A HISTORY OF RADIO CORPORATION OF AMERICA

THE YEARS 1938 TO 1958

Pioneering efforts by RCA contributed much to the expansion of television service into the UHF spectrum. Shown is RCA's tower and transmitter building of KC2XAK, the first licensed experimental UHF station at Bridgeport, Conn. After the experiments were completed, the tower and antenna were shipped to Portland, Ore. to be put on the air as part of KPTV, the first commercial UHF television station in the world.

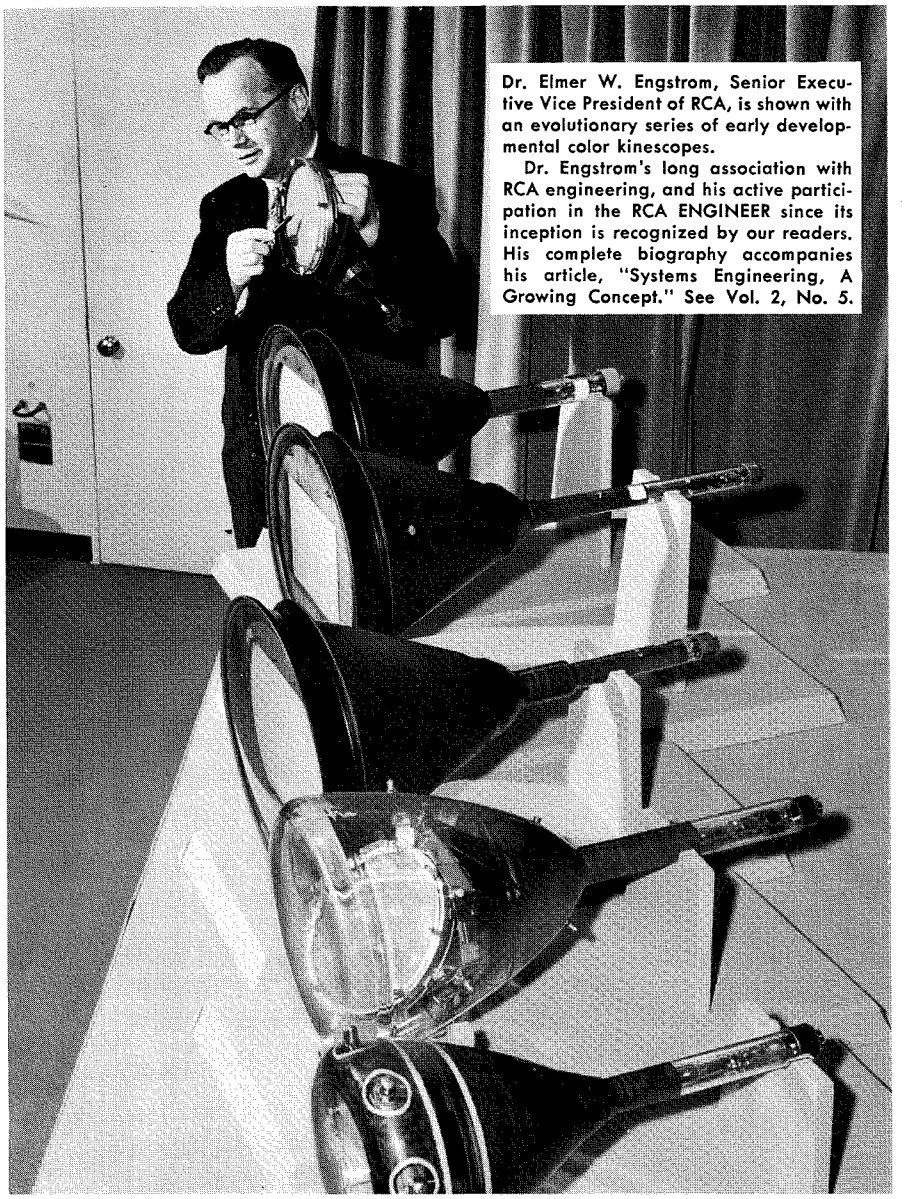
by **DR. ELMER W. ENGSTROM**
Senior Executive Vice-President
Radio Corporation of America

AS A HISTORIAN writing in 1938, the late J. C. Warner, then Vice President, Radiotron Division, of the RCA Manufacturing Company, undertook to review the first 18 years of RCA's corporate life in an article appearing in this magazine. His concluding words at the time were: ". . . if we live up to our opportunities we will some day look back at 1938 and see that we have only started to scratch the surface." *(See Part 1, Vol. 3, No. 1)*

None of us associated with Warner in 1938 would have disagreed with this estimate. At the same time, it is doubtful that anyone could have foreseen the phenomenal growth that has marked the second 18 years of RCA's existence. From a $100 million corporation in 1938, RCA soared to the billion dollar corporate rank in 1955, a position it maintained in 1956 and 1957. In 18 years, its plant and equipment multiplied six times in value and the total number of employees quadrupled, to some 80,000 persons.

