted on photoemission by hundreds of scientists for many purposes. It appeared that the Iconoscope already had been given a photoemissive surface nearly as sensitive as could be expected. Research directed toward further improvement could pay only small dividends. Looking at the next step in the process, the research men knew that only about 10 per cent of the stored electrical charge was finally converted into a useful signal. If this conversion efficiency could be increased to 100 per cent, the desired tenfold increase in sensitivity would be achieved. It was well known that the 90 per cent loss of stored charge was caused by the scattering of the "secondary" electrons knocked out of the target by the high-speed electrons of the scanning beam. There seemed no satisfactory way to control these secondary electrons so it was decided to eliminate them completely. To do so would require that the target be scanned by a beam of very low-speed electrons. No one had ever found a way to focus and control such a beam so the solution of the problem required invention of a high order.

DR. H. B. DE VORE MAKES A PRELIMINARY ADJUSTMENT ON THIS HIGH-VOLTAGE TEST CAGE, IN WHICH THE TUBE IS FINALLY CHECKED IN A COMPLETE CIRCUIT.

The story of the development of the more sensitive Iconoscope—now called the Orthicon—is a highly technical one which can hardly be told here. The necessary inventions were made and the ideas were developed to practical form through much painstaking research with the result that the Orthicon met the "almost impossible" requirements which had been specified to the tube research men. This development made it possible to transmit by television scenes which previously had been too dim. One of the most interesting aspects of the development is that a new path was opened, the following of which promises further large increases in sensitivity. The day may come when any scene which is illuminated brightly enough so that one can see it directly can be transmitted by television.

Projection Kinescope

The Kinescope, too, was found short of perfection. The television image in the receiver was reproduced on the end of a glass bulb where it was viewed directly. Naturally, the picture could be no larger than the end of the bulb. The high cost of large glass bulbs limited the size of the picture to perhaps twelve inches on the diagonal as a maximum. This was large enough for a few people to enjoy the picture, but it would obviously be very much better if the picture could be considerably larger. There was even a demand for a picture large and bright enough for a theatre.

The solution of this problem was by no means easy. Several different approaches were tried. One of the more obvious was also one of the least hopeful: the projection Kinescope. The idea was simply that the picture would be projected on a screen from the end of a small Kinescope by the use of a projection lens, much as in a magic lantern. The great weakness with this proposal was that not enough light could be produced on the end of the necessarily small Kinescope to provide a satisfactorily bright picture of useful size, even using the best and most expensive lens which could be bought.

Thorough analysis of the factors limiting the brightness of the picture on the Kinescope, hard work by a considerable number of physicists and engineers for some years, and a number of flashes of inspiration eventually led to a remarkable increase in the brightness of the Kinescope picture. The problem still was not satisfactorily solved and there seemed little more to be gained in the brightness of the Kinescope picture. The electronics research men—experts in the field of electron optics—had long been unhappy that so little of the light their projection Kinescopes produced was gathered and used by the lens. In the case of an f/1.5 lens—miniature camera fans will know what that means in optical perfection—less than 10 per cent of the light was used; 90 per cent was wasted!

Produce New Lens

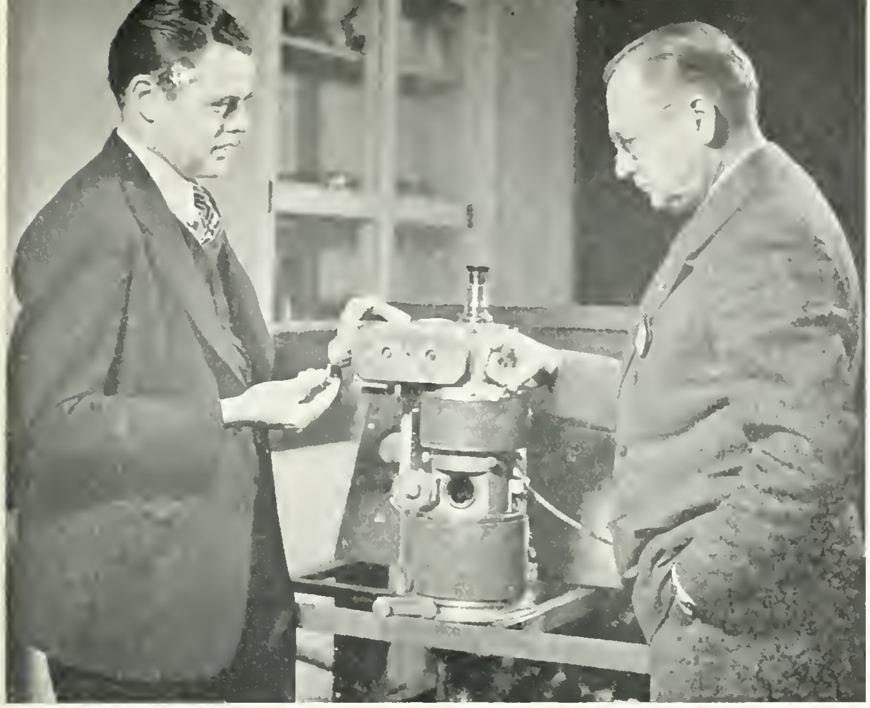
In spite of the fact that the optical experts said it was impossible, the electron optics men set about the task of producing a better optical system. Since they could hardly hope to produce a better conventional lens than the great optical companies had produced after many years of research, what was needed was a radical idea. Through their own efforts, they eventually produced a reflective optical system with a "speed" of f 0.7 — which means that it gathers nearly four times as much light as the best conventional lens.*

In industrial control and industrial heating—certainly among the most important fields of electronics—there already have been developed a host of tubes to serve as tools for a great variety of jobs, some of them having been borrowed from radio and many having been developed for the particular purpose. Great developments in these fields will certainly come and it may be expected that tube engineers will be called on to contribute their part.

In looking to the future, it seems reasonable to expect an acceleration in the rate of development of radio and electronics. After the war, the peace-time tasks will not simply be picked up where they were dropped. Much has been learned in the war effort which will contribute to man's entertainment, comfort, and safety. Whether or not electronics will live up to the very rosy predictions now being made for it is not for the research man to say. His field is not prophesy. He has confidence that the combined efforts of many research men will solve the technical problems put before them. The electron tube research man expects that he will continue to have his full share of the work.

THIS DISPLAY OF TUBES REPRESENTS ONLY A FEW OF THE ULTRA-HIGH FREQUENCY POWER AND RECEIVING TUBES, CATHODE-RAY AND ELECTRON MULTIPLIER TUBES DESIGNED BY RCA RESEARCH MEN.

* This development is discussed more fully in an article by I. G. Maloff, which will be found on page 25.



DR. JAMES HILLIER (LEFT) AND DR. V. K. ZWORYKIN DEMONSTRATE THE NEW ELECTRON MICRO-ANALYZER. DR. HILLIER PREPARES TO INSERT A SPECIMEN, WHILE DR. ZWORYKIN HOLDS THE PHOTOGRAPHIC PLATE.

DEVICE IDENTIFIES ATOMS

Electron Micro-analyzer Developed by Dr. Hillier in RCA Laboratories Reveals Chemical Composition of Ultra-microscopic Matter.

IDENTIFICATION of atoms in ultra-microscopic particles of matter no larger than 1/100,000 of an inch in diameter can be accomplished quickly and accurately for the first time by a revolutionary new tool of science—the electron micro-analyzer — developed experimentally by Dr. James Hillier of RCA Laboratories.

Revealed by Dr. Hillier in a letter published in the current issue of the magazine *Physical Review*, the new instrument — like the RCA Electron Microscope — promises to go far toward overcoming one of the great barriers to the accumulation of knowledge about the infinitesimally small particles of matter of which all things are made. Information vital to the solution of many practical problems in the physical, chemical, and biological sciences, according to Dr. Hillier, can be obtained.

"The chemical elements constituting such unimaginably tiny objects as the head or tail of a bacterium or virus," he said in an interview today, "can be identified within a few minutes by this new instrument."

Supplementing the electron microscope, the micro-analyzer comes ever closer to observing the building blocks of nature, Dr. Hillier explained. Scientists in recent years have been turning up invaluable information as to the size, shape, and internal structure of microscopic particles of matter, and now they can identify the atoms of which they are made.

"The vital question: 'Of what particular atoms, or chemical elements, are these different particles of matter constructed?' can be answered by the electron micro-analyzer," he continued. "For the first time, the scientist, using this new instrument, will be able to determine the chemical constituents of a particle weighing only 10^{-15}, or 1/1,000,000,000,000,000, grams. And, more important still, he will be able to see the relationship of the particles to the rest of the specimen under examination."

In operation, the micro-analyzer uses an "electron needle" of extraordinary fine focus to knock other electrons loose from their parent atoms in the specimen, measures the amount of energy lost by the incident electrons in the process, and thereby reveals the specimen's chemical content.

"With the new instrument, the image of the specimen may be observed by means of an electron microscope, which is incorporated as a part of the micro-analyzer, and a selection made by the exact portion to be analyzed," Dr. Hillier said. "Then by manipulation of a few controls, a photographic exposure is made of what we call the 'electron velocity distribution.'

"This results in a series of small marks on the photographic plate, each one of which indicates by its position the presence of a chemical element in the specimen. Thus, with one exposure, information is obtained that would have required weeks or months to obtain by present indirect methods, which too often result in failure."

In explaining how the instrument works, Dr. Hillier pointed out that in the table of chemical elements each atom, or element, is differentiated from another by the number of electrons surrounding the atom's nucleus. The electrons are arranged around the nucleus in "shells," he added, and it is known how much energy, or voltage, is required to knock holes in the shells of different atoms.

"In the micro-analyzer," he continued, "the electrons of the 'needle' that strike the selected area of the specimen are all moving with the same velocity, say 50,000 volts. After they have passed through the specimen area, some of the electrons—the ones that struck atoms—are traveling with less velocity, or energy.

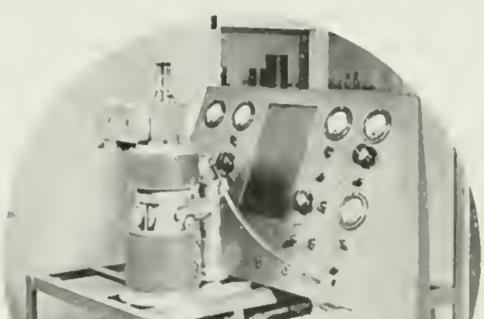
"The next thing of importance in micro-analysis is the fact that the energy loss suffered by the speeding electron is different for each chemical elements. What's more, the differences are large enough to be easily distinguished by a method of measuring electron velocities. If, for instance, one of the energy losses shown is 298 volts, we know that a carbon atom has been struck; if it is 400 volts, the element is identified as nitrogen, and so on."

