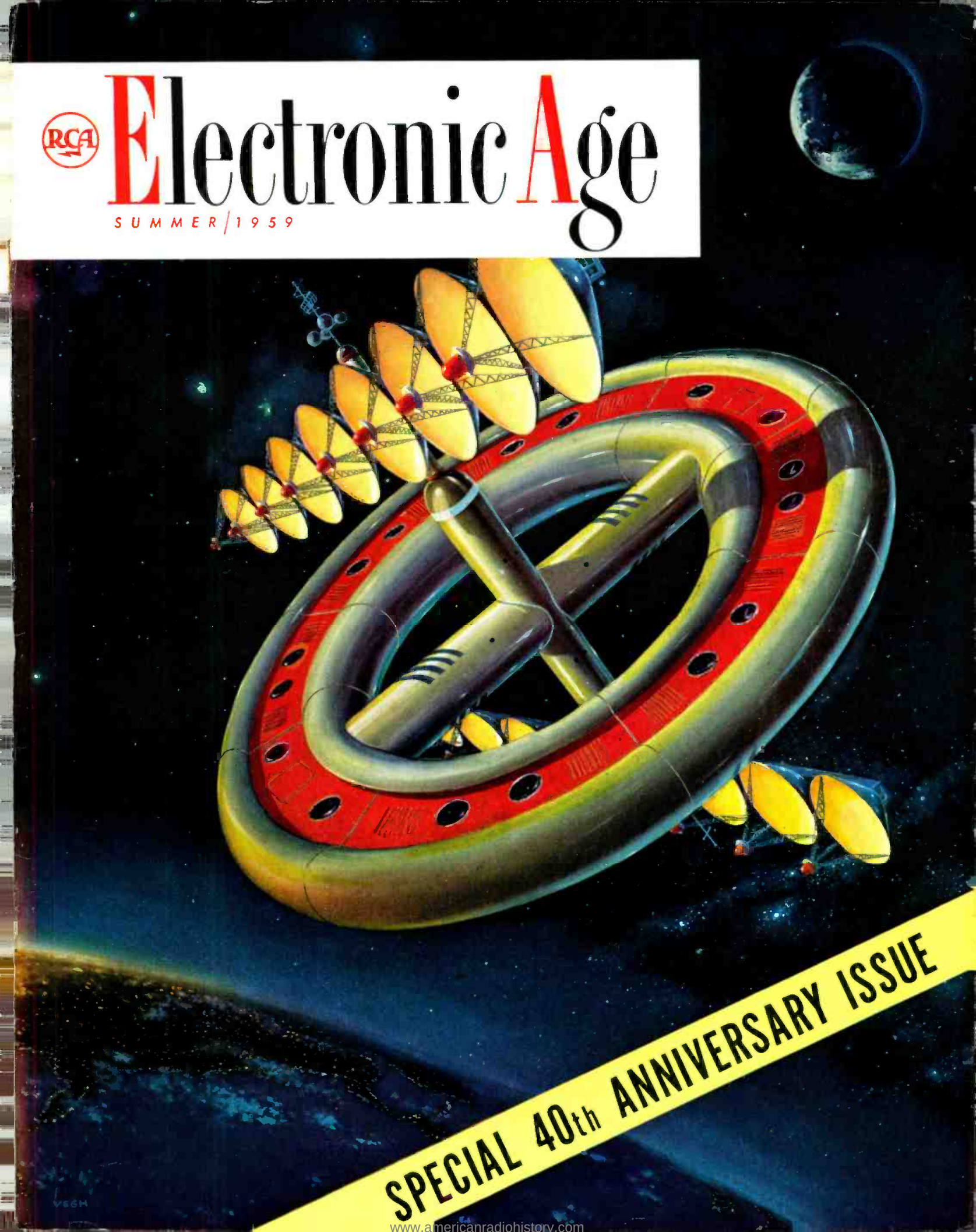
RCA Electronic Age

SUMMER / 1959



SPECIAL 40th ANNIVERSARY ISSUE

RESEARCH

MANUFACTURING

COMMUNICATIONS

BROADCASTING

TELEVISION

Electronic Age

SUMMER 1959 / VOLUME 18 / NUMBER 3

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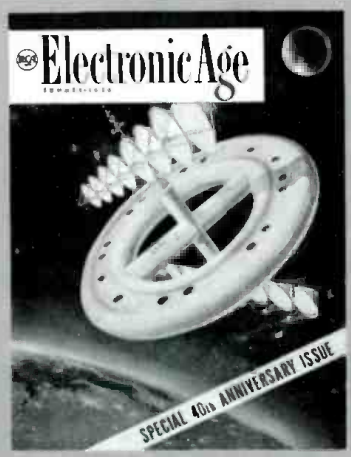


COVER STORY: *Communications space stations of this type—based on actual plans developed by engineers of RCA Astro-Electronic Products—may become future "orbital post offices," relaying messages around the world by microwave radio. Satellite would remain in fixed orbit at 22,000 miles altitude, with its antennas beamed at receiving and transmitting stations on earth.* *See pages 15-17.*

ELECTRONIC AGE: Published quarterly by Radio Corporation of America. Jack Long, Editor. Printed in U.S.A.

NOTICE: When requesting a change in mailing address please include the code letters and numbers appearing with the stenciled address on the envelope.

QUEEN Elizabeth II visits RCA's "See-Yourself-on-Color-TV" exhibit at Chicago Museum of Science and Industry. With her are Museum President Lenox Lohr, Governor William G. Stratton of Illinois, Canadian Prime Minister John G. Diefenbaker, and Mrs. Diefenbaker.

RADIO CORPORATION OF AMERICA
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

DAVID SARNOFF, *Chairman of the Board* — JOHN L. BURNS, *President* — FRANK M. FOLSOM, *Chairman, Executive Committee*
JOHN Q. CANNON, *Secretary* — ERNEST B. GORIN, *Treasurer*

Since 1919 the Radio Corporation of America has been a pioneering leader of the nation's fastest growing industry, which is rapidly changing the patterns of today's living.

Forty Years of Electronic

Brig. General David Sarnoff, RCA Chairman, and John L. Burns, President, display micro-module radio, and satellite TV tape recorder.

Progress

FORTY YEARS ago, when RCA started in business, radio was just emerging as a means of wireless telegraphic communication. There was no radio broadcasting, no television, no electronics industry.

Today, electronics is the fifth largest and fastest growing industry in the United States.

From a single product, the radio, it has branched out until it encompasses ten important areas. These areas include home entertainment in all its phases; broadcasting and communications services; home appliances; data processing systems; industrial controls and sensing devices; defense and space electronics; navigation, guidance and communications systems; atomic fission and fusion; components and systems manufacture; and international applications in all these fields.

The mere recital of these ten areas sharply underscores the expanding opportunities that have opened up to electronics companies in recent years. Indeed, there is scarcely any human endeavor that has not felt the pervasive impact of electronics.

To take full advantage of this growing range of opportunity, RCA is broadening the base of its activities. It is becoming a company richly diversified in its income-producing operations, as compared with one that only a short time ago derived its earnings primarily from the field of entertainment. There is emerging an RCA with an ever-widening scope of interests and activities in research, engineering development, production and service.

In just the past two years the non-entertainment aspects of RCA's business have increased by more than 30 per cent. We have created fifteen new units to move decisively into such growth activities as missiles and satellites, automation, electronic data processing and atomic energy.

Last year alone we introduced almost 100 new products or components, ranging in size from tiny television tubes to mammoth radars. If you include the new products that will be brought to the market during 1959, the list grows from 100 to nearly 400, a rate of growth that is three times as great as last year.

We are broadening our base of activities by stepping up our efforts in basic circuitry; by moving more aggressively into the three "C's" — computers, controls and communications; and by expanding our contribution to national defense and space exploration.

Underlying all these activities is our research and development program. Today's research efforts — in new materials, in novel sources of energy, and in the application of electronics to atomic fission and fusion — will determine the course of our progress in the approaching decade of the Sixties.

Electronics will make it possible, simultaneously, to probe the far reaches of the universe and the invisible world of the atom. It will help achieve levels of productivity far beyond the capacity of human hands and eyes. Electronics will bring into the American home new conveniences and new opportunities for personal advancement. It will stimulate the growth of existing industries, and lay the foundation for many new ones. It will provide a protective military shield behind which all our advances can be made.

In this issue, Electronic Age looks backward at the major trends in electronics as they have developed over the past forty years — and looks ahead at the dominant role electronics will play in bringing to realization the exhilarating hope and promise of the Sixties. ■

The 70-story RCA Building, Radio City, New York, houses executive headquarters of Radio Corporation of America and the National Broadcasting Company.

John L. Burns

President, Radio Corporation of America

OUT OF TODAY'S RESEARCH,

TOMORROW'S REALITIES

FROM THE SUB-ATOMIC UNIVERSE COMES A NEW TECHNOLOGY

BEHIND THE EXPLOSIVE rise of electronics — from fiftieth place among American industries before World War II to fifth place today — lies a dynamic program of scientific research and engineering development that is turning out an ever increasing flow of new products and services.

Fundamental and applied research represent an investment of hundreds of millions of dollars annually, employing tens of thousands of scientists and engineers in hundreds of electronics laboratories across the nation.

Electronics research must, in fact, be reckoned among the major assets of an American society faced with the three-fold challenge of military security, economic expansion, and exploration of interplanetary space. In each of these areas scientific and engineering

Scientists at David Sarnoff Research Center, Princeton, N. J., study electronically active materials.

progress — particularly in electronics — is a controlling factor upon which ultimate success depends.