More significant than this impressive growth was the basic change in the nature of the Corporation itself. In 1938, RCA was in transition from a radio communications concern to a broadly diversified electronics organization with a growing interest in such new fields as radar, television, and airborne electronics. Today it has become an outstanding research, engineering and manufacturing enterprise, holding a position of leadership. The second 18 years of RCA not only have lived up to the opportunities which Warner referred to in 1938 but have created a host of new and exciting opportunities for the future.

Shortly after Warner had published his review, two events occurred which were to influence profoundly the future of the Corporation. In April, 1939, seven years of intensive research, engineering development and field testing by RCA culminated in the introduction, at the New York World's Fair, of the first public television service. Four months later, Hitler's assault on Poland and the declarations of war by England and France opened the Second World War.



Dr. Elmer W. Engstrom, Senior Executive Vice President of RCA, is shown with an evolutionary series of early developmental color kinescopes.

Dr. Engstrom's long association with RCA engineering, and his active participation in the RCA ENGINEER since its inception is recognized by our readers. His complete biography accompanies his article, "Systems Engineering, A Growing Concept." See Vol. 2, No. 5.

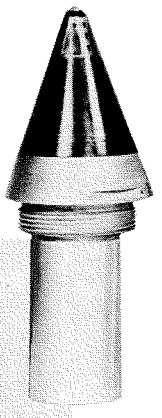
The official inauguration of television service was the harbinger of a new era in mass communications, but it required a keen eye to see in the actual event the shape of the nation-wide television service we know today. It was an extremely limited service, covering only the New York metropolitan area, and operating on the "experimental" basis authorized by the Federal Communications Commission. Programs emanating from the NBC transmitter atop the Empire State Building were viewed on a relative handful of 9-inch direct view and 12-inch reflection-type receivers produced at Camden for sale in the New York area.

Standing before the Iconoscope cameras in front of the RCA Building at the World's Fair on April 20, David Sarnoff announced the beginning of regular television service by NBC. And he added:

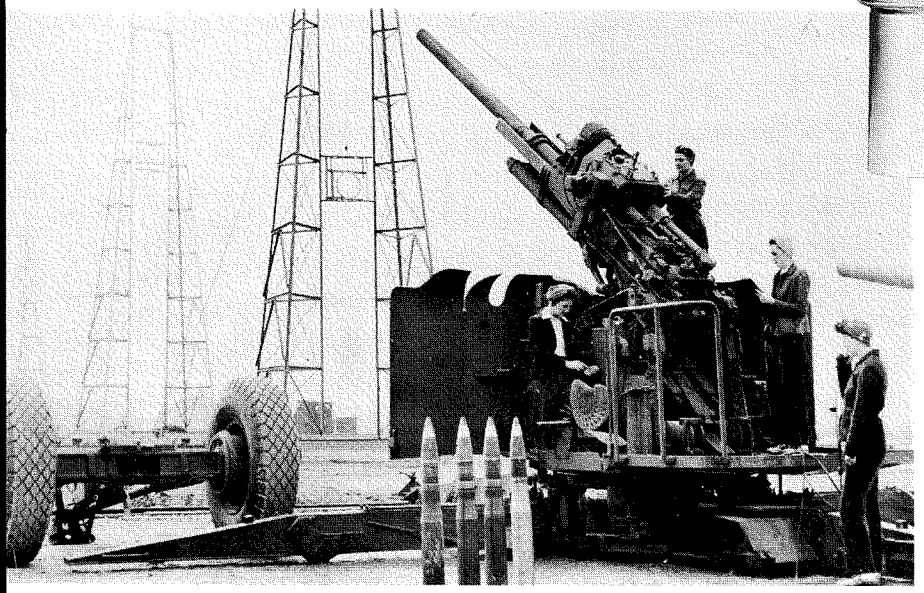
> "Now we add sight to sound. It is with a feeling of humbleness that I come to this moment of announcing the birth in this country of a new art so important in its implications that it is bound to affect all society . . . This miracle of engineering skill which one day will bring the world to the home, also brings a new American industry to serve man's material welfare . . ."