An experimental model of the electron micro-analyzer has been set up by Dr. Hillier in the RCA Laboratories at Princeton, N. J. Test operations have been highly successful, although much further work in developing techniques of application must be done before the instrument can be made available for general laboratory use.

Gives Elemental Analyses

In discussing the future significance of the micro-analyzer, Dr. Hillier said that before the extra information being revealed by the electron microscope can be applied by any of the physical, chemical, and biological sciences, it must be translated into a form that is of significance to the individual problems being investigated.

"After looking at an electron micrograph and noting the physical characteristics of the object," he continued, "the scientist invariably asks, 'What is this?' He knows that he had a test tube of a specimen consisting of a number of chemicals, but now he has within his vision a number of different types of particles which are undoubtedly made up of some of the chemicals from the original bulk specimen.



"If the original specimen was a test tube of bacteria, the scientist knew that it consisted of a number of proteins and other organic materials. But on looking at the electron micrograph, he finds that the bacteria have flagella, cell membranes, and structure in their protoplasm which often includes granules and particles surrounding it which he did not know existed. To find out the chemical structure of these particles, he must perform a number of tests on the bacteria. This procedure is very tedious, and not always successful."

At present, the electron micro-analyzer gives elemental and not compound analyses. Dr. Hillier said that he believes further developmental work on the instrument will enable it to show the amounts of each element in a specimen. He sees very little hope, however, of ever being able to show the way in which they are combined.

An incidental development made by Dr. Hillier in designing the micro-analyzer was the improvement of the resolving power of the electron velocity analyzer. Until two years ago, measurement of electron velocities to 1 part in 200 was considered quite good. In the micro-analyzer, Dr. Hillier has used an electron optical trick to remove almost completely any limitations on accuracy. In the experimental model he now has, measurements of 1 part in 4,300 are possible.

Dr. Hillier is one of the nation's youngest and most brilliant scientists, not yet having reached the age of 30. He participated in the design of the first practical electron microscope to be produced in this country—a development directed by Dr. V. K. Zworykin, Associate Research Director of RCA Laboratories. He joined Dr. Zworykin's staff in the late 30's, after doing post-graduate work in electron optics at the University of Toronto.

THIS CLOSE-UP VIEW OF THE ELECTRON MICRO-ANALYZER SHOWS THE DESIGN OF THE MAIN SECTION, TOGETHER WITH THE CONTROL BOARD.

30,000 WAR WORKERS LINKED IN YULE PARTY

Employees In Five RCA Plan Hear Program Simultaneousl David Sarnoff Is Host.

THIRTY thousand war worke in five eastern and midweste cities were brought together Thur day afternoon, December 23, for Christmas party unique in Amer can industry and, fittingly, th were united through the mediu with which they work—electronic

In a special closed circuit ne work, five manufacturing plants the Radio Corporation of Americ were linked together so that t company's workers in Camden ar Harrison, N. J., Lancaster, Penn Bloomington and Indianapolis, Ind could hear a 15-minute progra which was brought to them at the desks, machines, and benches ov each plant's internal broadcastin system.

David Sarnoff, President of RC was host of the program, whic originated in New York, and whic also included Gladys Swarthou Metropolitan Opera and conce soprano.

Dramatic highspot of the pr gram was a telephone reunion b tween John Pugliese, Camden em ployee representing the thousand of RCA war fathers and mothe with sons and daughters in servic and his war-wounded son, Tony, 2 seaman second class, who was c in from Norfolk, Va. Tony wa badly injured when the destroy on which he was serving attack a Nazi U-boat. Mr. Pugliese ha two other sons in the armed force one of them a prisoner of war i Germany. In the studio with hi was a fourth son who recently r ceived a medical discharge from th Army and is now also employed a the Camden RCA plant.

Climaxing the party, Mi Swarthout sang "The Lord's Pray er" and led the RCA glee clubs an the unseen audience of workers i all the plants in singing "Silen Night."

As a finale, managers of the fiv plants extended greetings to th other plants.

HOLLYWOOD AND TELEVISION

"Bagdad on the Pacific" Is Seen by Strotz as Great Production Center for New Service of Radio Early in the Post-war Period.

By Sidney N. Strotz

Vice President in Charge of Western Division—NBC, Hollywood, Calif.

"BAGDAD on the Pacific." That's what the columnists used to call Hollywood before radio came. They would have to strain even their collossal Hollywood imaginations to coin a phrase that would properly describe the show business created by the combination of motion pictures and radio in Southern California.

I don't think I'm going out on a limb when I say that I consider Hollywood the biggest radio production center in the world. NBC alone originates twenty-three top coast-to-coast commercial programs from Hollywood Radio City. Of the top fifteen programs in the country, Hollywood originates twelve. Of these, ten are on NBC. Their ten combined Crossley ratings represent an aggregate listening audience of a quarter billion people.

In addition to this tremendous volume of commercial programs which Hollywood talent is turning out, nearly every special program produced by the War Department for men overseas is put together and recorded on the West Coast. To meet the requirements of the servicemen overseas, the Special Services branch of the War Department currently is making some 1,200 records a week for distribution to its overseas stations. This supplements a regular short wave schedule of our entire commercial list to all corners of the world. Such is a quick picture of Hollywood production today.

The reason for this concentration of radio production in Hollywood, with its fabulous world influence, obviously is the concentration of talent on the West Coast. This is of great significance to the future of both radio and television.

On the radio side of the picture, I can see a great post-war expansion in the international field. The programs that are going overseas today can't help being heard by the civilian populations of foreign countries. Their quality is so far superior to anything those people have been getting that without a doubt they will want to hear American programs again when the war is over. Our American stars are becoming as popular abroad as they are in the United States. They will have a ready audience waiting for them after the war in any country where the English language is understood.

Now, what about television in Hollywood? The same factors that made Hollywood a great radio center will also make it a great television center. I believe that it will be not only wise, but necessary, for NBC to establish television studios in Hollywood as soon as possible after the war, to take advantage of the talent that already has such a tremendous hold on the public.

Every major motion picture studio in Hollywood is already in the television picture, either through research, television planning or actual participation in experimental telecasts. Motion picture technicians are studying keenly the possible relation of their own field to this new medium. Makeup experts are being engaged to study and develop special television makeup. One of the biggest studios has set up a special department of television to lay the groundwork and provide an organization for the time when the end of the war will make television operations practical.

This makes it obvious that we in the radio industry will have to keep on our toes to stay in a position of television leadership. From NBC's standpoint, I feel that we are doing this. In Hollywood, we already have the site for television studios on the Sunset and Vine property which also houses our broadcasting studios. It's interesting, and perhaps symbolic, that this site is the same one that cradled the motion picture industry some twenty-five years ago. On it was located the old Famous Players-Lasky lot, where such performers as Mary Pickford made their first pictures.

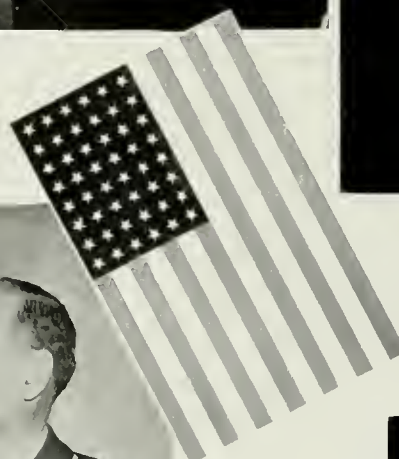
We are ready to begin building our television studios and transmitters as soon as the war is over, and building materials are available. I know that plans for such construction are already under consideration in New York by Niles Trammell, President of NBC, and other officials.

Hollywood is an ideal spot for television production, because it is the only place in America that has so many competent technicians who are familiar with both motion picture and radio production. I have no doubt that film will be used extensively in the technique of television. I don't think there is enough talent in the world to supply the demand that would have to be met if all television entertainment were put on a live basis. Rehearsal hours, memorizing lines and staging live productions, to say nothing of the mechanical factors like sets and scenery, would make it a formidable if not impossible problem. I believe that television production will have to embody both live shows, such as special broadcasts of news and sporting events, and entertainment previously put on film, as the motion picture studios are doing today.

Anyway we look at it, Hollywood is bound to increase in importance as a center of both radio and television, unless some great cataclysm wipes out both the motion picture industry and the climate that has lured so many of our stars into taking Greeley's advice. I for one will bet that "Bagdad on the Pacific" will be here for a long time to come.

AIR COMMODORE C. P. BROWN, BRIGADIER GENERAL H. M. MC CLELLAND, AIR COMMODORE A. F. LANG, BRIGADIER H. M. PATERSON, CAPT. T. A. SOLBERG, CAPT. G. F. BURGHARD, AT RCA LUNCHEON.

CAPTAIN T. A. SOLBERG, COMMANDER FREDERI
ERSON, BRIGADIER GENERAL H. M. MC CLELL
ADMIRAL JULIUS A. FURER, CAPTAIN G. F. BUR
AND AI



O. B. HANSON, VICE PRESIDENT OF NBC, IN CONVERSATION (ABOVE) WITH BRIGADIER GENERAL H. M. MC CLELLAND.

British Technica

A HIGH British technical mission, headed by Sir
Watson-Watt, outstanding English inventor, and a s
group of United States officials, headed by Dr. Karl T. Co
visited the Radio Corporation of America in New York on N
ber 30 and the RCA Laboratories at Princeton, N. J., on Dec
2. In New York, the groups were luncheon guests of
Sarnoff, President of RCA.

With Sir Robert in the British group were: Captain
Burghard, Brigadier H. M. Paterson, Air Commodore
Brown, CBE, DFC, Dr. C. E. Horton, Professor J. D. Coc
FRS, Dr. W. B. Lewis, Brigadier F. C. Wallace, Group C

CAPTAIN G. F. BURGHARD, SIR ROBERT WATSON-WATT, AND OTTO S. SCHAIRER AT LUNCHEON AT RCA LABORATORIES.