Electronics research today is a major enterprise bearing little apparent relationship to the makeshift facilities and small staff with which RCA launched one of the industry's first combined research and engineering efforts nearly forty years ago. This pioneering program was housed in a tent on eastern Long Island and was carried on by a handful of engineers concerned with long-distance radio communications techniques. Today RCA research, and that of other leaders in the industry, is carried forward by teams of highly skilled scientists equipped with the most modern tools for the discovery of useful new materials and techniques.

The new basic knowledge resulting from today's research has profoundly altered the direction and broadened the scope of electronic science. This alteration involves a strange paradox: with the multiplication of research facilities and the vast increase in complexity of research tools and procedures, the science has become increasingly concerned with happenings that occur within infinitesimally small segments of space and time — a constant pursuit of the almost imperceptible.

No one has ever seen, nor probably ever will see, an electron. The electron is a small constituent of the atom, which itself is so incredibly minute that one million million atoms would barely cover the head of a common pin. Knocked loose from its parent atom, the electron may be impelled with small effort nearly to the speed of light, which travels at slightly more than 186,000 miles per second. These are formidable facts — yet upon growing familiarity with the behavior of the electron and the ability to control its action with ever greater precision, a great new science and technology is being built.

Within the laboratories of the electronics industry today, scientists are discovering new and better ways of controlling and employing electrons that move from one atom to another within a tiny piece of material, and even electrons that remain localized within a single atom. Digging deeply into this sub-atomic world with the aid of fabulously accurate and complex tools of research, they are learning how to achieve an astonishing variety of electron actions within minute crystal structures.

Electronics is concerned very largely with transmitting, storing, and processing information in myriad forms for use in systems of communication, computation, data-handling, detection, and automatic control. Exploring thousands of materials and compounds, the scientists have found new means to achieve or enhance many of the basic functions that go into these jobs. Of greatest actual or potential importance among these discoveries are the means to do these things:

— to generate, detect, and amplify electrical signals by means of pea-size devices;

— to store electrical information in specks of magnetic material for instant recall on demand;

— to perform functions of selection and switching at incredible speeds in the routing of information through large systems.

Furthermore, new useful effects have been discovered to broaden the application of electronics, including these significant examples:

— methods of producing electrical energy directly from light, heat, and nuclear radiation;

— materials and techniques for converting electricity to visible light;

— methods of cooling and heating simply by the passage of electric current through certain materials.

In the laboratory, the accomplishments so far are recognized as a mere beginning, an initial scratching of the surface.

The result is the emergence of a new order in electronics, featured by unprecedented versatility and finesse. Built into devices and systems, the new effects permit the design of smaller, more economical equipment to handle familiar jobs — the miniature radio systems that clip to a belt or slip into pockets, the small solar cells generating electricity from sunlight, the drastically shortened television picture tubes with large display area, and the high-frequency radio relay and tape storage systems that are made to fit within an earth satellite.

Even brighter promise is apparent in totally new applications that lie just ahead or stretch on into the more distant future.

RCA research specialist peers into metallurgical microscope.

Moving through the latter stages of research toward engineering development are such results as these:
— large-area luminescent panels that emit light from an extensive surface, rather than from a single point, as in the incandescent bulb, or from a line, as in the fluorescent lamp;
— thermionic generators, producing watts of electric power directly from heat;
— thermoelectric cooling and refrigerating units operating solely from electric current, without moving parts.

Typical of current advances is the laboratory concept of "integrated electronics" — the combination of several active electronic functions within a single minute piece of material. RCA scientists have reported major progress in development of a multifunction logic element, the building block of electronic computers. Displaying the tiny integrated element recently beneath a low-power microscope, one of the research specialists called attention to the incidental hazards arising from this trend toward ultra-miniaturization:

"We have to be careful when we turn on the fans in the laboratory. It's pretty easy for the experiment to blow away."

The concern with happenings within small bits of material has accelerated electronics research along a revolutionary new course. The transition can be described in terms of a single device.

Until just about a decade ago, the keystone of the electronics science and industry was the electron tube, which provided both a source of free electrons and a means of controlling them. In the tube, electrons are "boiled" out of a hot cathode into a vacuum, where they can be manipulated in various ways to perform a desired function. Compared to the ease of freeing and manipulating electrons that function within solid material, obtaining free electrons by boiling them out of a hot cathode is doing it the hard way.

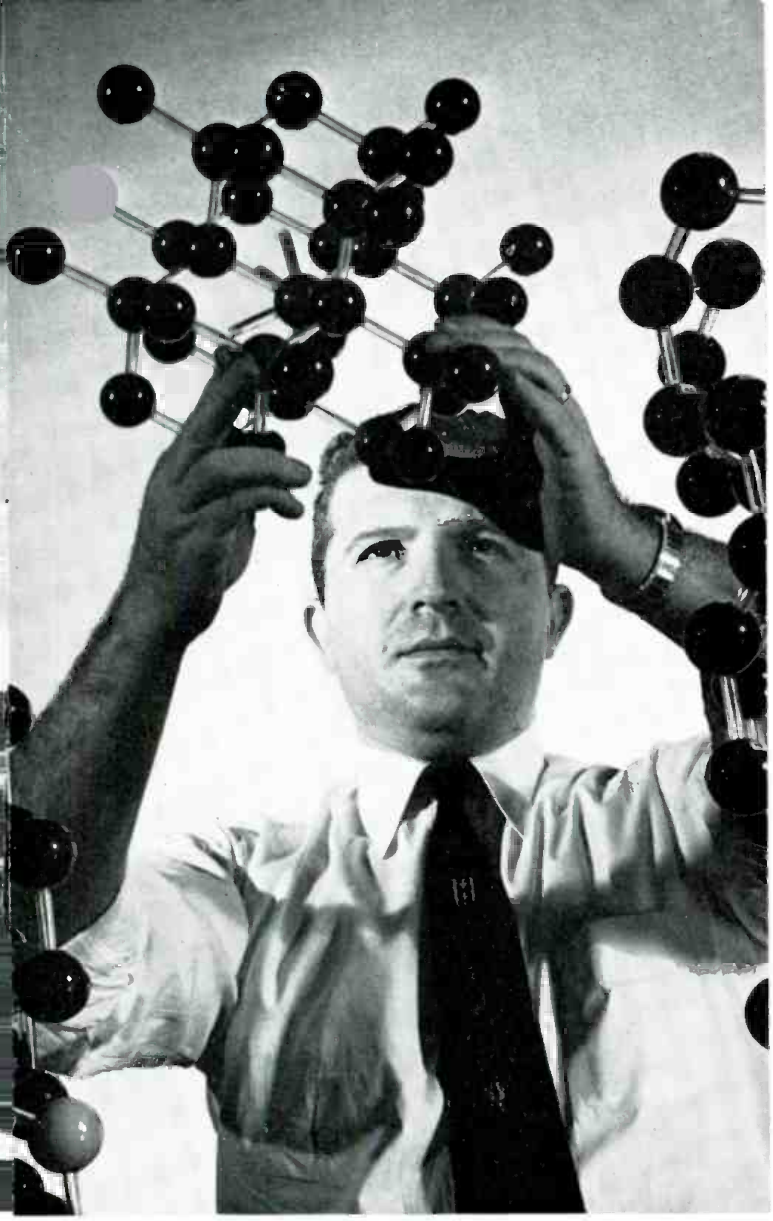
A new era began with the transistor, whose invention at the Bell Telephone Laboratories in 1948 presented electronic science with the first effective solid-state device capable of amplifying in the manner of the electron tube. It was followed by other devices based on the use of materials with varied characteristics of conductivity, luminescence, and magnetism. The end results will be translated into goods and services for application in society, strategy and space.

Today's electronics research center is an impressive congregation of specialized talents and precision equipment. To explore the infinitesimal world of electrons, atoms, and molecules, the laboratories have been enlarged to hold new research tools whose size and complexity seem to grow in inverse proportion to the size of the subject—mass spectrometers, particle accelerators, elaborate vacuum systems, and nuclear reactors. Such tools are essential in detecting and measuring important effects that may be altered by the presence of one strange atom among a billion identical atoms, or by happenings that can occur during a billionth of a second.

Today's research program requires the talents not only of the electrical engineer, but also of the physicist, the chemist, the metallurgist, and the mathematician. An example is the technical staff at RCA's David Sarnoff Research Center at Princeton, one of the largest laboratories in the nation devoted exclusively to research in electronics. Of approximately 300 RCA specialists at the Princeton center, more than half — some 160 — represent the sciences as distinct from electrical engineering. Nearly 100 of the total are physicists, followed in numerical order by chemists, mathematicians, and metallurgists. The majority of them are young men; the average age of the technical staff is thirty-five.

Nearly half hold Ph.D.'s, and many others have earned their Master's degree and are working for a doctorate. The international flavor of scientific research is reflected by the fact that one scientist in every six was born, raised, and received most or all of his technical education abroad. Among the outstanding members of the RCA staff are physicists, chemists, and engineers from Canada, England, Sweden, Switzerland, France, Greece, Nationalist China, and other nations of the free world.

Dr. Betsy Johnson, RCA laboratory physicist, studies interaction between atoms and molecules in crystals.



Dr. Frank Herman assembles large-scale model of a cadmium sulphide crystal.

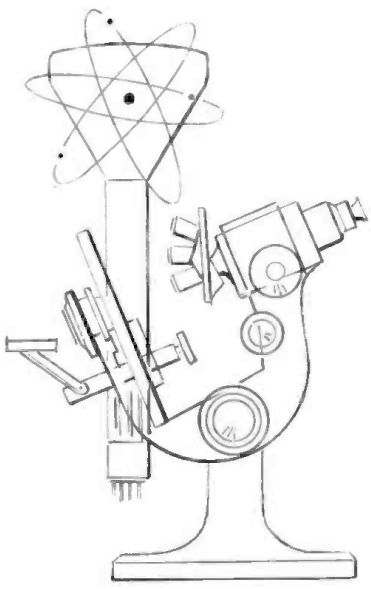
The procedures of research have changed as radically as have the facilities and staff. Individual creativeness, the hallmark of the effective research worker, remains as important as it ever was — but it is seldom exercised in solitude. The majority of today's scientific projects involve a combination of two or more branches of scientific knowledge, calling for group effort by a research team comprising an array of specialized talents. This is the logical result of increasing complexity both in the science and in its application in extensive systems for communications, industrial automation, missile technology, and space exploration.