RCA IN WAR

The outbreak of World War II effectively halted the further progress of commercial television. The clear need



Described as second only to the A-bomb as the most effective weapon to come out of World War II, the Variable-Time fuse for artillery and naval projectiles consisted of a 5-tube transceiver which detonated the shell at its moment of maximum effectiveness. RCA manufactured over half the total production of V-T fuses.



During World War II, RCA electronic equipment was used in testing muzzle velocities of large-caliber guns at Aberdeen Proving Grounds. A magnetized shell was fired through two detecting coils, and the time difference was converted into muzzle velocity.

for military preparedness led to increasingly heavy demands through 1940 and 1941 on industrial research, engineering and production facilities both for American forces at home and for Britain and France through the Lend Lease program. RCA, with long experience in communications and with a pre-war record of major contributions in the important military areas of radar, underwater sound and airborne electronics, was in the forefront of this program from the start. By the time of the Japanese attack on Pearl Harbor in December, 1941, virtually all of the Corporation's facilities were devoted to military requirements for radio equipment, radar, special tubes, acoustical devices and navigation systems.

The increasing demand for military electronic equipment led, early in the war, to several important changes in RCA's organization and facilities to expedite research, engineering and production. The first of these related to the RCA research organization.

During the 1930's RCA's research facilities had been concentrated largely at the manufacturing plants in Camden and Harrison in addition to the communications research groups on Long Island. By late 1940, the growth of defense activities had generated a need for increased staff and facilities, both for research and manufacturing. At the same time it was recognized that the research program could benefit from a separate environment in which the laboratories might physically be brought together to obtain better coordination and direction. Thus, in March, 1941, the research staffs were incorporated as a new department called RCA Laboratories. Concurrently, work was started on a new research center at Princeton, New Jersey, approximately mid-way between the Camden and Harrison operations.

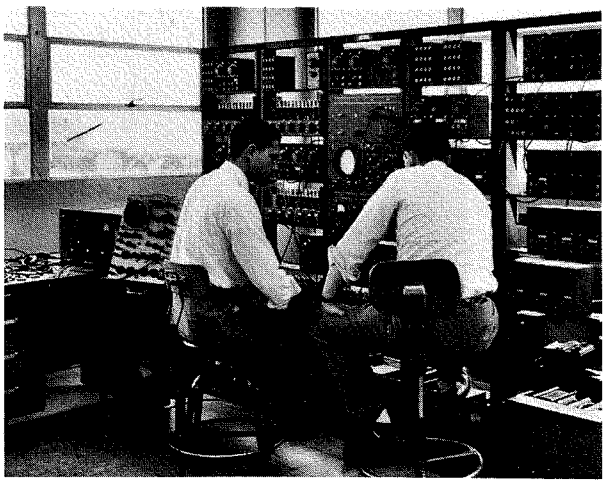
Dedicated in September, 1942, the new building—the present David Sarnoff Research Center—provided the RCA research staff for the first time with complete modern facilities in an environment fully conducive to creative research. Further, it provided a physical as well as an administrative unity impossible under previous conditions.

In addition to the new research center at Princeton, expansion early in the war included new facilities for production. Advances in military electronics, particularly in such high-frequency applications as radar and microwave communications, led to a greatly increased demand for special purpose radio and electron tubes. To meet this need, the U. S. Navy undertook construction of a large new plant at Lancaster, Pennsylvania, to be operated by RCA. Completed in 1942, the plant operated at full capacity through the war to produce hundreds of thousands of tubes for military applications. At the war's end, it was purchased from the Navy by RCA.

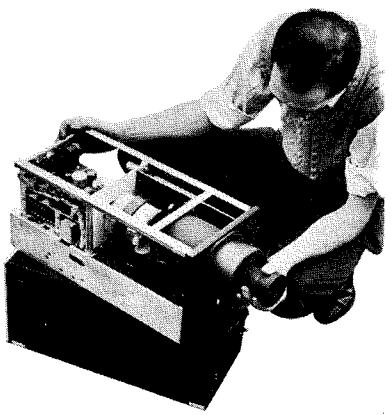
A further organizational change of significance was made in December, 1942, to achieve closer coordination of all RCA manufacturing activities. The RCA Manufacturing Company, established in 1935 as a wholly owned subsidiary of RCA, was consolidated with the parent Corporation to become the RCA Victor Division, comprising all of the Corporation's tube and electronic equipment production facilities.