H. H. BEVERAGE, ASSOCIATE RESEARCH DIRECTOR, RCA LABOR
TORIES, DR. KARL T. COMPTON, AIR COMMODORE C. P. BROW

, AIR COMMODORE A. F. LANG, BRIGADIER H. M. PAT-
BERT WATSON-WATT, COLONEL DAVID SARNOFF, REAR
ADMIRAL JOSEPH R. REDMAN, DR. KARL T. COMPTON,
C. P. BROWN.

lission Visits RCA

D. H. Johnson, Lieutenant Colonel A. J. M. Fisher, BAS, and Mrs. Allison Munro, secretary to Sir Robert.

With Dr. Compton, a member of the National Defense Research Council, in the American group were: Dr. Lee A. DuBridge, Rear Admiral Joseph R. Redman, Rear Admiral Julius A. Furer, Commander Frederick R. Furth, Brigadier General H. M. McClelland, Colonel T. C. Rives, Colonel J. J. Downing, Lieutenant Commander H. L. Vanderford, Captain T. A. Solberg, and J. H. Teeter.

Otto S. Schairer, Vice President in Charge of RCA Laboratories, was host to the two groups during their visit to the laboratories at Princeton.

DR. W. B. LEWIS, L. F. JONES OF RCA VICTOR, AND F. R. DEAKINS, ALSO OF RCA VICTOR, CAMDEN, AT PRINCETON LUNCHEON.

BRIGADIER GENERAL H. M. MC CLELLAN
COLONEL DAVID SARNOFF, SIR ROBE
WATSON-WATT, AND DR. KARL T. COM
TON AT RCA LUNCHEON IN NEW YOR

COMMANDER FREDERICK R. FURTH AND COMMANDER L. E
BLAYLOCK (ABOVE), DURING LUNCHEON AT RCA LABORATORIES

CAPTAIN T. A. SOLBERG, BRIGADIER H. M. PATERSON, AN
MEADE BRUNET OF RCA VICTOR, WASHINGTON, D. C.

New Trend In Industry Training

BROAD, VERSATILE EDUCATION PROGRAMS DEVELOPED FOR EMPLOYEES AS WAR MEASURE PROMISE TO CONTINUE IN PEACE TIME — RCA VICTOR OFFERS FLEXIBLE SCHEDULE TO LARGE GROUPS

By R. C. Maslin
Personnel Director, RCA Victor Division, Camden, N. J.

THERE are many new trends and developments in American life which, born of wartime necessity, promise not only to help win the war but also to continue as a beneficent influence in the post-war world. One of the most significant is the development of a new force in education—the broad, versatile, and flexible training programs being conducted by American industry.

Engendered by the desperate need for skilled production personnel, this highly constructive offspring of the manpower problem is essentially a complement and not a competitor of the more formal programs of technical training and liberal education offered by this country's institutions of learning.

The scope of the training and education program of the RCA Victor Division is exemplified by activities at the Camden, N. J. plant where about 18,000 employees in the last three years have received specialized training through a variety of organized courses ranging from two to twenty weeks' duration.

Although it was not until May, 1941, that a definite need for organized job training became apparent at RCA Victor, the company has maintained from its inception a limited training program consistent with its established policy of upgrading of employees and promotion to fill vacancies from within.

In 1936, training for selected student engineers which had long been given by the company, was formalized and outstanding graduates received internships of up to two years, affording them an opportunity to learn every phase of the business. After-hour classes, held for several years prior to 1936 and at first designed only for the student engineers, were expanded to permit other qualified employees to enter.

Later, when war became imminent, the size of the engineering study groups was increased and the training made more specific. Its objective was the quickest possible preparation for maximum effective war production. Training on the job, under expert scientists and engineers, was intensified.

Plant-wide coordination of the entire training program was achieved last April with the appointment of George A. Mattson to the new post of Director of Education and Training for the Camden plant. Before coming to RCA, Mr. Mattson was engaged for seventeen years in the field of education and training, serving various institutions in the roles of instructor, supervisor, and administrator. From 1940 until April, 1943, he was supervisor of the war production training program of the Camden County Vocational School.

RCA's program now embraces eight distinct types of training, includes courses in more than 60 subjects, and utilizes the cooperative

GEORGE A. MATTSON (LEFT), DIRECTOR OF EDUCATION AND TRAINING AT RCA VICTOR'S CAMDEN PLANT. SCORES OF MEN AND WOMEN ATTEND RCA CLASSES (BELOW) TO BE TAUGHT NEW INDUSTRIAL SKILLS.

services and facilities of seven outside educational institutions in the Philadelphia-Camden area.

Vestibule training, conducted in classrooms in the plant, is used to develop work habits and operational skills which are pre-requisite to work done on a production basis. The term may range from two to six weeks, depending on subject matter, educational background and aptitude of the trainee, and production needs. The eight-hour day is divided into six and one-half hours of operational activities and one and one-half hours of related work in the classroom. During the 1942-43 season, 1,239 men and women studied crimping and soldering, wiring, and assembly in these classes, and 12 women studied engineering drafting.

On-the-job training, which is the type predominantly used at RCA Victor, has been given to thousands of employees since its beginning in 1941. In this program, needed skill is acquired through work experienced on a given machine or assembly line while related instruction is made available through the assignment of qualified instructors. While working on the machine or assembly line, the trainee is at all times under the guidance and direction of skilled mechanics as job trainers.

Departmental training, or "during hours" training, is similar to and supplements the plant-wide plan of on-the-job training, but is distinguished by the fact that it is coordinated through department heads to meet specific needs of their respective employees. Under this phase of the program, 5,135 employees have received classroom training during working hours since 1941.

Courses offered under the heading of "job instruction training" are made available to supervisors and foremen through the Training Within Industry service of the War Manpower Commission and the State Board for Vocational Education.

A yearly enrollment of 560 foremen and supervisors participate in a foreman conference program, under the immediate supervision of three conference leaders who meet regularly each week with scheduled study groups. Materials for discussion, prepared by the conference leaders under the supervision of the educational director and reviewed by a management committee on labor relations, are based on (1) needs for instruction in and clarification of company policies; (2) needs for creation and improvement of techniques for the development of departmental and interdepartmental coordination and good working relations; and, (3) general ideas, opinions, and questions presented by members of the conference groups.

"LEARNING BY DOING" UNDER THE SUPERVISION OF SKILLED INSTRUCTORS. THESE WOMEN ARE BEING TRAINED IN A "VESTIBULE SCHOOL" AT RCA VICTOR'S CAMDEN PLANT.

After-hour Classes

Progressing to the more formal types of training, the RCA Victor program offers a four-year period of training for apprentices in tool making. Each year the company inducts into this apprenticeship program eight to ten young men (usually high school or vocational school graduates), who are placed under the immediate supervision of the department head. The training at present consists of eight hours of shop practice or work experience daily and two evenings of class work each week at the Camden County Vocational School. The class work includes such subjects as blueprint reading, mechanical drafting, mathematics and science. In addition to developing skills needed for craftsmanship, the apprenticeship program recognizes the importance of developing responsibility, self-reliance, appreciation of growth and achievement, and other personal qualities.

After-hour classes, in which a total of about 5,000 RCA Victor employees have been enrolled through 1941, 1942 and 1943, are designed to assist employees (especially those in professional, semi-professional, technical, and semi-technical occupations) in terms of increased efficiency and skill, either for their present positions or to prepare them for upgrading to positions of greater responsibility. They include courses in forty subjects sponsored and financed by the U. S. Office of Education under its Engineering, Science and Management War Training Program, and courses in ten additional subjects sponsored and financed by the company.

Although physical facilities and faculty supervision of cooperating colleges and universities in the Philadelphia area are utilized in the E.S.M.W.T. courses, the majority of the instructors engaged in teaching these classes, as well as all instructors for the company-sponsored after-hour courses, are RCA employees who have demonstrated required qualifications.

Perhaps the most significant and unusual of the numerous educational opportunities afforded RCA Victor employees by the company is the tuition loan and refund plan, under which 1,107 men and women workers have enrolled in various schools and universities in the Philadelphia-Camden district since the inauguration of the plan in 1941.

Employees who qualify may matriculate at any recognized college, university, or engineering school in the Philadelphia metropolitan area, in courses directly related to the work in which they are engaged, borrowing the cost of tuition from the company and repaying it in monthly installments out of salary. An employee presenting evidence that all course requirements have been satisfactorily completed is reimbursed by the company for a substantial portion of the tuition, depending on the grade obtained. These refunds are scaled at 90 per cent of the tuition cost for a grade of "A," 60 per cent of the tuition cost for a grade of "B," and 40 per cent for a grade of "C." This provides a strong incentive to strive for a higher grade.

Under this plan, employees are now enrolled in electrical and mechanical engineering at the University of Pennsylvania and Drexel Institute of Technology, in business administration at the University of Pennsylvania, Temple University, and the Gibson Institute of Accounting, and in languages at the Berlitz School of Languages and the Philadelphia Academy of Modern Languages.

New educational services just being introduced at RCA Victor to meet needs indicated by recent experience are a conference program for junior engineers and junior executives, designed to encourage their participation and advancement in the company's activities and to provide a medium for the exchange of ideas and pooling of their training and experience, and a specialized 192-hour course to faciliate upgrading of employees for supervisory posts.

Alert to recognize and meet new needs as they arise, the Education and Training Department has kept the program sufficiently flexible to allow for such additions and changes whenever it appears that they will serve the purpose of providing properly trained personnel when and where needed, getting and keeping the right employee in the right job, and encouraging and utilizing the best capacities of all employees.

HAVING COMPLETED A COURSE IN SUPERVISION, NELLIE KNOTTS RECEIVES A CERTIFICATE FROM WALTER GROEBER, MANAGER OF THE CRYSTAL MANUFACTURING DEPARTMENT AT RCA VICTOR, CAMDEN.

School of Tomorrow

THE sound system will be as familiar in the school of tomorrow as the pot-bellied coal stove of "the little red schoolhouse" era and the time-honored blackboard of present-day classrooms.

That's the prediction of the Educational Department of the RCA Victor Division, Radio Corporation of America, as expressed in a recently published brochure, "Planning Tomorrow's Schools."

Outlining postwar suggestions to the nation's educators, the booklet points out new developments in audio-visual education.