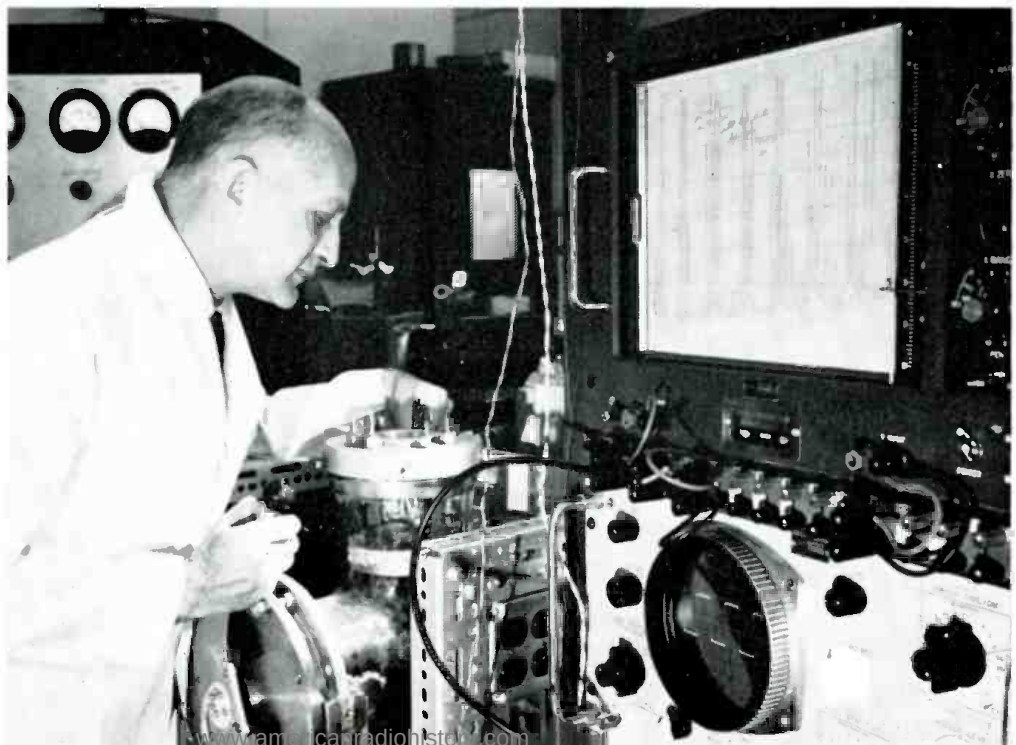
Considering the rate at which new knowledge is being generated by today's exploration of the subatomic world, the effect upon the laboratory is a pale shadow of the ultimate effect upon society. This larger effect has become difficult to estimate, because the results of research multiply so rapidly.

Nearly twenty years ago, Brig. General David Sarnoff was called upon to state the reason for the corporation's continuing substantial investment in scientific research. His reply has taken on even deeper significance with the subsequent expansion of electronic science and the growing challenges of military security and economic growth.

"There is no security in standing still," he said. "Those who rest on the rock of stabilization sooner or later find that that rock becomes their tombstone. There is hope and opportunity in what we can learn tomorrow. That is the greatest asset on the balance sheet of humanity and on the balance sheet of any organization engaged in scientific research." ■

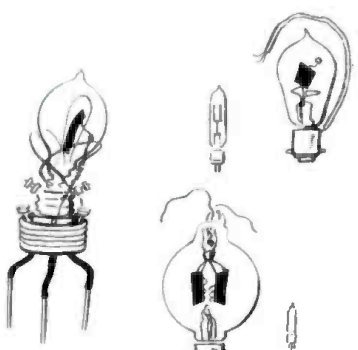
RCA staff scientist Louis Pensak engaged in experimental work with germanium, for possible use in new types of electronic devices.

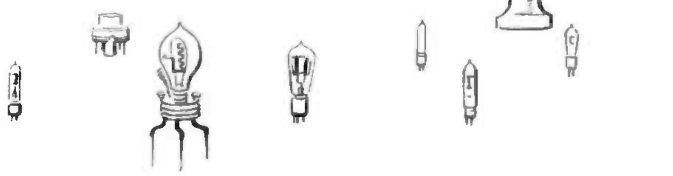




Water-cooled, super-power transmitter tube at right weighs 140 pounds and delivers 500 kilowatts of useful output in radiotelegraphy service.

Semiautomatic machine tests 1,600 transistors per hour at RCA plant, Somerville, N. J.





NEW SHAPES OF THINGS TO COME

MICROMODULES, MINIATURE TUBES, SEALED CIRCUITS ARE CHANGING THE BASIC CIRCUITRY OF ELECTRONICS

THE BASIC building blocks of electronics are changing their shape today with a rapidity which leaves even the experts breathless.

Not long ago an electronics engineer, testifying before a Congressional committee in Washington, was asked how many systems of a certain type his company had developed. "I don't know," he replied.

"I thought you were the man in charge!" exclaimed the chairman.

"I am," the engineer agreed. "But you see, I've been away from our laboratory for two days."

New electronic systems, improved components, and radically different materials are being developed in unprecedented numbers to meet the ever-increasing Space-Age demands on the electronics industry.

Thimble-size vacuum tubes will soon be making TV sets, air-borne communications, and guided missile systems more compact and more rugged.

Transistors, those tiny cousins of the tube, are increasing in efficiency and expanding their uses in devices ranging from pocket-size radios to computers.

"Micromodules" are changing the geometry of electronics and giving us radio receivers no bigger than a cigarette lighter.

A new concept of "integrated electronics" is expected to make electronic brains smaller and smarter than ever before.

As RCA President John L. Burns has pointed out, it is advances such as these in basic circuitry which "determine what you can and cannot do in electronics." Innovations now coming from the laboratory will provide tomorrow's improved systems for the home, office and factory, for missiles and space exploration.

The eventful history of the industry shows that every great step forward in the science and art of electronics has been preceded by technical improvement in components — often in an unexpected or seemingly unrelated area. It is an exciting story of imaginative pioneering and rapid progress.

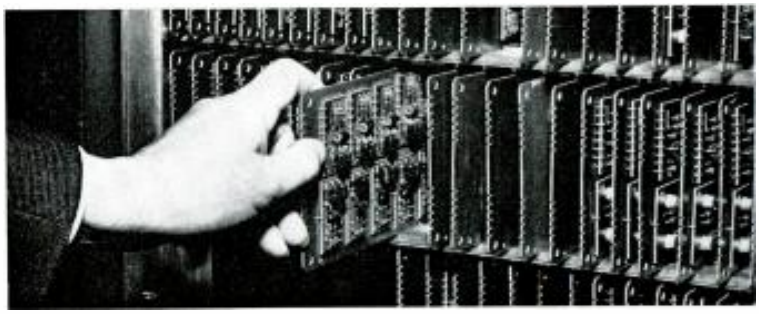
For example, Edison's discovery of electron emission from a hot filament grew out of his experiments with early light bulbs. After many refinements by other scientists, this resulted in the development of the first electron tubes.

Gradually it was realized that tubes could be designed to produce radio waves capable of traveling great distances, while other tubes could detect these signals and amplify them millions of times so that they could be made audible. With their ability to transmit and control energy with the speed of light, tubes were on their way to becoming the heart and brain of innumerable electronic devices.

World War I brought a great spurt in the development of electronic communications for military purposes, and a few basic tube types were standardized for mass production. After the war the founding of the Radio Corporation of America, and the beginning of the broadcasting boom of the 1920's, were both in a sense results of the wonder-working new vacuum tube.

For a time there was a period of stability when changes in electron tube design hardly kept pace with the rapid rise and fall of women's hemlines during the late gay 20's and sober early 30's. Then in 1933 RCA introduced a miniature "acorn" tube which opened a

Printed circuit boards slide easily into RCA 501 computer.



completely new ultra-short-wave band of communications. In 1935 came the first metal tubes for mobile communications, and commercial and home receivers.

Small, sturdy high-frequency tubes such as these were essential for many types of military devices from walkie-talkie to radar sets. Between 1942 and the end of World War II, RCA alone manufactured 20,000,000 miniature tubes.

The war created a need for a multitude of other tube types, and the number of new designs has been growing ever since.

EYES FOR TELEVISION

Another basic building block of electronics — the cathode ray tube — became the cornerstone of a new industry called television. Its growth followed the normal cycle of research, development, and commercialization as new equations were scribbled on laboratory blackboards, new circuits tested, and new components put through their paces.

The first tubes designed for television had screens the size of playing cards and were capable of reproducing a blurred picture of Felix the Cat — the first star of laboratory TV. In 1929 Dr. V. K. Zworykin demonstrated his first practical kinescope picture tube in operation together with his earlier iconoscope, eye of the television camera. These two tubes made possible the beginning of the RCA all-electronic television system. Research also provided a new wide-band amplifier tube essential to good picture definition, and a powerful 5-kilowatt transmitter tube capable of sending clear picture signals farther than ever before.

By 1939 television was ready for introduction at the New York World's Fair, but it was not until after World War II that rapidly sprouting roof antennas began to give a new look to the American skyline.