CONTRIBUTIONS TO VICTORY

The contributions to victory of the divisions and services of RCA, in research, engineering, production and



RCA has continued its active participation in military electronics in post-war years. Engineers are shown here with computer equipment at the Moorestown Missile and Surface Radar Engineering Plant.



Experimental RCA "Block" television equipment was developed and tested during World War II for various airborne applications. This compact equipment was the forerunner of modern miniature television systems.

service were extensive, varied and distinguished. Although the list is too long for brief mention, they include the following:

RCA Laboratories: New devices, systems and techniques including the Shoran navigation and blind-bombing system, airborne radar equipment, electronic fire control, and airborne television equipment for aircraft, and guided missiles.

RCA Victor Division: Design and quantity production of tubes and electronic equipment including 200 types of electron tubes and 350 types of electronic apparatus. Among the large-quantity items were some 20 million miniature tubes and five million proximity fuses. Outstanding among types of equipment were radar altimeters, sound-powered telephones, battle announce equipment and R/F power generators.

RCA Communications: Initially providing the only means of communication with the war zone, RCA Communications worked closely with the Government to keep vital networks in operation.

Radiomarine Corporation: Produced more than 40,000 major units of marine radio equipment, comprising 42 different types of radio and radar apparatus for installation on merchant and supply vessels.

RCA Institutes: Trained thousands of Army, Navy and Marine servicemen in radio and electronic techniques.

National Broadcasting Company: Provided world-wide coverage of military operations for broadcast to the public and developed many special morale programs. Television facilities, more limited than radio, were turned to morale and instruction purposes.

The outstanding performance of the various RCA divisions through the war was recognized by seven Army-Navy "E" pennants, two U. S. Navy Bureau of Ordnance Flags, the U. S. Maritime Pennant, the Victory Fleet Flag and 27 stars for continued excellence in operations.

RETURN TO PEACE

With the return of peace in 1945, RCA found itself, with all other electronics manufacturers, in a vastly changed environment. World War II had triggered a swift transformation in electronic technology. Research and engineering led to major advances in high-frequency techniques, in electronic systems development, in electron optics and in other fields of future peace-time importance.

The post-war environment for the industry was characterized by two totally novel features—a far more versatile and sophisticated technology than in the pre-war years, and a substantial increase in the number of participating and competing companies. Moreover, this greatly expanded art and industry faced a tremendous demand for its products and services from a public recently released from war-time austerity.

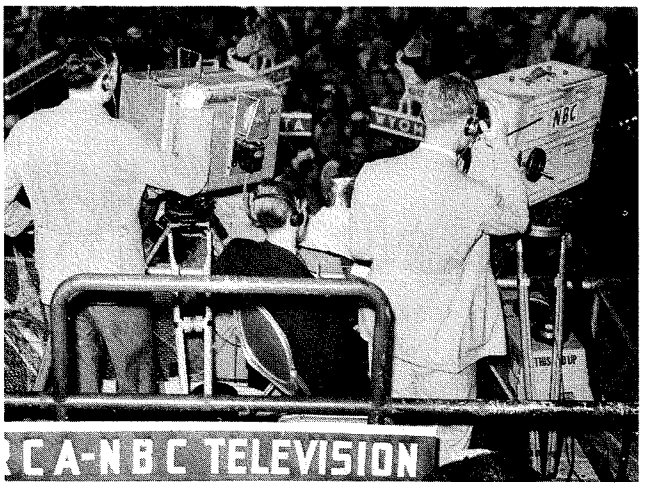
Plans for converting its research, engineering and production facilities to a peace-time basis were undertaken by RCA during the late stages of the war, when it had become apparent that victory was at hand. As a result, the process of conversion was rapidly carried out after V-J Day. Within eight weeks, RCA Victor plants at Bloomington, Indiana, and Camden were producing radios for the civilian market. Before the end of 1945, commercial tube production had been resumed at Harrison. By mid-1946, production of television picture tubes and tubes for broadcast transmitters and industrial uses was under way at the newly acquired Lancaster plant.

One organizational development of importance in the conversion pattern was the establishment, in February, 1945, of the RCA International Division. In anticipation of an expanded foreign market for electronic equipment, the new division was given responsibility for distribution of products manufactured by RCA, the operation of foreign subsidiaries, and coordination of all RCA international activities.