The school sound system, already adopted by thousands of schools and expected to be even more widely utilized in the future, provides a quick, easy distribution of radio programs, phonograph recordings and on-the-spot vocals, as well as serving as a time-saving communication center for the school administrator. Public address equipment likewise can be employed to advantage in the school auditorium, gymnasium or athletic stadium.

As for visual aids, RCA research is reported to be developing improved motion picture projectors for classrooms and auditoriums. The Electron Microscope will be made available to schools and colleges throughout the country. Up-to-date test and demonstration equipment can be installed in science laboratories.

Electronics should play an important part in everyday life in the postwar period—in the home, the school, business and industry. RCA now is developing test equipment and special electronic apparatus for instructional purposes in training postwar students to cope with these advances in the world of science.

IN ITALY, NILES TRAMMELL AND LIEUT. GEN. MARK CLARK VISIT THE WOUNDED IN A FIELD TENT (TOP LEFT); GENERAL CLARK AND TRAMMELL INSPECT A "LONG TOM" (TOP RIGHT) ON THE BATTLE FRONT NORTH OF NAPLES; GENERAL CLARK, AIR VICE-MARSHALL MAC NEECE FOSTER OF THE JOINT COMMAND, TRAMMELL AND FIELD OFFICERS (RIGHT) STUDY MAP.

NBC Heads Visit Fronts

TRAMMELL AND ROYAL, AFTER TRIP TO EUROPEAN THEATERS, PLAN INCREASED NEWSCASTS TO U. S. SOLDIERS OVER SEAS

By Niles Trammell

President, National Broadcasting Company

A TRAVELER in the battle-scarred war-fronts brings some poignant memories that time can never erase. With that John Royal, NBC vice-president in charge of international relations, who accompanied me on a recent six-weeks visit to England and the Mediterranean, will agree.

We saw much that was inspiring, much that was grim. We saw the perfect discipline of our American troops, a discipline comparable to that of the finest European armies, yet withal tempered by an understanding and camaraderie between officers and men. We saw the ebullient, rowdy, irrepressible sense of humor of the American soldier, a sense of humor that never fails him, not even when the going is toughest. We saw America transplanted to strange and foreign soil but still the same America.

We saw General Clark at the front talking to the soldiers. He would get out of the vehicle, walk up to the men, and make inquiry regarding their food and general welfare. He knew everything that was going on at their front and kept informed of troop movements from hour to hour.

German prisoners, according to our boys, are morose; Italians seem to be glad the fighting is over. In one of the fighting sectors we visited in Italy, the German prisoners we saw were about 15 or 16 years of age. A few may have been a little older but the rest looked like high-school sophomores. The Germans were still tough, our boys say, and it is going to be a long time before the end of the war will be in sight.

The American soldier thinks the British Tommy is a great soldier, a good guy to know. There is a healthy competitive spirit between the Americans and British, out of which has come a deep respect for the British Tommy. In England, our boys have earned the good-will of everybody.

Our soldiers want more news from home — newspapers, maga-

JOHN ROYAL, TRAMMELL, AND GENERAL CLARK (ABOVE) SEE ENEMY'S POSITION ON MAP; WITH GENERAL CLARK IN THE LEAD, TRAMMELL AND ROYAL STRIDE ALONG AN ITALIAN ROAD (BELOW) DURING TOUR OF FRONT LINES.

zines, and radio news broadcasts. At the present time, they have a great deal of difficulty hearing our short-wave broadcasts.

In Tunis, Algiers, and other centers, the Army operates low-powered radio stations which send out recorded broadcasts of all our popular American programs — Bob Hope, Fibber McGee and Molly, Kate Smith, Fred Waring, and the others. The real complaint among the boys is that they don't get enough news about happenings on the home front.

These complaints will be ironed out. We feel certain that the various agencies of the government concerned with the upkeep of the morale of our soldiers will do their utmost to improve this important matter of supplying news overseas. We have several plans to correct these shortcomings and we intend to discuss them with government officials.

Both the newspaper and radio correspondents on the fighting fronts are doing a great job, in my opinion. Our correspondents have done superb work in giving factual accounts of the successes of the troops. But they haven't personalized the war as I think it can be done and as these generals want it done. For instance, when some Johnny Doughboy single-handedly takes a machinegun nest and permits some platoon to occupy a high place as a result of his activities, there ought to be some credit given that particular kid. At present nothing is being done to bring home to the American public the accomplishments of the boys who are bearing the brunt of the fighting.

It was inevitable that this trip should have some effect on our post-war planning and we have come to the conclusion that after the war there must be an organization, representing the free countries, whose sole mission it will be to see that radio henceforth shall be used for good instead of evil.

Radio must no longer be an instrument for propaganda. It must become a free medium for mass communication — entertaining, instructing, but never warping the minds and souls of people as it did in Italy and Germany.

GEORGE K. THROCKMORTON (LEFT), RETIRING VICE PRESIDENT AND DIRECTOR OF RCA, CONGRATULATES HIS SUCCESSOR, FRANK M. FOLSOM.

FOLSOM HEADS RCA VICTOR

Former Chief of Procurement Branch of Navy Succeeds Throckmorton As Vice President and Director of Radio Corporation of America

FRANK M. FOLSOM, Chief of the Procurement Branch of the Navy Department, was elected a Vice-President and a Director of Radio Corporation of America on December 4, David Sarnoff, President, announced. Mr. Folsom, who served with the Navy until December 1, will be in charge of the company's manufacturing division, RCA Victor, with principal plants in six cities and headquarters at Camden, N. J. He assumed his new duties January 1. Mr. Folsom was born in Sprague, Washington, and is 49 years of age.

Mr. Sarnoff also announced that the Board had accepted with regret the resignation of George K. Throckmorton as an RCA Vice-President and Director. Mr. Throckmorton, who was head of the RCA Victor Division, is retiring for reasons of health, but will continue as a consultant to the company.

Personal messages to David Sarnoff, from Secretary of the Navy Frank Knox, Under-Secretary of the Navy James Forrestal, and Chairman of the War Production Board, Donald M. Nelson, expressed deep appreciation of the value of Mr. Folsom's services to the Navy.

In commenting on Mr. Folsom's election, Mr. Sarnoff said:

"The operations of the RCA Victor Division, with its large plants and many thousands of employees, involve the design and manufacture of important war production assignments for the Navy, Army, Air Forces and Maritime Commission. These assignments call for leadership, experience and ability of the highest order. The need for a man of unusual qualifications is enhanced by the prospect of our post-war manufacturing activities in radio, television, electronics, phonograph records and allied fields. Recognizing the problems of full scale war production, as well as post-war conversion and the expanded role distribution will need to play to provide maximum employment, we feel the company is extremely fortunate in its choice of Mr. Folsom."

Television Expansion Foreseen

WITH EXPECTED PRODUCTION OF $200 HOME RECEIVER, NEW SERVICE WILL EXTEND TO 152 KEY CITIES OF U. S. WITHIN FIVE YEARS AFTER WAR, REACH 60% OF NATION'S PEOPLE, JOYCE BELIEVES

WITHIN five years after commercial resumption of television, sight and sound programs, broadcast by network and individual stations in 157 key cities, will be available to 60 percent of the people of the United States if the radio industry can produce a television home receiver priced at approximately $200.

This was forecast by Thomas F. Joyce, Manager of the Radio, Phonograph and Television Department of the Radio Corporation of America, speaking recently before a joint meeting of the American Television Society and the Advertising Club of New York.

"Such a receiver, I believe, is possible," he said, "based on 1940 labor and material costs, and assuming no excise taxes. Of course, the postwar price would be increased by the factors of inflation and excise taxes."

In a clear-cut analysis of postwar television markets, marked by a strict adherence to practicalities and known facts, Mr. Joyce declared that the number one problem of the postwar television industry was an acceptable low cost radio television receiver. He cited an 11-city survey which showed that more than 61 per cent of men and women questioned said they would buy a good television receiver priced at $200.

Within ten years after full commercialization of visual broadcasting, Mr. Joyce declared, television will be a billion dollar industry. This, he said, is based on the development of a low cost automatic rebroadcasting television transmitter to relay programs in areas outside the scope of the key network stations.

"Such a development will make it economically feasible to bring television service to practically every home in the United States," he said, adding that at that time retail billing of television sales should be between six and seven hundred million dollars.

"This billing," the RCA executive stated, "together with replacement tubes for existing receivers, service, transmitter sales, advertising revenue, and other items, will make television the billion dollar industry that many have prophesied it will be."

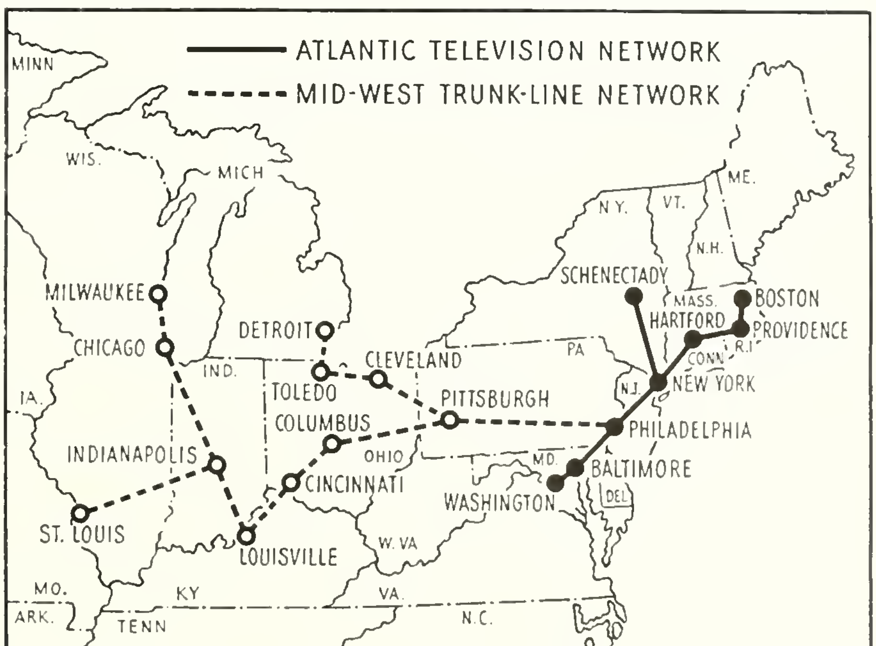
In presenting this picture of the postwar television market, however, Mr. Joyce warned against any radical changes in standards that would make the $200 television receiver improbable, at least for the immediate postwar period.