The next modern miracle to grow out of advances in components and circuitry was color television, a triumph of research. The RCA color picture tube — the basis of today's compatible all-electronic color TV — was demonstrated publicly in Washington in 1950. Brig. General David Sarnoff called it a revolutionary and epoch-making device, and said that when historians at the close of the Twentieth Century evaluate the most important scientific developments, "I predict that this tube will be among the great inventions of the second half of this century."

Today color television is making a place for itself in America's living rooms, while in the laboratories new miracles are being prepared for tomorrow.

The invention of the transistor made possible miniature home radio receivers, light-weight military communication systems, and computers such as the RCA 501 with a work capacity of older "brains" twice its size. Printed or etched wiring — known today as "sealed circuits" — also helped to reduce bulk and speed automated manufacture.

Space-Age requirements for fantastically complex missile and satellite guidance systems — which must be tough, small, and light — gave added importance to what the engineers call "miniaturization." New components, new materials, and new techniques were needed, and the "micromodule" concept was one result. Today, under a U. S. Army Signal Corps contract, RCA and more than 60 sub-contractors are working on a program to reduce the essential parts of electronic systems to tiny blocks measuring a third of an inch on each side. Each block is made up of ceramic wafers about 3/10ths of an inch square and 1/100th of an inch thick, on which electronically active materials are fused. Bulky wiring and connections are eliminated.

Micromodules are expected to make possible a ten-fold — and in some cases a thousand-fold — reduction in the size and weight of military communications equipment and in guidance and control systems for missiles and satellites. For example, a digital computer under development for a missile will have 8,000 components sealed in a can only 2 by 4 by 5 inches. This little "brain" will be an essential part of the guidance system, and it will be replaceable in a few seconds.

An even more advanced concept, called "integrated electronics," has enabled scientists to create computer components so small that 100,000,000 of them can fit into a cubic foot of space. They are microscopic bits of semiconducting material, such as silicon, which will amplify or control electric signals just as do tubes, transistors, resistors and condensers. They will make up the logic circuits which enable computers to calculate, sort, and remember information. RCA scientists describe these versatile dots of matter as a step on the road to computers as compact as the human brain.

Despite advances such as these in "solid state" electronics, the tube more than holds its own today among new components. Engineers point out that new applications for tubes are being found every day. Keeping in step with the trend toward smallness, RCA researchers recently announced a "Nuvistor" tube, smaller than a thimble, which sets new standards for performance, toughness, and dependability. And a new super-tube — the size of a beer keg and capable of generating 5,000,000 watts of power — is under development for long-range missile detection in America's defense network.

So it appears that the electronic building blocks of the future will come in many sizes and shapes. They will perform complicated daily tasks in the service of humanity — tasks that would have been considered, yesterday, as beyond the realm of possibility. ■

RCA 501 computer, *completely transistorized to save space and power, brings modern data processing within reach of smaller businesses. A new computer service center at Cherry Hill, N. J., has been opened to process paper work and train operators. Similar centers will be opened elsewhere in the country to serve small firms as well as large.*

Those Three Fabulous C's In The Electronic Alphabet

COMPUTERS, CONTROLS AND COMMUNICATIONS HAVE BECOME CORNERSTONES OF THE AUTOMATED FACTORY, OFFICE AND HOME

OUT OF THE INGENUITY and effort being applied today in defense and space electronics are coming tomorrow's revolutionary new devices for business, industry, and the home.

Especially is this true in the field of automation, which is based primarily on electronics.

Automation involves three principal areas of electronics — sometimes called the three "C's" — computers, controls, and communications.

In today's offices and factories, electronic computers or data processing systems are providing business with speedy new ways to handle old routines. These electronic "brains" — closely related to types that guide missiles and jet aircraft — now read, write, file, analyze, and compute. Without them automation would not exist.

A major advance in the field is the RCA 501 — a completely transistorized, general purpose electronic data processing system that bridges the gap between electro-mechanical accounting machines and giant computers. The system permits a bank, office, or factory to begin automated data processing on a moderate scale and expand the operation gradually.

As a pioneer in electronic systems, RCA has introduced in the 501 such advances as transistors, printed circuits, ferrite core memory units, and other minaturized components. Efficiency has been increased and size reduced to half that of conventional systems. One-third the air-conditioning and electric power are required. A steel manufacturer recently ordered a 501 to provide daily sales invoicing and up-to-the-minute inventory on the firm's 17,000 products, ranging from tiny magnets to die steel blocks weighing 20,000 pounds. When installed at Pittsburgh, the system will work with the company's present teletypewriter communications network, linking fifty-three plants, warehouses and offices from San Francisco to New York and from Dallas to Minneapolis.

Data received by teletypewriter on mill and warehouse sales will be fed into the 501 for high-speed printing of invoice reports. The system will route orders to proper points for handling or "memorize" them for followup action. It will supply data to management — daily reports on sales and gross profits, marketing studies, and information on which to base decisions on expansion.

Just as a scoop shovel gives a man power to move tons of earth with the touch of a few levers, electronic data processing relieves human drudgery and solves in seconds or minutes problems that might otherwise take days or weeks.

ELECTRONIC CONTROLS

The second aspect of automation in which electronics figures prominently is controls. Electronics provides sensing devices for perfect timing, for split-second switching, for remote direction and control. A good example is in gas pipeline operations where the flow is pre-determined and controlled automatically.

Electronically controlled processes are used for the production of electronic equipment itself. In some cases, a high degree of automation has already been achieved. This is true in the production of television picture tubes, for instance. While the electron gun of the tube may be assembled manually, the mounting of the gun in the tube, the laying down of a fluorescent screen, the aluminizing of that screen, the pumping, heat treating, and the sealing of the tube can be done without manual handling.

Use of electronic controls is carried over into the production of many types of tubes, semi-conductors and printed circuit boards. Every day new services are being rendered to industry through automatic inspection, packaging, bottling, and printing.

COMMUNICATIONS

A noted scientist describes electronic communication as "the magic artery linking the performance of computers and controls into man's most advanced productive means — automation." Delivering instructions and information to electronic control centers for automated tasks is essential to perfect performance. This is the job of the third "C" — communications. Punched tapes and cards, and coded digital information, are some of the means of getting machines to do what is required of them.

The electronic wizardry of modern computers has been linked to standard modes of communications so that data can be interchanged swiftly between widely scattered points by radio, microwave or land lines.

The RCA AutoData System accepts processed data from the computer at the sending end of the line and converts it to a code for transmission. At the receiving end, an AutoData unit transforms the coded material back to a form suitable for computer use. More than one computer can feed information into the AutoData System on a priority basis.

While the AutoData technique is certain to find wide application in the business and industrial world, its greatest immediate contribution will come in the high-speed relay of information to and from U. S. military installations around the world.

And apart from its indispensable contributions to automation, electronic communication is playing an increasingly vital role in business and public affairs.

Government and industry — faced with expanding communications requirements — have found an answer to their problem in microwave radio.

On superhighways, construction projects, electric utility operations, oil and gas distribution, mining developments, railroads, bus lines, trucking and a host of other busy fields, this relatively new form of electronic communication provides fast, dependable service.

Practically invulnerable to storms, microwave radio signals provide multiple-channel means of communication. Microwave relays carry radio-telephone, facsimile, teletype, and telemetry information, and permit push-button control of unattended equipment at remote points.

For well over twenty-five years, RCA engineers have been researching and developing microwave systems. Results of their work are in evidence across this country and around the world. RCA installations are the backbone of communications on the Illinois, Ohio, Pennsylvania, and New Jersey Turnpikes, providing round-the-clock networks for routine checkups and instant warning of storms, accidents, or other types of emergencies.

Woven into these networks are mobile radio circuits which keep in touch with the cars and trucks that service and police the turnpikes. Radio-equipped patrol cars give police a big advantage in catching lawbreakers. Fire and police departments now rely heavily on mobile radio systems for communication between headquarters and vehicles on the move. Taxi cab companies and truckers use this flexible and effective form of communication to increase efficiency and save time and money.

Development of such advanced instruments as RCA's Personal-fone — miniature two-way radio systems that can be carried, for instance, on a patrolman's belt — has broadened radio service. These now are being used widely in police work.

A major advance in the growing field of personal communications came in the latter part of 1958, when RCA introduced a low-cost Radio-Phone or "citizens radio" for two-way conversations between private individuals over a distance of several miles. It is already finding many applications.

Another significant new product is the television tape recorder. A self-contained unit, the RCA recorder includes features designed to bring the art of tape recording to its most advanced state. Because of its amazing versatility, the video tape recorder is certain to

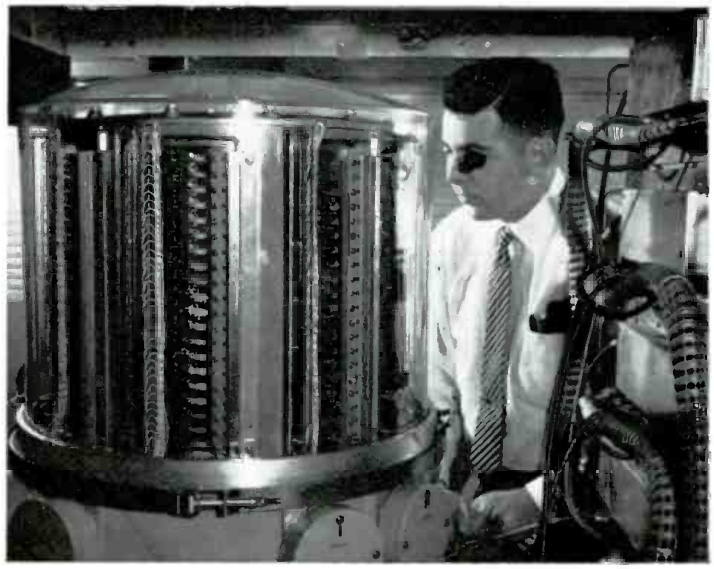
Ocean liner Brasil depends on radar and radio direction finder for safe navigation in the thickest weather.

find many uses outside the television field — in medicine, education, industry and commerce.