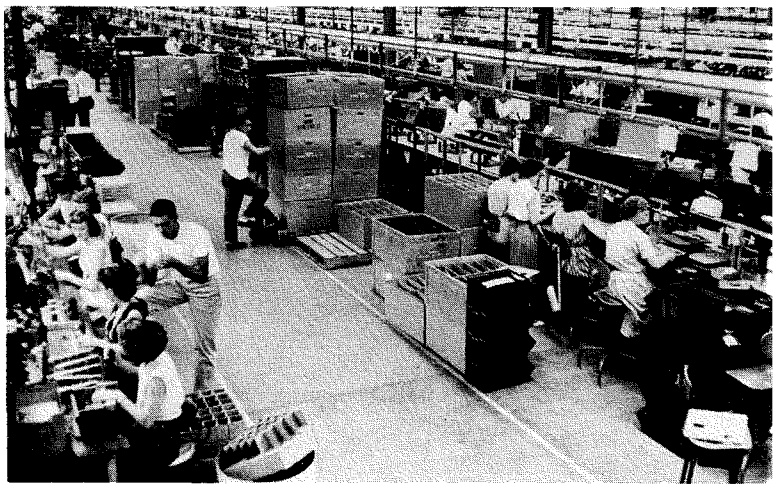
POST-WAR TELEVISION

Full attention could now be given to the expansion of a civilian television system which literally had been nipped in the bud by World War II. The pre-war sharing with other manufacturers of RCA's television research and engineering experience and the availability of important technical developments to RCA licensees had made possible a broad manufacturing base for home receivers. By 1941, standards for the present television system also had been worked out by the National Television System Committee, an industry group, and approved by the FCC.

Thus, by the end of the war, television not only was ready for commercial application; it also was a better system, because of research and engi-



Early NBC experiments with televising on-the-spot news events provided invaluable technical and artistic experience which paved the way for the post-war television boom.



An overall view of the record-changer and amplifier assembly lines at RCA Victor's factory at Cambridge, Ohio. The plant, world's largest producer of packaged hi-fi instruments, has fifteen assembly lines capable of turning out 6,000 sets in an eight-hour shift. Inset is one of the instruments in RCA's complete hi-fi line.

neering advances achieved for military purposes. Among these were a more sensitive camera tube — the Image Orthicon; more powerful transmitting equipment operating over the full bandwidth allocated to commercial service; improved picture display techniques based on radar developments during the war, and effective network relay techniques.

Television activities resumed on a large scale during 1946, when the first network was opened, linking NBC facilities in New York and Washington by co-axial cable, and including Philadelphia and Schenectady.

It also was during 1946 that the RCA Victor Division placed the first post-war television sets on the market. The basic model was the famed 630TS, with a ten-inch picture tube. Marketed at a price of $375, the 630TS' economy, reliability and high quality swept it into immediate popularity. The nation's first quantity produced and marketed receiver, it was television's equivalent of the "Model T." As much as any other single factor, the 630TS was responsible for the swift appearance of television in American homes during the early post-war years.

The pre-war practice of sharing with other manufacturers the results of RCA television research and engineering experience also was resumed vigorously. Engineering data relating to the 630TS was made available to other manufacturers in conjunction with industry symposia held at Camden. The result was a rapid growth of television production by many organizations in the industry.

Another factor in television growth was the initiation of large scale picture tube production at the Lancaster plant during 1946. By 1948, nonetheless, receiver sales had expanded so rapidly that a shortage in picture tubes threatened to develop. This was minimized by RCA's ability to supply tubes from the surplus accumulated at Lancaster during the previous two years in anticipation of just such an emergency.

Further expansion of RCA manufacturing facilities, extension of the NBC network, and improvements in the television system itself characterized the years after 1946. A new plant for tube manufacture was acquired at Marion, Indiana, and placed in operation during 1949. In February, 1950, the RCA Victor Division produced its one-millionth home television receiver. At the same time, the size of the picture tube steadily grew larger, expanding in 1949 to the 16-inch metal cone, to 19 inches in 1950, to the popular 21-inch size by 1952. The NBC network, keeping pace with the growth of home television, reached rapidly across the nation to link principal cities in all of the 48 states. From the four-station network of 1946, it has grown today to more than 200 network affiliates.