His estimates on the probable postwar rate of market development for television, he explained, is based on a complete agreement on standards approved by the Federal Communications Commission, which would give the industry the "green light" to go ahead without any "ifs."

"It has been assumed for estimating purposes," he said, "that there will be no changes in the standards or in the place which television occupies in the broadcasting spectrum, which might substantially delay the start of television or bring about more complicated engineering and manufacturing."

The nucleus of a television network has already been started, Mr. Joyce pointed out to the audience of top ranking television experts and advertising executives. Programs

THIS MAP SHOWS A POTENTIAL POST-WAR TELEVISION NETWORK AS PROJECTED BY THOMAS F. JOYCE IN A RECENT ADDRESS IN NEW YORK. SOLID LINES INDICATE AN INITIAL NETWORK, AND THE BROKEN LINES SHOW HOW IT COULD BE EXPANDED.



THESE WOUNDED SAILORS IN THE U. S. NAVAL HOSPITAL AT ST. ALBANS ARE WATCHING ONE OF THE SPECIAL TELEVISION PROGRAMS ARRANGED BY NBC FOR THE BENEFIT OF CONVALESCENT SERVICE MEN IN NEW YORK AREA.

originating at NBC, in New York, are now being broadcast to Philadelphia, New York, and Albany-Schenectady. Television broadcasting facilities also exist in Chicago and Los Angeles. A television station would also begin broadcasting from Cincinnati as soon after the war as equipment became available, Mr. Joyce revealed. These cities would logically be the first television markets, he said.

Mr. Joyce estimated that within two or three years after the full commercialization of television, about 10 per cent of the wired homes in the foregoing cities, or 741,000 families, representing a probable audience of 7,000,000 persons would own television receivers.

"We can assume further," he continued, "that within three or four years after commercial resumption of television, Washington, D. C., Baltimore, Hartford, Providence, and Boston will have television transmitters. These cities, together with Philadelphia, New York, Schenectady and Albany, could be interconnected with a television network circuit about 600 miles long.

"This network circuit would make television broadcasting service available to 33,336,000 people, 9,379,039 wired homes, representing 36.62% of the total U. S. buying power."

The RCA executive then went on to describe the development of the television network by trunk lines, thus linking the middle west with the Atlantic seaboard, bringing television service to Pittsburgh, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, and Milwaukee.

This trunk line television network, with the secondary networks that would be off-shoots from it, he said, can be expected to develop approximately five years after the full commercialization of television.

By the end of the fifth year, he said, engineers should be able to develop the automatic transmitter for rebroadcasting television programs, thus blanketing areas of the country unreached by the stations in the 157 key cities.

Mr. Joyce also took occasion to remind his audience that it was too much to expect television to spring forward as an industry the day the fighting ceases.

"It may be a year, or two or three years after the war before television is ready to go forward on a commercial basis," he iterated. "That depends upon the character of the recommendations made by the Radio Technical Planning Board and the action taken by the Federal Communications Commission on the recommendations by that Board. Of this, though, we may be certain: that the generations that come after the war will take home television service just as much for granted as the present generation takes radio."

MAJOR sports events and other spectacles held in Madison Square Garden are being televised by the National Broadcasting Company for the enjoyment of wounded soldiers and sailors in hospitals in the New York area.

Plans for this new television service, arranged in cooperation with Army and Navy medical authorities, were announced recently by John F. Royal, NBC vice-president in charge of International Relations, Television and Short-Wave. John T. Williams, NBC's Manager of Television, is in charge of the project.

Television receivers have been installed by the National Broadcasting Company in the Halloran General Hospital, Staten Island, U. S. Naval Hospital, St. Albans, N. Y., the Tilden General Hospital at Fort Dix, the Naval Hospital at the Brooklyn Navy Yard, the U. S. Navy Convalescent Hospital at Harriman, N. Y., and one other institution.

The first television program for the wounded men, over NBC station WNBT, was the rodeo direct from Madison Square Garden on Monday evening, October 25.

Under arrangements made with Ned Irish, manager of Madison Square Garden, NBC plans to televise track meets, basketball and hockey games and other sports events originating at the Garden from time to time.

Arrangements were completed by Royal and Williams with Col. C. M. Walson, of the Medical Corps, Second Service Command, and Lieutenant Willard B. Stone, USNR, District Welfare-Recreation Officer.

The television area reached by the programs for the wounded men will extend approximately 75 miles from Radio City, with re-broadcasts through WPTZ, Philadelphia, and WRGB in Schenectady, N. Y.

At least one receiver has been installed in each hospital. As many more instruments will be installed as NBC is able to obtain.

Music Aids Production

Selected music in high-geared war industries lifts workers' morale, reduces fatigue and is a definite aid to production.

That's the word from War Production Drive Headquarters following an extensive survey of 100 war plants, undertaken for the WPB by Wheeler Beckett, well-known conductor and composer.

LARGER TELEVISION IMAGES

RCA Scientists Solve Difficult Optical Problems in Projection—Develop Methods of Molding Plastic Lenses for Both Home and Theater Receivers.

R. LEUSCHNER TESTS AN ASPHERICAL LENS (ABOVE) FOR DEVIATIONS FROM THEORETICAL DESIGN; THE AUTHOR REMOVES A PLASTIC ASPHERICAL LENS (BELOW) FROM THE MOLD IN WHICH IT WAS MADE.

By I. G. Maloff
RCA Victor Division,
Camden, N. J.

IMAGE size in television—for either the theater or the home—is no longer a serious problem in engineering or economics.

It is possible to build, as was demonstrated experimentally by RCA just prior to the United States' entrance into the war, projection-type television receivers that reproduce images of any desired size up to full theater-screen dimensions.

Not generally known, however, is the story of how certain features of one of the great instruments of astronomy — the Schmidt-Kellner camera—were adapted to television projection. The story concerns behind-the-scenes laboratory work, calling first for the solution of an unusually difficult mathematical problem in optical design, and finally, for development of a method to reduce the production cycle of a new lens from months to minutes.

To those who have seen the all-electronic system of television in operation, it is well-known that images received from a television transmitter are reproduced on the broad, nearly-flat end of a tube called the kinescope. The kinescope can be built in various sizes, but when it is given a diameter much larger than 12 inches the cabinet in which it and its accompanying equipment are housed becomes undesirably bulky for practical home use.

For this reason, it was apparent some years ago that if larger television images were to be available in homes, a system of optical projection must be developed. Tests with standard projection optics produced screen images that were much too dim for practical use. Thus, the situation called for a new approach—an original conception.

It had been known for a long time that aspherical* lenses in combination with either spherical or aspherical mirrors may be arranged into optical systems of high definition combined with great light gathering power. Astronomers were first in making use of this principle, especially in an arrangement consisting of one spherical mirror and one aspherical lens. The high costs and difficulties in constructing aspherical lenses retarded more general utilization of such systems.

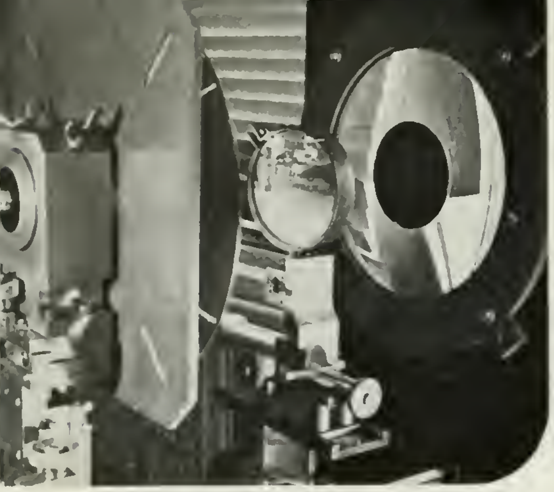
Conceives New System

Quite a few years ago, D. O. Landis, an optician working in the laboratories of the RCA Manufacturing Company (now RCA Victor Division), and having contact with the needs and aims of men working on television research, conceived the idea that an optical system could be built using aspherical elements for projection of television images. He realized, too, that the shape of the aspherical lens in his new system would be different from that of the astronomical lens. This, he understood, was because the astronomical camera is focused on infinity but in his case a short and finite distance separated the optical system from the projection screen.

Landis submitted his idea to E. W. Engstrom, now Research Director of the RCA Laboratories (then heading the Research Division of RCA Manufacturing Company at Camden, New Jersey) and was encouraged to construct a working model. It may be mentioned here that Mr. Engstrom's action was not in accord with the more conservative opinions of some members of his staff at the time Landis commenced his work. The design of aspherical infinite focus systems seemed to offer little assistance to the evolution of aspherical finite focus projection systems.

Landis went ahead struggling with his system and doing most of the work in the basement of his home, where he had a well equipped optical shop. He was then a well known figure among amateur astronomers as well as among amateur telescope makers. After a few months of long hours at the grinding and polishing machines his first

* Conventional lens design makes use of entirely spherical surfaces; in aspherical lens design, the surface has a variable curvature.



THE GREAT LIGHT-GATHERING POWER OF RCA'S TELEVISION PROJECTION OPTICAL SYSTEM IS DEMONSTRATED IN A SET-UP (LEFT), WHICH SHOWS THE BRIGHT IMAGE OF THE PHILADELPHIA SKYLINE, INVERTED IN THE CENTER LENS, UNDESTROYED BY FULL DAYLIGHT ILLUMINATION. A PHENOMENON OF THE SYSTEM IS A "GHOST" IMAGE (RIGHT), WHICH APPEARS IN THE AIR ABOUT TWO FEET AWAY WHEN A SMALL OBJECT IS SUSPENDED IMMEDIATELY IN FRONT OF THE SPHERICAL MIRROR. THE "GHOST" IN THIS CASE IS AN RCA LAPEL EMBLEM.

aspherical system, for projecting television images from cathode-ray tubes onto a viewing screen, was ready; special tubes were built for it, and the first demonstration was given at the Camden laboratory.

Research engineers viewing the demonstration were astounded by the brightness of the projected picture but, while the definition of the system seemed nearly satisfactory for the quality of the picture then transmitted, it was not high enough for the pictures planned for the immediate future. Mr. Engstrom then assigned a number of engineers to the many problems connected with producing aspherical reflective projection systems of high light gathering power, high contrast, and high definition. Two immediate applications seemed obvious: first, a theater television system for pictures about 15 by 20 feet, and second, a home television system with pictures around 15 by 20 inches in size.