Already we have seen how important communications and other aspects of electronics can be to business and industry. But great as the accomplishments have been so far, we are still in the pioneering stage.

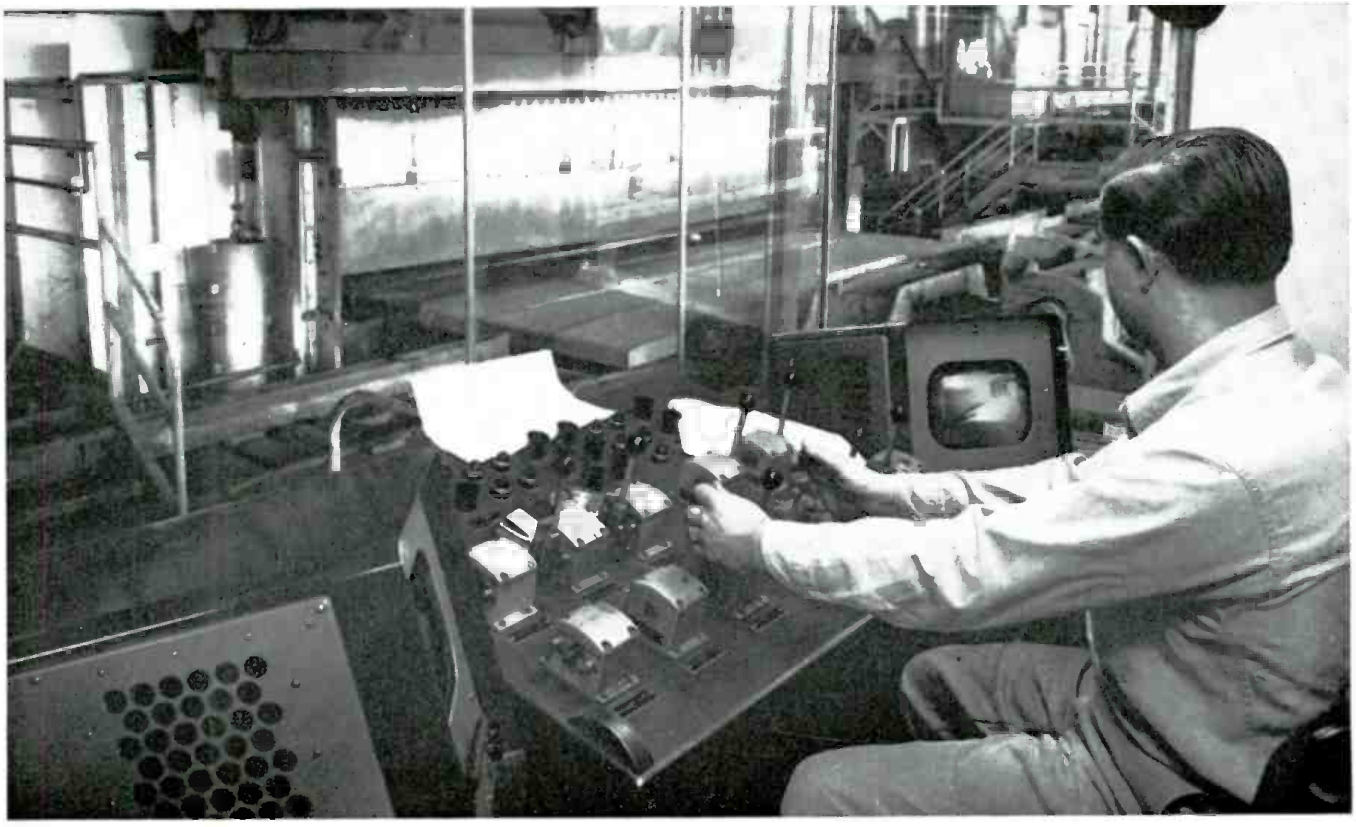
Ultimately, the three wondrous "C's" — computers, controls and communications — will free millions from arduous and hazardous toil. Together, they offer the stimulating prospect of greater security, wider industrialization and a higher standard of living.

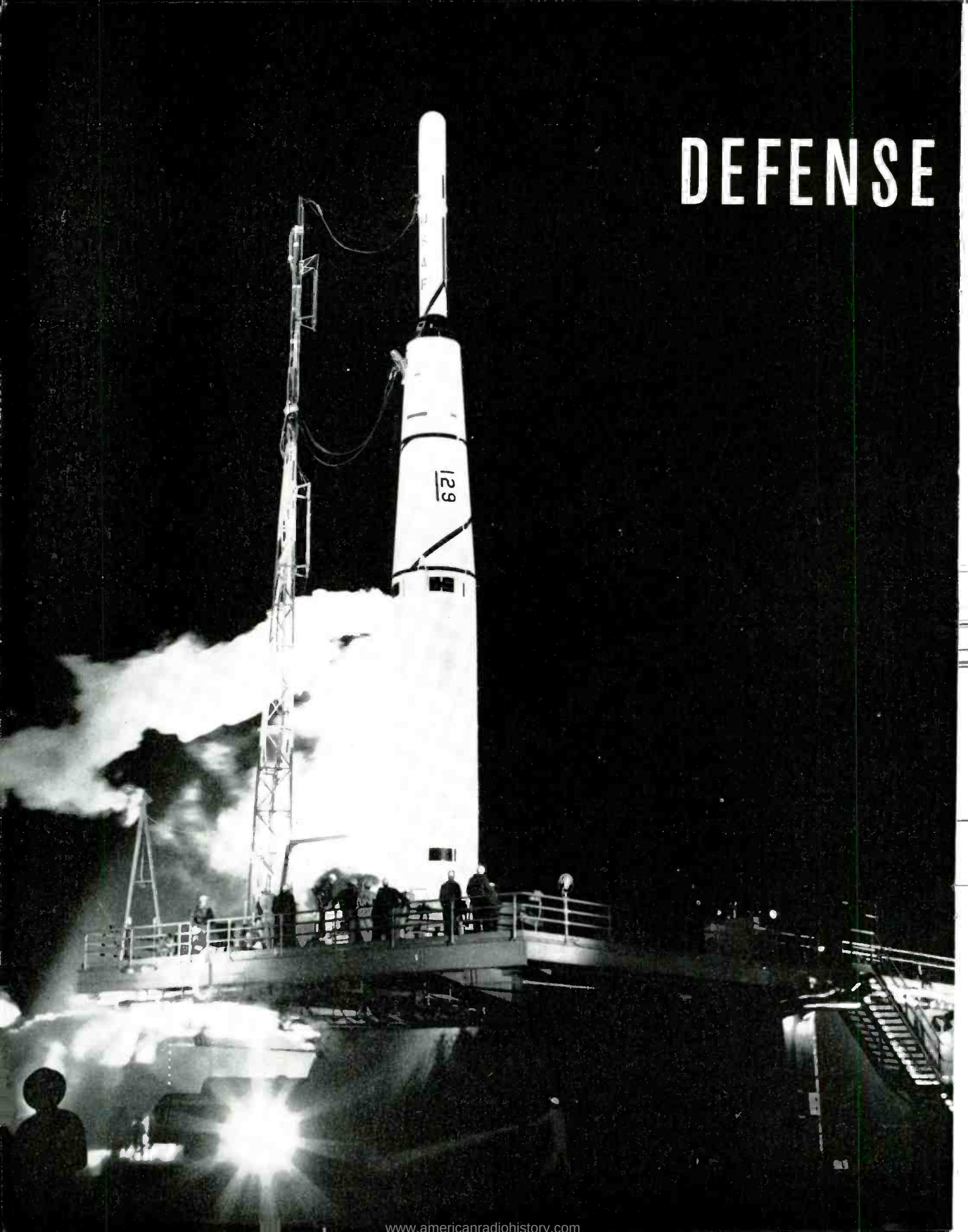
The three "C's" — a concept far advanced from the simple radio upon which electronics was founded — provide some measure of the explosive growth and the broadening base of this fabulous industry. ■



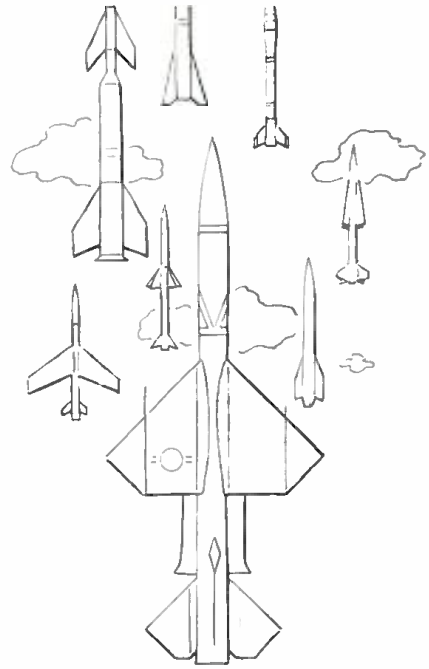
Engineer inspects "random access memory drum" which can store 1,500,000 letters or numbers for 501 data processing system.

RCA television cameras give furnace operator closeup view of interior of re-heat ovens at Jones & Laughlin steel plant, Aliquippa, Pa.





IN THE SPACE AGE



Electronics holds the key to military supremacy in the era of missiles and satellites

IN THE FAR NORTH, radar experts are installing bases for systems of silent sentinels to scan the space above the Eurasian land mass and warn America against hostile missile attack.

At the underground bomb-proof caverns at headquarters of the Strategic Air Command, outside of Omaha, communications men are in touch with jet bombers poised for retaliatory action all over the world.