COLOR TELEVISION

As the commercial television system expanded, RCA undertook an energetic post-war program of color television research and development. Although mechanical techniques offered promise in terms of early commercial advantage, RCA decided, soon after the war, to strive for an all-electronic color system fully compatible with black-and-white. Outstanding progress was achieved at RCA Laboratories during 1947 and 1948. Several demonstrations were held, showing a color system employing three kinescopes and combined with an optical system to present a composite color picture.

In 1949, the FCC scheduled a series of hearings to consider, among other matters, the establishment of standards for color television transmission. At issue were two competing systems—a non-compatible mechanical system of color, and the all-electronic compatible color system advocated by RCA.

As the hearings progressed, the research staff of RCA Laboratories, supported by engineering groups at the tube plants at Harrison and Lancaster, moved with full speed to the development of the final basic element in the compatible system—a single tube capable of producing pictures in full color. The result of this extraordinary effort, demonstrated publicly in March, 1950, was the tri-color kinescope, one of the outstanding achievements in early post-war electronics. In the words of General Sarnoff: "Measured in comparison with every major development in radio and television over the past fifty years, this color tube will take its place in the annals of television as a revolutionary and epoch-making device . . . As the master key to practical color television, it is an outstanding development of our time."

Despite the basic technical superiority of all-electronic color transmission, the FCC gave its approval to the mechanical, non-compatible system. In effect, this banned the compatible system from the market place.

Through court actions, RCA vigorously sought reversal of the FCC decision. Meanwhile, it proceeded with further refinements in compatible color transmission. In December, 1953, the FCC finally approved new and compatible standards recommended by the NTSC.

While receiver and tube production forged ahead, color broadcasting equipment was speeded to television stations. By October, 1955, 111 stations of the NBC network alone were equipped to broadcast in the new medium. Today the compatible color system embraces roughly half the stations in America and is capable of reaching 96 per cent of the nation's television homes.

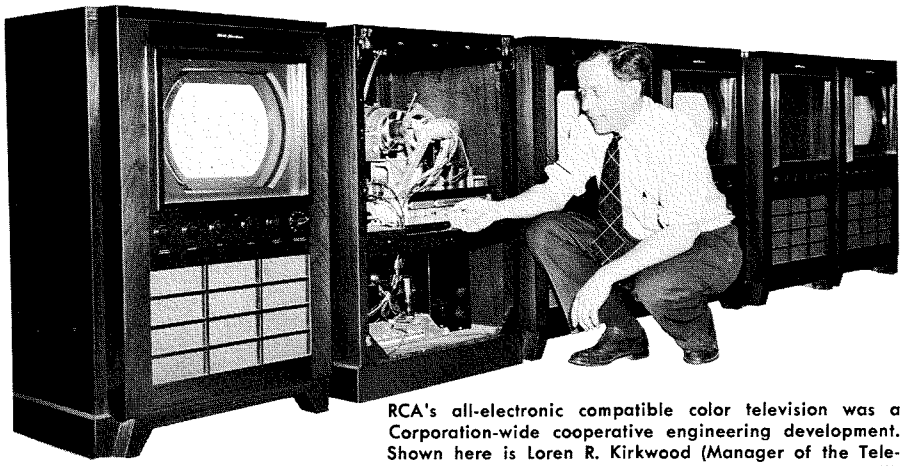
In 1949, television, now firmly established as a national broadcast service, moved in a new and significant direction. Development by RCA scientists of the small and highly sensitive Vidicon pick-up tube opened vast opportunities for closed-circuit television for industry and education.

OTHER DEVELOPMENTS

If television, in all its aspects, was perhaps the most spectacular of the early post-war electronic developments, by no means was it the only one. A dramatic transformation in which RCA played a dominant role, was under way in the phonograph and recording fields. In 1949, the Corporation introduced its 45-rpm system of recorded music, including the fastest automatic record changer ever devised.

By the end of the year, 45-rpm records of unbreakable vinyl plastic were being produced at the rate of more than 25,000,000 annually and the number doubled in 1950. That year also saw the introduction, by RCA, of a three-speed record instrument.

The growth of popular interest in high-fidelity music reproduction spurred a number of other RCA contributions to the new form of home entertainment. Among these was the LC1A duo-cone speaker, placed in



RCA's all-electronic compatible color television was a Corporation-wide cooperative engineering development. Shown here is Loren R. Kirkwood (Manager of the Television Division's Color Receiver Engineering at Cherry Hill) with a line of developmental color receivers.

production a year after its debut, in 1947, at the Berkshire Music Festival. In 1953, RCA introduced two high-fidelity "Victrola" phonographs designed for the mass market. At the same time it began to market a complete line of high quality "intermatched" components for home assembly.