The new engineering group tackled the problem from many angles, theoretical as well as practical, and the results were very gratifying. The first public showing of a theater-television system was made by the Radio Corporation of America when it demonstrated at its annual stockholders' meeting in New York City on May 7, 1940, a projected-television picture 4½ by 6 feet in size with a high-light brightness well above the 5 foot-lambert value. The demonstration was given before some 300 stockholders and press representatives. The same system was shown informally to members of the FCC on February 5, 1940, in Camden, N. J. The optical system used in these demonstrations had been completed long before the demonstration. Landis applied for his patent (U.S. No. 2,273,801, now granted) in 1938.

The next step was to build a system for a full-size theater screen. This was done and on May 9, 1941 a demonstration of such a system, using a 441-line television signal and a projection screen 15 by 20 feet, was formally given before a large group of invited guests. The demonstration was held in the New Yorker Theater, 254 West 54th Street, New York City. The program included dramatic sketches from the NBC studios, Lowell Thomas, a singer, and was climaxed with a championship boxing bout. Previous to the formal May demonstration, one was held in the same theater on January 24, 1941 for members of the FCC and the press.

Among several workers, besides Landis, whose efforts contributed to the improved optical systems used in these demonstrations were E. G. Ramberg and D. W. Epstein, who worked out the theory of the finite-throw systems and produced practical designs; also, R. Leuschner, whose skill in working glass surfaces saved much time and effort.

System Highly Efficient

In the system demonstrated in New York, a scene transmitted from a studio is reconstructed as a picture on the curved wide end of a cathode-ray tube about 7 inches in diameter. This picture is very brilliant, but small. The spherical mirror, 30 inches in diameter, gathers the light emanating from the tube and reflects it through a 22½-inch lens on the theater screen. This screen is the regular motion picture screen. All the light (except for slight losses in reflection and transmission), which the large mirror gathered, finds its way to the screen, and this accounts for the superiority of the new optical system over conventional projection lenses.

While a great deal of effort was being devoted to the theater television, the home-projection television receiver was getting as much attention if not as much publicity. Optical systems for home projection were being built, tested, rebuilt, improved and tested again. The same result as with the theater-size equipment was obtained with living-room-size pictures, namely: a large gain in light with ample resolution and contrast.

The major obstacle to the use of reflective optical systems in projection television receivers for the home has been the high cost of the aspherical lens. The spherical mirror while quite large, ten inches in diameter and more, is an old familiar item to the 150-year-old optical industry, since most of the conventional optical surfaces are spherical and are easily made. With the aspherical surface, similar to a figure of revolution of a shallow letter S around one of its ends, the story was different. Such a figure is not a naturally generated surface and there were no machines for the straight forward production of such surfaces. True enough, astronomers, with their traditional patience and lack of hurry, managed to produce excellent aspherical lenses of such type on machines used for making astronomical instruments, but only by a tedious step-by-step method.

This method comprised grinding, polishing and optical testing operation repeated a great many times and at great expense in time and money. While the RCA men succeeded in reducing the number of operations, especially those of optical testing, they were still using the general methods and machines developed by astronomers. Their shortcuts were chiefly due to the fact that they did not need and did not strive for true astronomical accuracies.

The gain in light over the conventional projection lens was very attractive, but the cost of individually produced lenses was prohibitive. The apparent solution to the cost problem was molded aspherical lenses. A development was undertaken, and soon was concentrated on clear transparent plastics known under the complicated name of methyl methacrylate with simpler terms of Plexiglass and Lucite as their trade names.

A new set of difficult problems presented themselves. The manufacturers of plastics lent a willing and helping hand, but they did not know how to mold precision optical elements. The problems of making metal molding surfaces in shapes of negative replicas of aspherical surfaces promised to be formidable. The intensive efforts directed to this problem, however, proved successful, and experimental models of projection television receivers with plastic aspherical lenses were operating in RCA laboratories as early as 1940.

The molding process is essentially that of applying very large pressure to heated plastic material confined in the mold and cooling it under pressure until it reaches room temperature. The mold is then opened, the lens extracted and the hole for the neck of the protruding cathode-ray tube is bored out. The lens is then ready for use, with no polishing or finishing of any sort needed. As a rule, plastic lenses have been found to be of better quality than their glass counterparts, since it is permissible to spend a great deal more time and money on a mold good for, say, 1,000 pieces than on one piece by itself.

RCA MEN ROVE WAR FRONTS

Service Engineers, "Unsung Heroes," Install and Maintain Radio-electronic Equipment for Armed Forces at Far-flung Battle Stations—Teach "Know-how."

By W. L. Jones
Vice President and General Manager, RCA Service Co., Inc. Camden, N. J.

HE was on duty at Pearl Harbor the infamous morning of December 7, 1941, when the Japs staged their sneak attack; he's been an island-hopper in the Southwest Pacific; he demonstrated radio "know-how" to our allies in darkest Africa; he moved with Allied forces as they pushed the Germans out of North Africa, out of Sicily and northward into the mountains of Italy.

He doesn't receive military decorations, win medals, march in parades or have his exciting odyssey glamorized by Hollywood, but you will find him in the Aleutians, on Guadalcanal or with Uncle Sam's fighting men on other far-flung war fronts.

His only reward—and the only reward he desires — is the sheer satisfaction of knowing he's doing his part in the battle against the Axis.

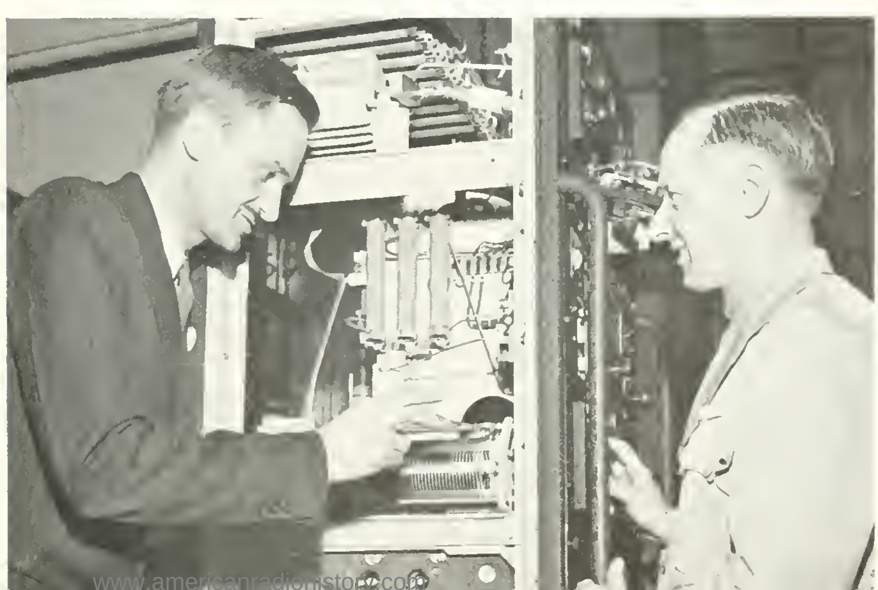
He is the unsung, unassuming civilian field engineer assigned to the Navy by the RCA Service Company to install and service RCA electronic equipment for the armed forces, and to give instruction on operation and maintenance.

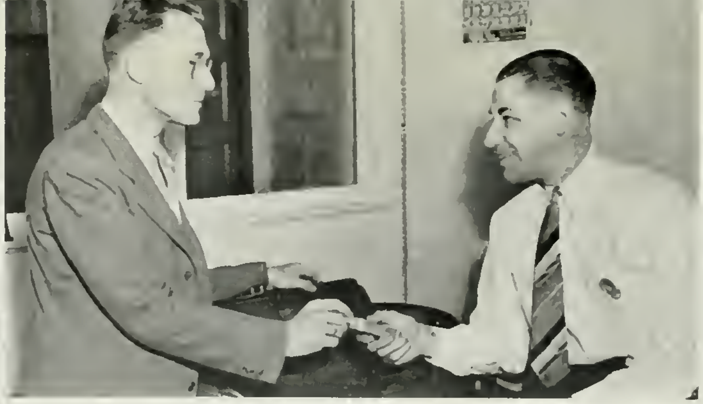
After months of high-geared activity at far-off battle stations, the RCA engineer is called home long enough to brush up on new developments in radio and electronics. Then he stands by in readiness for his next assignment.

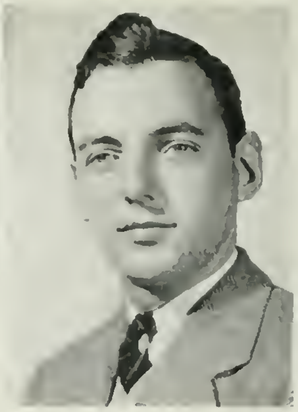
Frank Hartwick, recently back from Guadalcanal and nearby islands, has won the sobriquet of "circuit rider of the Southwest Pacific." Called by the Navy from Pearl Harbor on what apparently was a short emergency assignment, he was given a roving commission to go from one island to another, wherever he thought he was most needed and could do the most good.

Riding herd on the complicated equipment which is the voice, the eyes and the ears of the armed

BATTLEFRONT ENGINEERS MERRILL CHAPIN (LEFT) BACK FROM THE ALEUTIANS, AND FRANK HARTWICK, "CIRCUIT RIDER OF THE SOUTHWEST PACIFIC," INSPECT A RADIO TRANSMITTER AT THE RCA CAMDEN PLANT.







E. D. VAN DUYNE (LEFT) SPENT SIX MONTHS IN THE CARIBBEAN; GODFREY RENDELL (LEFT ABOVE) IS GREETED ON HIS RETURN FROM IRELAND BY W. J. ZAUN; AND W. W. BUTLER (RIGHT), WHO SERVED IN AUSTRALIA.

forces in modern warfare, Hartwick flew more than 100,000 airline miles during a year in the Pacific.

Although more or less stoical about "the bomb or bullet that has your name on it," Hartwick nevertheless acquired an automatic reaction of diving for cover when bombs started blasting around him or when a Zero came in low with machine guns blazing.