On the sandy spit of Cape Canaveral, Florida, and downrange for 5,000 miles, corps of experts are testing and evaluating guided missiles and rocket vehicles for the arsenal of the Free World and the conquest of outer space.

In plants and laboratories across the nation, scientists are designing computers to perform astonishing feats of precision in guiding today's supersonic aircraft and tomorrow's space vehicles.

These examples point up the vital role of electronics in national defense and space exploration.

The Radio Corporation of America, as one of the nation's top defense contractors, is a leader in military electronics today, as it has been for more than 25 years. Since RCA's founding in the wake of World War I, a vast revolution has taken place in the development of electronics for defense. During World War II, for example, aircraft and their electronic equipment were designed separately. As one engineer says: "The furniture didn't always fit the house."

This method is being replaced by what is known as the "systems concept," which precludes "furniture that doesn't fit." It takes into consideration all aspects of the desired military function. The problem is approached as a whole and resolved in a single package operation.

The systems concept is epitomized by RCA's new Advanced Military Systems unit, soon to have new headquarters adjoining the David Sarnoff Research Center in Princeton, New Jersey. On its staff are nationally known experts in the physical, engineering, and military sciences, as well as mathematics.

Their role is to look ahead to the ultimate objective — the complete aircraft, missile, or satellite system — and to create electronic components as integral parts of the whole.

VITAL ROLE OF RESEARCH

Out of the research laboratories of America are coming ideas that are changing the basic concepts of military electronics.

For example, RCA scientists foresee a new class of ultra-miniature devices, combining several functions in a single piece of material. An initial development in this program, supported by the Air Research and Development Command, consists of a sliver of germanium only half an inch long, potentially capable of equaling performance that now requires a circuit arrangement of twenty transistors, forty resistors, and twenty capacitors.

The trend to smallness is apparent in many areas of research and development. An outstanding advance is the micromodule concept for shrinking electronic equipment. The program has already resulted in an experimental radio receiver circuit reduced to the size of a sugar lump. Micromodules will become vital parts of missiles, satellites, and military field equipment where compactness and ruggedness are essential.

Today's accelerated research is leading to improved radar, new military communications systems, solar converters and batteries, new techniques such as thermoelectrics (for heating and cooling without moving parts), thermionics (for obtaining electricity directly from heat), and such devices as a television system which permits astronomers on the ground to

focus a telescope suspended in a balloon fifteen miles above earth.

This RCA TV system, known as the "stratoscope," will provide views of outer space unrestricted by particles and gases in the earth's atmosphere. Watching the television image on ground monitors, observers will be able to control the telescope and train it in any direction desired by radio signals.

A prime function of today's electronic research is to provide knowledge that can be translated quickly into useful products, systems and services — and into military "hardware" by development, design and product engineers.

DEVELOPING DEFENSE AND SPACE PRODUCTS

"In any future war," says General Carl Spaatz, former Air Force Chief of Staff, "superior electronics would be decisive."

Thus the need to extend and transform the findings of research into effective military tools, swiftly and at reasonable cost, has become imperative.

Out of RCA's radar research, for instance, has come the most accurate radar in the world, together with a system to trace the path of a space-bound missile and evaluate its performance by means of a digital computer. This tracking radar is now in use at Cape Canaveral, Florida, and other major military missile ranges where it observes and records to an accuracy of less than two inches per mile.

From television research has emerged a special miniature TV camera for pickups from an earth satellite in orbit. At a height of 15,000 miles, this camera can cover an immense area, equal in fact to almost half of the United States. To assure delivery of the image back to earth when the satellite is out of range of ground stations, development engineers have devised a TV tape recorder for this system, permitting storage of images until a station can be reached directly.

Research on automatic methods in connection with countdown and checkout procedures for the Talos Defense Unit has led to development of an electronic launching system that helps to make the Atlas Intercontinental Ballistic missile ready for firing virtually immediately after warning of impending enemy attack. This new system is designed to reduce substantially the countdown period, which in some instances has required as long as ten to fifteen hours.

Another electronic system essential to defense is the radio and color TV system used by the Strategic Air Command. By means of advanced radio communications techniques and equipment, command headquarters at Omaha can maintain constant touch with our bombers all around the globe. Briefings at the home base are conducted with the aid of color TV.

Under development for the Air Force is a Data-Link program to provide automatic ground-to-air communication of commands for intercept, tactical control, traffic control, and other air operations. This system makes use of digital computer techniques for data transmission and reception, facilitating the control of large numbers of aircraft.

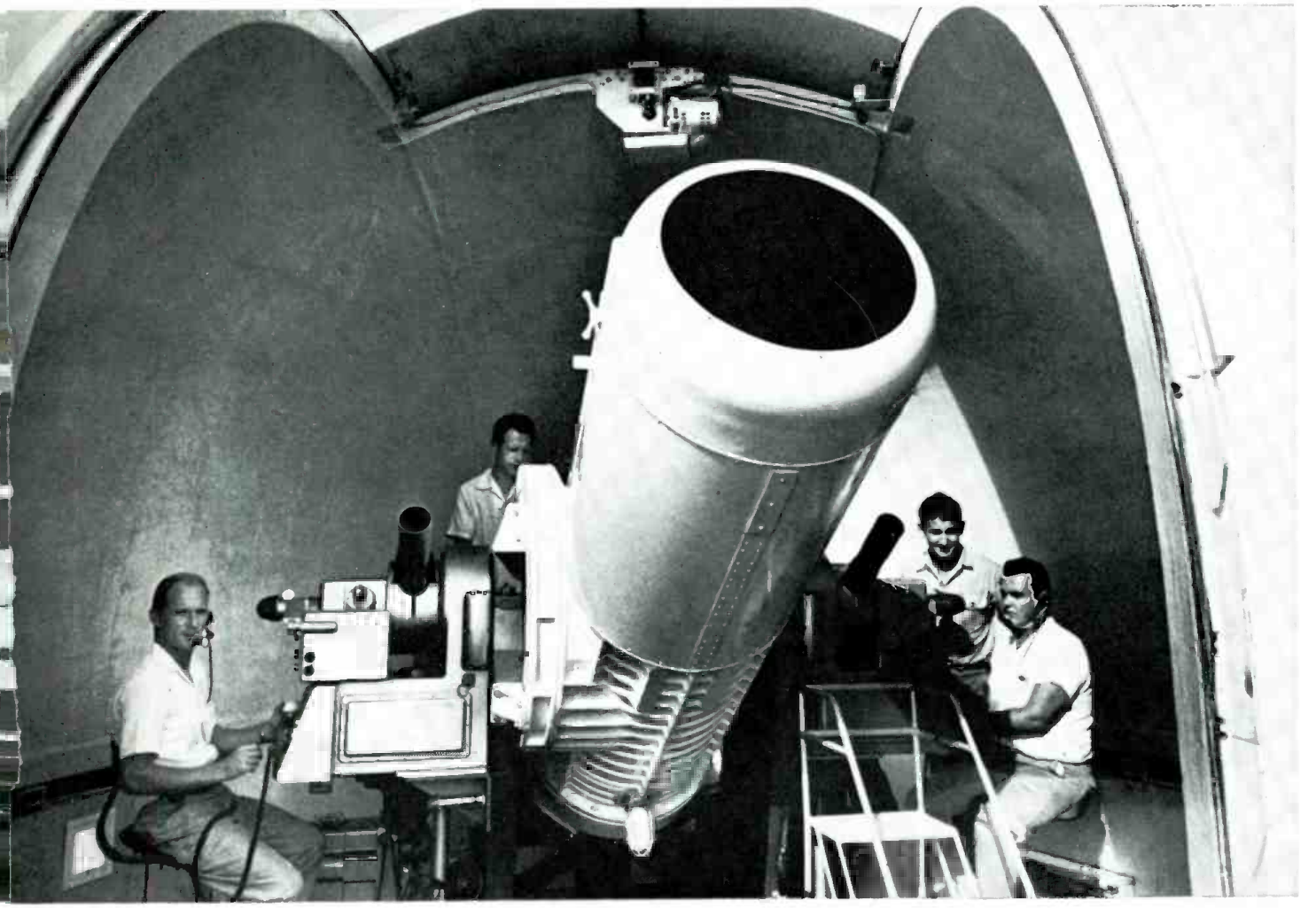
Now under construction is America's Ballistic Missile Early Warning System (BMEWS). This system, started early in 1958, is being built to provide an early warning of a mass intercontinental ballistic missile attack upon the United States and Canada. RCA, as weapon systems manager to the Air Force for BMEWS, is responsible for planning, system design, production supervision, installation, and initial operation.

Giant projects like BMEWS are taken in stride by systems engineers, who have grown used to the mounting challenges of defense and space electronics.

When the Air Force's Atlas missile blasted into orbit on December 18, 1959, it carried the world's first successful satellite communications relay system, designed and produced by RCA's new Astro-Electronic Products Division, in cooperation with the Army Signal Corps. This "talking" satellite brought the voice of President Eisenhower to earth from outer space.

By the time the history-making satellite relay ceased functioning with the exhaustion of its power supply after nearly two weeks, it had shown the way

Backstrut for long-range radar goes into place at BMEWS installation in the Far North.



Tracking camera on San Salvador collects missile flight data during a test firing at Air Force Missile Test Center.

to an era of world-wide communications in which television and radio microwaves will span oceans and continents in international service.