NATIONAL SECURITY

World War II, which saw the development of jet aircraft, radar, sonar, the V-2 rocket and other weapons of high complexity and growing effectiveness, presaged a new era of military technology in which electronics would play a determining role. Any doubts as to the need to maintain a strong military posture, supported by the latest technology, moreover, were dispelled by the militant agressiveness of the Soviet Union.

Thus RCA, which emerged from the war as one of the nation's foremost contributors to military progress, continued to devote a significant proportion of its research and development to problems of advanced military technology.

Its work for the Government included a variety of development and production projects in such fields as sonar, advanced radar apparatus and fire control. In 1950, for example, RCA Laboratories completed for the U. S. Navy the development and construction of the world's largest and most accurate electronic analogue computor to evaluate the performance of guided missiles, airplanes, ships and submarines.

When war in Korea erupted in 1950, RCA's activities in the fields of military electronics increased sharply. The Government field service activity of the RCA Service Company stepped up to such an extent that by the end of the year, approximately twice as many trained field engineers were assigned to military activities as at the peak of World War II. In manufacturing, new projects for the military included equipment in the fields of electronic sound, sonar, missiles, navigation and communications.

This, in turn, necessitated additional plant expansion, devoted wholly or in large part to defense purposes. Cincinnati; Los Angeles; Woodbridge and Moorestown, New Jersey; and a new engineering laboratory at Waltham, Massachusetts, were some of the sites for these new RCA facilities. In 1954, announcement was made of what was to become one of the most significant RCA contributions to national defense—the beginning of RCA Service Company maintenance and analysis of electronic guidance apparatus for missiles at the Air Force Missile Test Center at Cape Canaveral, Florida.

The extent and scope of RCA's military electronic activities may be gauged from some of the projects in which it was engaged during 1957, such as, instrumentation radar, the Talos Defense Unit, and the "Telemite" television camera, fitting the palm of a man's hand.

ORGANIZATIONAL CHANGES

The expansion by RCA into these many areas of electronics was paced by a comparable realignment and extension of RCA executive and administrative functions.

In July, 1947, following the retirement of Lieut. General James G. Harbord, David Sarnoff was elected Chairman of the Board of Directors of RCA. The following year, Frank M. Folsom was elected President of RCA.

Keeping in step with the needs of a steadily expanding business in a constantly changing industry, 1954 saw a series of sweeping revisions of the Corporate structure. The RCA Victor Division, formerly responsible for all RCA manufactured products, became two separate groupings, RCA Consumer Products and RCA Electronic Products, each under the direction of an executive vice-president. RCA Sales and Service Subsidiaries formed a third grouping. The importance of RCA Laboratories to the progress of the Corporation was recognized by the elevation of its position in the Corporate structure. Behind these basic changes was the purpose of intensified research, expanded manufacturing capacity and greater diversity of output.

THE REVOLUTION IN MATERIALS

Underlying the Corporation's growth and change after 1950 was a revolutionary transformation in the nature of electronics itself, resulting from fundamental advances in the field of new materials and their application. These opened the way to new devices, techniques, and systems that previously were impossible of achievement, either technically or economically.

A major development which made projection television practical was the development of a molded-plastic aspherical correcting lens for the Schmidt-type optical system. Ioury G. Maloff (currently with the Television Division's Advanced Development Engineering at Cherry Hill) is shown removing a lens from a mold.

Throughout the 30's and 40's, basic research interest grew in the field of physics of the solid state. This was fundamental to the forthcoming rapid advance in the use of electronically-active solids—the semiconductors. RCA's effort blossomed first on photoconductors potentially useful in television camera tubes.

Bell Telephone Laboratories research in semiconductor materials led to development of the transistor. RCA research in this area moved at an early stage to an alloy junction type which soon became standard in receiving circuitry. Through the early and middle 1950's, the corporation's research and development work ranged ever more widely over the materials field, covering the various semiconductor materials, including photoconductors, thermoelectric materials, and materials exhibiting photovoltaic effect; and a wide variety of luminescent and magnetic materials. Among the outstanding results of this work were new types of transistors with greater power output and higher frequency performance.