From another Pacific outpost — sandy Midway Island, 1,100 miles beyond Honolulu — came Edward Edison several weeks ago. Edison, who was the only civilian on Midway when he arrived there, found time between installations and service assignments to make several flights in Navy patrol planes and to go along on sea runs to see electronic equipment in actual use.

The only "natives" of Midway, according to Edison, are the gooney bird, whose call is a ringer for the Bronx cheer; the moaning bird, which gives a spine-chilling imitation of a man who has been stabbed in the back; and brightly-colored little canaries, whose pleasant notes help compensate for the raucous cries of the goonies and moaners. This, however, is little enough musical entertainment for Navy personnel stationed on Midway, so practically every man there has his own radio or phonograph. Several hundred RCA 5-tube sets are helping keep the boys in good spirits, and swapping phonograph records is one of the favorite pastimes of the Pacific base, with a surprisingly large number of men putting in quick bids on light classical music of the Victor Red Seal type.

Edison, recently relieved by A. E. Hilderbrand, and Tom Shipferling, just back from Pearl Harbor, relate how American boys in the Pacific listen, via short wave, with mingled amusement and contempt to "Tokyo Rose," an American-educated Japanese woman announcer who mixes American swing with Jap propaganda. The lads get a kick out of the music, but laugh up their GI sleeves when "Tokyo Rose" starts her usual patter urging the boys to forget all about the war and go home.

"After all, we Japanese have nothing against you boys," she coos, "and certainly you have no reason to dislike us." The invariable reply to this chatter is a jeering "Oh, yeah?"

When the Japs struck at Pearl Harbor two years ago, RCA's Merrill Gander was on a ferryboat, returning from duty. Other RCA men who followed him to Hawaii include S. E. Baker, R. J. Ehret, T. R. Hays, R. H. Newton, K. C. Heddens and C. A. Hobbs.

Two Sent to Iceland

Elsewhere in the vast Pacific, RCA engineers have been Johnny-on-the-spot when the Navy needed them—such as Merrill F. Chapin, T. H. Flythe and R. W. Connor in the Aleutians, George Jacobs and William Butler in the Australian sector and E. C. Tracy in the Southwest Pacific.

Tracy, a replacement for "circuit rider" Hartwick, is on his second overseas assignment. After receiving from the hand of President Roosevelt a War Production Board "Citation of Production Merit" for a valuable production suggestion, Tracy went with Pryor Watts to Iceland—via Ireland and England.

They flew from Rhode Island to their embarkation point, where they polished off an important installation before joining an Iceland-bound convoy. Long after their ship should have docked in Iceland, they discovered the course had been altered because of a tangle between convoy vessels and enemy submarines. After docking in Ireland, they moved on to London, thence to Iceland, where R. S. Willard was the first RCA engineer envoy.

One of the first RCA service men to go on duty with men in uniform was Fred Lakewitz, of Boston, who had three surprise assignments in quick succession. One night after midnight he was called by the Navy, handed sealed orders and transported to a patrol vessel whose communication equipment needed servicing. Neither his family nor his office knew his whereabouts for the next three days.

On another occasion, Lakewitz was assigned to test electronic equipment on a battle cruiser during a trial run. Expecting to be back at his point of embarkation within a few hours, he left his car at the dock. Several days later he was put ashore at a port 800 miles from his starting point.

But Lakewitz' biggest thrill came when a submarine chaser on which he was testing equipment was ordered into action with three Navy blimps in an effort to run down an enemy submarine that had been sighted. Lakewitz stood "general quarters" duty, operating communications and other equipment for twelve hours, during which time three contacts were made with the enemy sub—two by blimps and one by the sub-chaser.

Godfrey Rendell was asked to be ready to leave on an hour's notice for a port in the British Isles.

Similarly, Ed Van Duyne, in the midst of holiday preparations last December with his wife and four youngsters in New York, was called on less than 24-hours notice to proceed to an Atlantic coast port for an assignment expected to require from ten days to three weeks. The job was to train crew members on destroyers at sea in the use of RCA equipment.

When he next planted his feet on solid ground, it was on the soil of a Caribbean base, where his services proved so valuable that his assignment was stretched to six months before the Navy agreed to the assignment of another engineer to relieve him. Temporarily a "man without a country" when he returned without passport or other credentials, he finally convinced U. S. Custom authorities of his American citizenship and was permitted to return to his home and family.

Scattered through the Caribbean area are several bases which have been operational locales for such field men as W. W. Gilreath, P. C. McGaughey, C. M. Brown, and others.

Although not actually serving directly with U. S. military forces, two RCA engineers did yeoman work for the cause of the United Nations by penetrating the Congo country of Africa to supervise installation of powerful radio transmitters for our Allies.

To natives of the Belgian Congo, the strange new structure at Leopoldville with its towering antennae is just "singa pamba"—literally translated: "bunch of wires; nothing." To the rest of the world, however it is Radiodiffusion Nationale Belge—the Voice of Free Belgium.

To this far-off outpost of democracy went Welden Shaw to install equipment purchased from RCA by the Belgian National Government. Shaw had the cooperation of veteran Belgian technicians in setting up the 50,000-watt short wave transmitter. Native laborers were not impressed with the significance of the project, but they did their work methodically and well.

Just across the Congo river, where it widens into the Stanley Pool, is the port of Brazzaville, in French Equatorial Africa, among the first French colonies to rally to the cause of General Charles de Gaulle. RCA Engineer Paul C. Brown was in charge of setting up a 50,000-watt transmitter for Radio Brazzaville, which is a beacon of information and inspiration for men and women in temporary bondage in Nazi-occupied French possessions.

Behind these installations on the Dark Continent is a story of men working 12 and 14 hours a day, some fighting fever and all menaced by clouds of malaria-laden mosquitos, with temperatures in the high 90's, humidity 100%.

Foreign lands are no novelty for Brown. From 1935 to 1940 he lived in Saigon, French Indo China, while in business as a distributor for RCA products in the Far East. He left Saigon in October, 1941, joined the service division of RCA and returned to the Camden plant to work on the transmitter destined for Brazzaville.

Throughout the world, there are still other RCA field engineers, wherever and whenever the military requires their counsel and skill in installing, repairing and servicing electronic equipment, and instructing personnel on its use and upkeep. These, for the moment, remain unidentified. One by one they will complete their assignments, be relieved by a fellow engineer long enough for a visit to RCA offices and laboratories, then stand on call, ready for any new assignment.

And so it will go, until the war is won—the unheralded and unpretentious RCA engineer speeding to every corner of the globe to provide a vital link between working men on the production front and fighting men on the battlefront.

ENGINEER PAUL C. BROWN TAKES LEAVE OF CAPTAIN S. KAGAN OF THE FRENCH COMMITTEE OF NATIONAL LIBERATION IN BRAZZAVILLE, WHERE BROWN SUPERVISED INSTALLATION OF A SHORT-WAVE TRANSMITTER.

ENGINEER BROWN GETS THE HELP OF NATIVES IN PUTTING INTO POSITION THE HUGE TRANSFORMER, WHICH WAS PART OF THE RCA TRANSMITTER INSTALLATION AT BRAZZAVILLE. NO CRANES OR DERRICKS WERE AVAILABLE.

J. FRANCIS HARRIS OF RCAC IS INTERVIEWED FOR NBC LISTENERS BY DICK CONNOLLY ON HIS RETURN TO THE UNITED STATES ABOARD THE DIPLOMATIC EXCHANGE LINER GRIPSHOLM.

RCA MAN BACK FROM JAPAN

Communications Representative in China, Japan, and Manchuria Describes Experiences as Prisoner of War Following Return to U. S.

Editor's Note.—J. Francis Harris has represented RCA Communications in China, Japan and Manchuria since 1932 and he was the Vice President in charge in that area from 1939 until the outbreak of the war. He was also a Director in the Victor Talking Machine Company of Manchuria, Ltd., and the Victor Talking Machine Company of China, Ltd. On Pearl Harbor Day, in 1941, he was captured by the Japanese in the RCAC offices in Shanghai. When, on December 1, 1943, he returned to the United States aboard the diplomatic exchange liner "Gripsholm," he was asked to describe his experiences for "Radio Age."

By J. Francis Harris

THE morning of December 8, 1941 at Shanghai (December 7 at Pearl Harbor), is a time I will never forget. About daybreak, there occurred the famous Battle of the Wangpoo in which the Japanese battle cruiser "Idzumo" and numerous shore batteries literally blew the heroic British gunboat "Petrel" out of the water. The captain of the "Petrel" had preferred to go down fighting rather than surrender his almost defenseless little ship.

After helping several of the seriously wounded British sailors who had swum ashore to the French Bund—an endeavor that was explosively interrupted by the arrival of Japanese marines in fighting humor—I proceeded to the RCA Communication offices.

At 4:18 o'clock, a Japanese Imperial Landing Party took over all American institutions in Shanghai. Alone in the office when the Japanese marines marched in, it was obvious to me that RCAC's business in Shanghai was at an end for the duration.

Although a Japanese officer ordered me to stay in the office I was carelessly guarded and managed to destroy a number of papers which seemed important at the time. After two days, the Japanese told me to keep the office open until they had time to complete their investigation and take over. There was nothing to do but obey. I spent the next few months liquidating our Shanghai business.

The RCAC offices in Tokyo, Osaka and Kobe, Japan; the Victor Talking Machine Company of Manchuria, Ltd., at Hsinking; and the Victor Talking Machine Company of China, Ltd., at Shanghai had the same experience as RCAC in Shanghai. They were not closed, but their facilities were taken over by the Japanese.

In January, 1943, I was interned in the Pootung prison camp near Shanghai where about 385 American and 800 British men were held. Chosen Assistant - Representative for the camp, it was my job to negotiate between the interned men and Japanese officials and to assist in the general management of camp affairs.

The Pootung camp is an old tobacco warehouse but we managed to make a fairly livable place out of it, since the internal management of the camp was left largely in our hands. The warehouse comprised three buildings of three floors each. It could probably have accommodated four or five hundred men fairly comfortably—it actually held about 1,200. In my room, eighty men were crowded into space sufficient for about forty under ordinary barrack conditions.