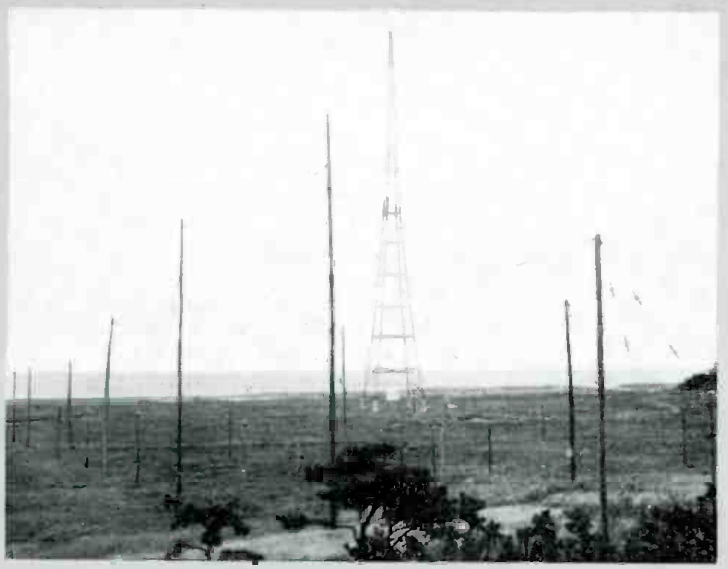
SATELLITE COMMUNICATIONS SYSTEM

Engineers at Astro-Electronic Products have projected plans for an "orbital post office" employing satellite relays to transmit messages by radio around the world. The satellite postal system would use standard forms like World War II V-Mail, which would be converted to radio signals, transmitted via the satellite repeating stations, and reconverted to letter form at the receiving end. Each space station would be manned by a crew of engineers who would live aboard and commute to and from the earth by rocket.

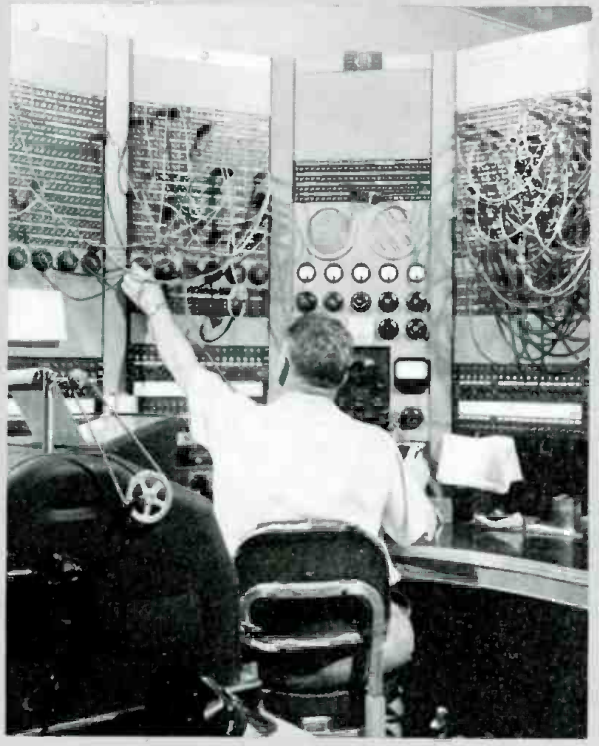
The cover of this issue of Electronic Age shows the form that such a communications space station might take. Conceived by Astro-Electronic Products engineers, the vehicle would be a so-called "synchronous satellite," rotating in orbit with the earth so that it would remain constantly in a fixed position 22,000 miles above the equator. Each of its narrow-beam, microwave antennas would be aimed at a specific city on the side of the earth facing the station. Three or four such satellites, equally spaced around the earth, would be able to relay microwave beams to cover the entire globe. They could handle all the world's communications, and would make possible simultaneous round-the-world television reception.

Much of the work of RCA Astro-Electronic Products is highly secret, involving projects for the military services and the Government's top space agencies. In cooperation with the National Aeronautics and Space Administration, a comprehensive scientific study program has been formulated to improve man's knowledge of what lies beyond earth's atmosphere. Much of the work of the division is in this area. The broad categories of activity include: earth-space exploration; satellite meteorology and weather forecasting; cloud information systems; early warning systems, communications relay systems; navigation systems for space vehicles.

Devices such as these which do man's bidding in millionths of a second — with the speed of the electron — are essential to the success of new weapons and new warning systems, and to the advancement of peaceful technology. Only electronics can meet these challenges of the Space Age. ■



RCA Radiomarine masts, Chatham, Mass., carry messages to ships at sea



Master control panel routes messages across the Atlantic

Control room of RCA West Coast communications center at San Francisco

FROM MORSE

In a New York cotton brokerage office a secretary types a message on her RCA Communications teleprinter. Instantly the words begin to appear on a teleprinter in the firm's branch office in Karachi, Pakistan. Minutes later the entire message has been delivered, a reply received, and both the home and branch offices have a complete written record of the transaction.

Talking-in-writing across thousands of miles of ocean has become routine for the many businesses which daily make use of RCA's international telex service — a communications medium that combines the best advantages of overseas telephone and telegraph. Through RCA telex service over 40,000 subscribers in the United States can be connected directly with their correspondents in any of 43 countries overseas.

RADIO SHRINKS THE WORLD

Only a century ago it took four months for an exchange of messages between America and Europe. The revolution in communications began in 1832 when Samuel F. B. Morse discovered that wires could carry coded information — the beginning of electrical communication. In the 1890's a young Italian scientist, Guglielmo Marconi, evolved what then seemed a miraculous method for sending messages through the air by "wireless."

When RCA entered the field in 1919, radio messages, in Morse code, were laboriously tapped out with a hand key on simple circuits that connected the United States with a handful of overseas nations. Today the RCA Communications system is a complex global network of 91 circuits comprising 256 high-quality radio channels. Modern automatic equipment processes greater volumes of messages faster and more accurately than was ever before possible and new RCA services, such as telex, have opened entire new fields of international communications.

The global radio facilities operated by RCA Communications now provide message telegraph service between the United States and 68 countries abroad.

TO MULTIPLEX

David Sarnoff, as a young radio telegrapher, received list of survivors of Titanic in 1912.

THE GROWTH OF RADIO COMMUNICATIONS AROUND THE WORLD "VIA RCA"

Last year this far flung system carried over 8-million overseas telegrams totalling more than 200 million words — or better than half a million words a day. Pictures as well as words are transmitted by radio and RCA radiophoto circuits regularly carry drawings, blueprints and front-page news photographs between the United States and 43 overseas points. RCA radio services keep ships and commercial aircraft in constant touch with world communication centers and provide the backbone of global news coverage, delivering up-to-the-minute dispatches to newspapers, magazines and radio and TV stations. RCA Communications also operates the terminals of 14 radiotelephone circuits in the Pacific area and can set up two-way program transmission service for broadcasters with almost any point on the globe.

Americans travelling around the world for business or pleasure depend on RCA Communications to keep in touch with home and office.

An increasing proportion of RCA's radio facilities today are being used to provide private leased channel communication service for international airlines, prominent industrial and commercial firms, and agencies of the U.S. and foreign governments. Leased channel service gives the customer the fulltime use of a private two-way radio channel for voice, teleprinter or facsimile communication. More recently RCA leased channels have also been used for the transmission of computer-processed data.

TECHNICAL PROGRESS

The millions of telegrams flowing over RCA's radiotelegraph circuits are processed by a modern teleprinter tape-relay system in which messages are manually typed only once — at the point of origin. All relays at intermediate offices are automatic. This system, which is now standard throughout the world, was pioneered on a commercial basis by RCA at the close of World War II. In addition, traffic carried by all major RCA circuits is "protected" by electronic error detection and correction equipment.

During the past 10 years RCA has also pursued a long-range program of more efficiently utilizing its allotted radio frequencies. Through the use of "multiplex" techniques, radio circuits which previously could provide only one radiotelegraph channel of 60 words per minute can now carry as many as 16 channels of 60 words per minute. The additional radio channels made available as a result of this program have enabled RCA to provide readily for expanding volumes of radiotelegraph traffic and to make available new services such as telex and leased channels.

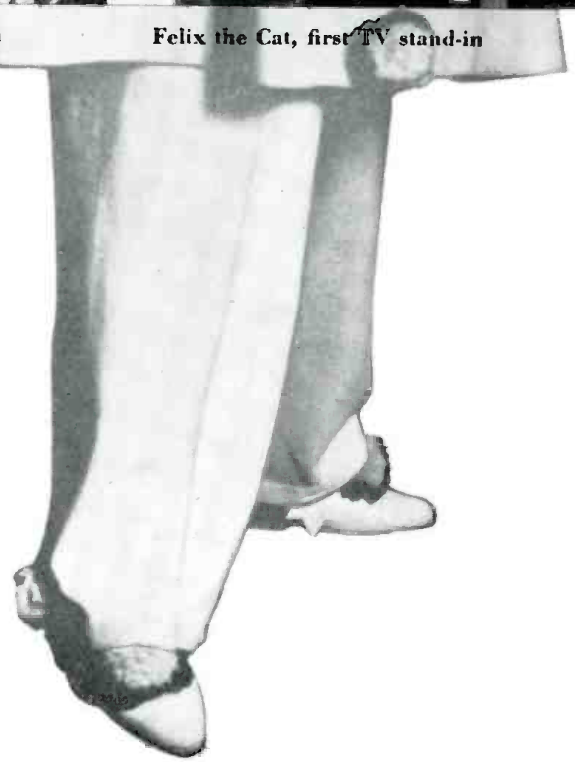
In recent years technological developments in many fields have brought with them increasingly heavy demands for new systems of international communication capable of greater speed, flexibility and capacity. Progress in jet aviation, the development of missiles and satellites, and the growth of electronic data processing have all had an impact on the international communications industry.