Other major accomplishments have resulted from increasing application of systems engineering techniques in both military and commercial electronics. Through the early 1950's, RCA engaged in an intensive program of research and engineering related to electronic systems to compute, sort, file, and recall large quantities of data and to perform a variety of computing, clerical and other paperwork functions. Out of this program came Bizmac, RCA's electronic data-processing system. In 1955, a four-unit Bizmac system, the world's largest electronic "brain," was purchased by the U. S. Army for its Ordnance Tank-Automotive Command at Detroit, to keep track of more than 100 million tank and automotive spare parts in the Army's world-wide inventory. During 1957, major Bizmac installations were purchased by the New York Life Insurance Company and The Travelers Insurance Company, Hartford, Connecticut.

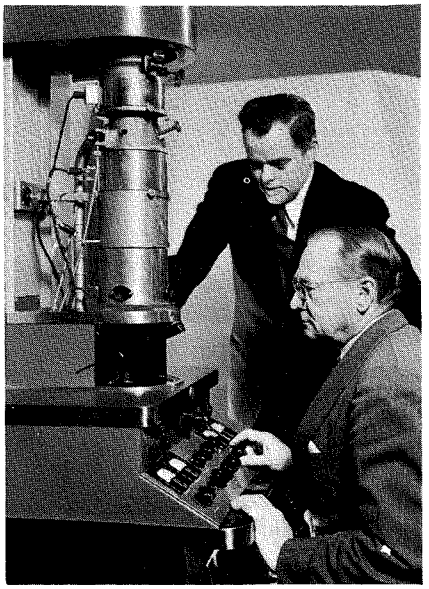
PROGRESS AND PROSPECTS

The quickened pace of electronic developments and the mounting importance of electronics to the national defense resulted in continued adaptation of the RCA organizational structure. In 1955, two new major operational units were created, Defense Electronic Products and Commercial Electronic Products. In 1957, CEP was reorganized into RCA Industrial Electronic Products, to provide still further impetus in this rapidly expanding area of electronic development. An indication of the rapid growth of RCA activities in the transistor field was the organization of the RCA Semiconductor Division.

Meeting the demands of the coming Age of Space, RCA established in early 1958 a new Astro-Electronic Products Division for the production of satellite and space vehicle systems.

In January, 1957, John L. Burns was elected President of the Radio Corporation of America. He succeeded Frank M. Folsom who was elected Chairman of the Executive Committee of the RCA Board of Directors. In making the announcement, General Sarnoff had this to say: "The election of Mr. Folsom as Chairman of the Executive Committee and the assumption by Mr. Burns, as President, of the key operating responsibility will enable our organization to keep pace with the changing demands and great opportunities of the rapidly expanding electronics industry."

What are these demands and what are the opportunities? As America enters the Space Age, electronics assumes a pivotal role in assuring continued national progress in the technologies of peace and security. As a leader in the industry, the Radio Corporation of America begins the third epoch of its existence with a flexibility in organization, a resourcefulness in research and a diversity of operations to meet the challenges of the years ahead.



A development of major importance to the field of science was the RCA Electron microscope. Shown with the device are Dr. V. K. Zworykin (seated) and Dr. James Hillier who contributed much to the development of the instrument.

In research, devices and systems now nearing final development point the way to new RCA opportunities for service to the consumer, to business and to industry. Participation by RCA in the cooperative nuclear reactor for industrial research in atomic energy at Plainsboro, New Jersey, will enable the Corporation to pursue fundamental electronics studies in the vital and closely related area of nucleonics. RCA research and engineering organizations are helping to explore methods for harnessing the power of the H-Bomb for peaceful uses.

In products and devices, color television, pioneered and developed by RCA, will dominate the broadcast scene as black-and-white television has done for the ten years past. On the basis of industry-wide projections, automation and electronic data processing undoubtedly will provide another great market for RCA systems, as will closed-circuit TV for industry. Out of today's research and development will come other products for the consumer, such as new forms of lighting, personal communications equipment, home television tape recording, and a variety of other novel electronic adjuncts to living.

If J. C. Warner could foresee the time when historians would look back to 1938 as a period when the surface had barely been scratched, what is there to say about the potentialities for RCA today? For all of RCA's tremendous past growth, not only is the surface of electronics still largely unscratched, but now there is the new challenge of the Space Age.

Writing in *Fortune* Magazine in 1955, General Sarnoff noted: "There is no element of material progress we know today . . . that will not seem, from the vantage point of 1980, a fumbling prelude." When that day finally comes, I am certain that some future historian will begin his review of RCA with exactly those words.