These buildings and the adjoining "field," which was in reality a shell-holed ruin of a Chinese village that had been destroyed in the 1937 Sino-Japanese fighting, occupied a total space of less than seven acres! But with bare hands as our only tools, we filled the shell holes and cleared up space enough to lay the foundation for a baseball diamond and to provide other recreational space. With the aid of old railroad rails, a drag was fashioned that eventually, after much sweat, provided Pootung Camp with the finest diamond I ever saw. Almost everybody played, even the British. In fact, to the amazement of everyone, the championship for the summer of 1943 went to a British team—our alibi being that the British had more young athletes than we Americans.

Life at Pootung was no picnic. We were given enough food to live on, but it was neither plentiful nor tasty. The daily diet, almost without variation, was cracked wheat (wormy), ribbon fish or water buffalo meat, rice and a vegetable.

Yet the morale of the American and British prisoners at Pootung was high. The men seldom worried about themselves, the welfare of their families at home being the great source of anxiety.

Although we had only Japanese language newspapers to read, it was surprisingly easy to keep track of the war in the Far East. The newspapers highlighted Japanese victory claims, but the northward progress of United Nations forces could be marked by the frequency with which "His Imperial Majesty's forces made a strategic withdrawal after achieving their objectives."

I believe that a vast majority of Japanese now know that they cannot win the war and that as their situation becomes desperate they will launch a peace offensive based on compromise. The acceptance of such a Japanese offer would be only the prelude to another war.

It was difficult to leave so many of my friends behind but September 19, when I started the long journey back to the United States, was a great day for me. When the ship stopped at Manila I heard the good news that James F. Waples and Harold Evory, Assistant-Superintendents of RCAC in Manila, and Fred J. Sager, Manila cashier, were in good health even though interned. I could discover nothing then about Lt. Earl G. Baumgardner, USNR, who had been Superintendent at Manila, but since arriving in the United States I have learned that Lieutenant Baumgardner is reported as a military prisoner in the Philippines.

Probably the most thrilling moment in my life, and in the lives of the 1,500 other returning Americans, was when the *Gripsholm* hove into sight outside the little harbor of Mormugao, Portuguese West India, where we had been taken by a Japanese ship to await its arrival. The prospect of being free men and women again at last seemed real. No other thrill matched this except our first glimpse of the grand old lady of New York Harbor, the Statue of Liberty, as she appeared through the fog and our tears the morning of our arrival in New York.

ELECTRONICS EXPANDS HORIZON FOR PLASTICS

Molded Products Being Turned Out Much Faster, Quality Improved by New Methods

NEW horizons for the plastics industry and resulting new conveniences for homes and offices, schools and factories, and other institutions were envisaged in a recent address by Fred W. Wentker, manager of the Electronic Apparatus Section of the RCA Victor Division, Radio Corporation of America, at a meeting of the Plastic Club of America in New York.

Molded plastic products already are being produced much faster, without the usual risk of damage to molds, and, most important, with marked improvement in quality, Mr. Wentker said, through new RCA electronic devices which produce and apply radio-frequency current to generate heat in raw material preforms before molding.

Further developments promise to make practicable the use of plastic materials and production of plastic products heretofore prevented by molding limitations. Increased strength resulting from the more complete and more uniform curing made possible by electronic heating, he said, will expand the use of plastics into fields involving stresses for which they have not previously been suited.

Mr. Wentker also indicated the possibility that the higher curing efficiency of electronic heating methods may make practicable the use of less costly plastic compounds for products in which a high degree of strength is not an especially important factor.

Experimental developments and practical experience thus far, he said, have influenced leaders in the plastics industry to state that the introduction of electronic heating is the most significant advance in the industry in more than a quarter of a century.

New plastic materials and new techniques made possible by electronics promise to maintain the momentum gained by the industry during the war, he pointed out, by establishing permanent advantages from the use of plastics in some products in which they have been introduced as wartime substitutes.

Unlike heat applied by steam, hot plates, gas flames, and other conventional sources, which must penetrate industrial materials from the outside, electronic heat is generated within the material by the passage of radio-frequency currents which are produced by electron tubes and their associated circuits.

In the heating of metals for processes such as case-hardening, annealing, soldering, and welding, these currents are induced in the material by passing it through an induction coil. In heat treating of plastics and other non-conducting materials, current is passed through the material by placing it between two electrodes.

Close control of application, which is inherent in electronic methods, makes it possible to confine the generation of heat to any desired area and depth, a particular advantage in such operations as case-hardening, it was explained, or to generate heat uniformly and almost simultaneously throughout a piece of material.

For the plastics industry the latter principle means thorough heating of the inside of a preform without overheating and consequent toughening of the outside, rendering the piece workable at once.

Research Director

E. W. ENGSTROM, WHO RECENTLY WAS APPOINTED RESEARCH DIRECTOR OF RCA LABORATORIES.

URGES FREEDOM FOR RADIO

Trammell Tells Senate Committee Broadcasting Cannot Remain "Half Slave and Half Free" and Continue to Render Great Service to Nation.

FEAR of the blight of government control hangs over the radio industry, declared Niles Trammell, president of the National Broadcasting Company, in his testimony December 7 before the Senate Interstate Commerce Committee hearing in Washington on the White-Wheeler radio bill.

Mincing no words in his testimony that radio cannot remain "half slave and half free," Mr. Trammell emphasized to the committee that American radio can continue to render a great service to the nation only if it is given "a new freedom from fear." The Congress must determine, pointed out Mr. Trammell, whether "the radio industry is to flourish under our free enterprise system or become a weak and subservient tool of government." He continued:

"The questions that arise in these respects bear upon the fundamental philosophy of radio legislation in determining whether radio will be made to creep or will be allowed to walk in post-war development. For example, present FCC regulations have already imposed a strait-jacket on the creation of television networks by prohibiting the ownership of more than three television stations by any one company."

"Ownership and operation of key stations by networks will be as important in this new service as they are now in standard broadcasting," Mr. Trammell testified. "These key stations will be needed to create the network program service and to provide the economic basis to meet the tremendous development costs. It is clear that such an enterprise cannot be self-sustaining until millions of television receivers have been sold."

He envisaged the marvelous post-war opportunities that promise to revolutionize broadcasting, all requiring large capital outlays. "If private enterprise is to convert these achievements into great public services," he said, "if enough enterprising investors are to be found to create competition in these public services, the radio legislation which you write must be such as to guarantee freedom of opportunity and operation of these services—especially freedom from government domination and control. Only free enterprise can obtain from these achievements the largest dividend in public service."

Pointing out that under a recent decision of the Supreme Court the Federal Communications Commission has been placed in virtual control of radio programs, Mr. Trammell emphasized the urgent necessity of Congress writing a law clearly inhibiting the FCC from controlling program policies or business practices of broadcasting stations.

Challenge In Television

He asserted that the entire concept of broadcasting since the beginning has been one of public service and that the industry acknowledges its social obligations. But that does not mean, he insisted, "that the radio industry wants those social obligations imposed upon it as a matter of licensed authority, especially if it is coupled with a fear of confiscation of investment or a bureaucratic control of its operation.

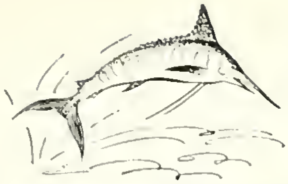
"Freedom to advance in the radio art demands that those who have developed broadcasting, who have established transmitters, studios and services, be given the opportunity to modernize their facilities to keep pace with scientific and technical progress. The broadcast station or network which is not permitted to transform itself into a sight and sound service will go the way of the silent film or the horse and buggy."

A technical revolution is imminent, awaiting only the conclusion of the war, he averred. Television, of course, offers the greatest challenge to the industry's ingenuity and enterprise, he submitted, and pointed out that today the radio industry is where the motion picture industry was 20 years ago when voice came to the silent screen. The broadcast industry in time must scrap its entire plant and build a new one; hundreds of new stations will be erected, new networks established and thousands of miles of new telephone lines and coaxial cables constructed. All this means, said Mr. Trammell, work for engineers, architects and artisans, work for lumber mills, textile mills and other manufacturers. More musicians will be needed, more performers required, more writers, more salesmen and more employment generally will result.

The task of properly developing wavelengths for the expansion of broadcasting services falls on private enterprise, he said. Private enterprise must carry on the research and development necessary to enlarge broadcast facilities with the encouragement of government or the industry will be placed in a strait-jacket. He declared that the development of broadcasting to its present state had been achieved by private enterprise and that "if private enterprise is to develop the new services now potentially available, it must be given the opportunity free from fear either of confiscation of investment or bureaucratic control of operations. Either would result in discouraging the risk, the initiative and the necessary enterprise."

Asserting that the entire broadcasting industry of the United States had been built on the use of less than 100 roads or wavelengths, he said that we now have available for future use many thousands or possibly millions of new roadways through the ether and thus the art is really in its infancy. "Wavelengths by themselves constitute no physical assets. They must be put to work before they become useful and this requires capital investment and development," he said.

"As we examine the technical developments in the field of radio, it should be apparent that there are vast opportunities for new types of broadcasting as well as many specialized program services," Mr. Trammell said.



"Just caught the biggest marlin I ever saw!"

"*We strayed out about 125 miles after that marlin so I guess we won't be home tonight . . . But don't worry. I just phoned the weather station and with our old reliable radio direction-finder, we'll make port easy tomorrow . . . I'll give you a ring in the morning . . .*"

* * *

This boat and its skipper are now probably in the service of the Government but when peace comes and once again the harbors and seacoast of our nation are dotted with pleasure craft, we shall see in these boats much that is new.

In radio-electronic equipment, for example, even the smallest craft will be fitted with ship-to-shore telephonic systems and radio-direction finders. They will also be equipped with other radio-electronic instruments which will help make yachting more popular, more pleasurable, and less hazardous than ever before.

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Electronic devices, equipped with electron tubes of proper design, can perform a great variety of tasks. They can control machines and processes. Operate traffic, fire-alarm and other signal systems. Protect factory workers from accidents. Provide quick, mobile police communications. Detect and trap criminals. Sort fruit, nuts, vegetables. Weld, solder, seal, sew, weigh, measure, gauge. Fill bottles. Ease pain, treat disease. Preserve foods. Guide and land airplanes. Spot submarines. Aim and fire guns. Even keep an eye on the baby—literally!

All these jobs can be done electronically—and in almost every case, *automatically*. And electronics, via electron tubes, is going to do immensely *more* after the war. Remember that the fundamental element in *any* electronic device of any *kind* is the electron tube; and that RCA is the fountainhead of modern electron tube development.

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