Today, RCA Communications' engineers have intensified their efforts to keep abreast of their industry's rapidly expanding horizon. New communications facilities now are being designed to meet the needs of proposed transoceanic data processing systems. Wholly automated central radio terminals are also being planned — terminals in which telegrams of the future will electronically route, process and transmit themselves. Earth-orbiting radio repeaters (see cover) are now being examined as a source of relief from today's over-crowded radio frequency spectrum. Satellite communications will also afford the means of even further increasing the flexibility and capacity of radio communications in the Space Age, via RCA. ■

Early "morning glory" horn phonograph

Felix the Cat, first TV stand-in

Will Rogers on early network broadcast



Enrico Caruso led the parade of great artists to "His Master's Voice" records

From Talking Machine to Color TV

HOW RADIO, PHONOGRAPHS, RECORDS AND TELEVISION HAVE TRANSFORMED HOME ENTERTAINMENT

When Thomas Alva Edison reproduced sound on a record for the first time in 1877, there were a few alarmists who protested that he had committed a sacrilege — that he had usurped a Divine prerogative in making a machine that could talk.

Today we have not only machines which talk with newly perfected electronic voices, but even more marvelous devices which bring the whole world audibly, visibly, and in full color into our living rooms. The wonders of radio, television, and high fidelity recording are no longer regarded as verging on the supernatural. Their wide acceptance has created one of America's greatest industries.

There are now about 25,000,000 phonographs in American homes. It is estimated that 44,000,000 U. S. homes (86% of the total) have television sets, and 49,500,000 homes (97% of the total) have radios. Social scientists have pointed out that the growth of home entertainment over the past 40 years has had a profound influence on family living in this country. Today the impact of television — as well as radio and records — has made the home the entertainment, information, and cultural center for the entire family from moppet to grandparent. The family, the nation, and the globe have been brought closer together by the magic of the electron.

Many early predictions about the growth of the electronics industry have had to be revised over the years. In the 1920's, when radio grew from a squawling infant into a powerful public servant, a number of prophets foretold the doom of the phonograph and record industry. After World War II, when television began its spectacular advance, others expected the end of radio. Yet today all these forms of entertainment and enlightenment work side by side to make life richer. One has not killed off another, because scientists and engineers have found many ingenious ways to adapt and improve their products.

The rough mechanical voice of the early phonograph has become today's marvel of high fidelity stereophonic reproduction, with disc and tape recording which captures the living quality of the musical performance.

Radios have been transistorized — have become lightweight, more efficient, pocket-size for personal use. FM radio has given hi-fi quality to broadcast music.

Television has been constantly improved and has achieved the miracle of color, an outstanding scientific accomplishment.

The history of home entertainment as we know it goes back beyond the turn of the century. But radio remained for many years a method of communication, with no place in the living room. It was in 1916 that David Sarnoff foresaw the vast possibilities of broadcasting and proposed the development of a "radio music box" which, he predicted, would become a "household utility."

The phonograph had meanwhile begun to find its voice without the aid of electronics. The first practical phonographs reached the public in 1888. They played wax cylinders, called "phonograms," and in summer it was advisable to keep them on ice to prevent melting.

Progress came in the form of a flat disc record and a spring-wound machine with a horn — the result of collaboration between Emile Berliner, a German-born telephone pioneer living in Washington, D. C., and Eldridge R. Johnson, proprietor of a small machine shop in Camden, N. J.

In 1901 Johnson founded the Victor Talking Machine Company and adopted as his trademark the famous little fox terrier Nipper listening to "His Master's Voice" — probably the most widely reproduced animal picture in history. The home music business was under way.

A revolutionary early improvement was the famous "Victrola," introduced by Victor in 1906. The horn was now for the first time inside the wood cabinet, adding to the quality of the sound as well as the appearance. Fussy housewives, who considered the old horn player an ugly dust-catcher, were won over by the new mahogany marvels, which became standard pieces of American parlor furniture.

Radio listening, as a form of entertainment rather than a hobby for "ham" wireless operators, got under way in 1920.

In 1921 the Radio Corporation of America set up a temporary installation at Hoboken, N. J., to relay the history-making blow-by-blow account of the Dempsey-

Piano virtuoso Van Cliburn adds his artistry to recorded library of RCA Victor masterpieces.

Carpentier championship fight to lucky owners of crystal sets and one-tube receivers. With this first broadcast of a sporting event, radio was on its way to building the mass audience that David Sarnoff had predicted for it.

The development of radio soon affected the phonograph. In 1925 the first electrical recordings were made, and a new world of sound was opened. Electronically amplified phonographs were introduced to reproduce the wider range and power of the records, and the marriage of the radio and phonograph techniques became a fact of life.

RCA engineers and scientists continued to upgrade the quality of recorded sound. Phonographs with automatic changers were introduced, and radio-phonograph combinations and portable "Victrolas" were developed.

A study called "Project X," begun in 1939 but delayed by World War II, produced in 1949 the RCA Victor 45-rpm record — distortion-free, unbreakable, small and light, and designed to be played on a completely new high-speed changer. Long-playing 33-1/3-rpm records became a favored means for reproducing lengthy classical selections.

THE TV REVOLUTION

A cultural revolution began in America with the introduction, in 1946, of the first postwar RCA Victor television sets. Model 630-TS, brought out in that year, was the nation's first receiver produced in quantity. With its efficient 10-inch picture tube, reliable reception, and $375 price tag, 630-TS became the "model T" of television history.

In 1946 there were fewer than 10,000 sets in the entire country. Five years later — by January, 1951 — 10,000,000 sets were in use in American homes. No major product in the history of American industry ever won so vast a market so quickly.

In the field of recorded music, "high fidelity" became a new slogan. RCA sound engineers defined hi-fi as "striving for perfection in the reproduction of musical tones — low notes, high notes, and in-between notes." Today RCA Victor has become the world's largest producer of high fidelity phonographs.

The latest new sound to fill the air is stereophonic high fidelity, or "music in the round." Listeners who first encounter stereo are astonished at the effect of a performance recorded through two or more separate microphones, combined on a single record or tape, and played back through two separate speakers. The music has what experts call "presence" — which simply means sound as close to the original as electronic science can achieve.

Stereo standards for the industry were adopted in the fall of 1957, and by June of 1958 RCA engineers

had designed and produced the first complete line of stereophonic record players.

Soon experiments were under way for stereophonic radio broadcasting and two-channel transmission of television shows. In October, 1958, the George Gobel show over NBC became the first network experiment of this kind. Sound from microphones on one side of the studio was fed through the TV sound system, while sound on the other side was broadcast over the radio network. All over the country, listeners with their radio and TV sets tuned to the program were completely surrounded by music and pretty girls.

But to televise a pretty girl at her best — or an opera, a circus, a ballet, or a ball game — another electronic marvel was required. Color television, called one of the greatest technical achievements of the century, has opened the most exciting chapter in the history of home entertainment.

After years of research and development, color TV became a new broadcasting medium in December, 1953, with FCC approval of the all-electronic compatible system pioneered by RCA. It was hailed as "a new era in communications . . . a new dimension in entertainment . . . a new power in advertising . . . a social and educational force."

NEW WONDERS FOR THE HOME

Latest developments in the broadcasting of sight and sound, as well as in high-fidelity music reproduction, were unveiled recently by RCA. Advances for 1959 include television sets which select a day's programs automatically; hideaway sets that convert into handsome tables; sets especially designed for built-in wall installation; and transistorized radios which operate for hundreds of hours on flashlight batteries.

In the field of high-fidelity music, RCA has designed stereophonic "Victrola" phonographs with up to 87 watts of power, with simplified controls and radically improved sound systems. New ways have been found to reproduce multi-channel sound for perfect home listening. In the "omni-range Panoramic wide-dispersion system," a woofer speaker for bass response is housed in a centrally placed console, while the mid-range and high-frequency speakers are mounted in movable twin units to provide the best stereo effect in any room.

Another hi-fi console has been introduced with a second speaker system which swings out of the side of the cabinet to provide separation for stereo reproduction. The auxiliary speaker can also be detached for further separation of sound. Even portable "Victrola" phonographs have been designed with detachable extra speakers systems.

A revolutionary stereophonic tape cartridge player, recently unveiled, will play up to an hour of stereo music from a plastic magazine only 7 inches long, 5 inches wide, and half an inch thick. The cartridge can be inserted in the player as easily as a phonograph record and never needs to be threaded or rewound.

RCA's new line includes "Mural" TV sets — both color and black-and-white — designed to be built into a home so that every television show becomes a living picture on the wall. "Tote-able" table models are made specially for the bedroom, with built-in clock, and wake-up and slumber switches. An amazing "Programmer" model automatically turns itself on and off and changes channels according to any pre-selected 12-hour schedule the owner chooses. A favorite program can't be forgotten with this "Magic Memory" selector.

The new RCA color receivers are equipped with a pre-set fine tuning system which provides perfect picture and color quality without dial twiddling. An all-function "Wireless Wizard" enables the viewer to control sound, color, and tint from across the room, and to turn the set off without getting up from his easy chair. The new color sets display a picture up to 40% brighter and with greater contrast than ever before.

In five years of growth, color TV has ceased to be a novelty. Color shows have become a regular part of daily network broadcasting schedules. In one recent month the National Broadcasting Company presented ten "color specials," which are eagerly awaited events in a growing number of TV homes. A survey has shown that families with color receivers watch television twice as much as those with black-and-white receivers.

As one color set owner said recently: "I'm old enough to have had a crystal set, a battery radio, a wind-up phonograph, and an early TV receiver. Each one seemed miraculous at the time, but color television is the greatest miracle of all." ■

RCA Victor's new multi-purpose color receiver can be used as table model or console, or built into the home.

From the National Broadcasting Company's color television studios come programs that are the ultimate in home entertainment.

The Evolution of

TODAY'S NETWORK RADIO AND TV ARE SOCIAL FORCES

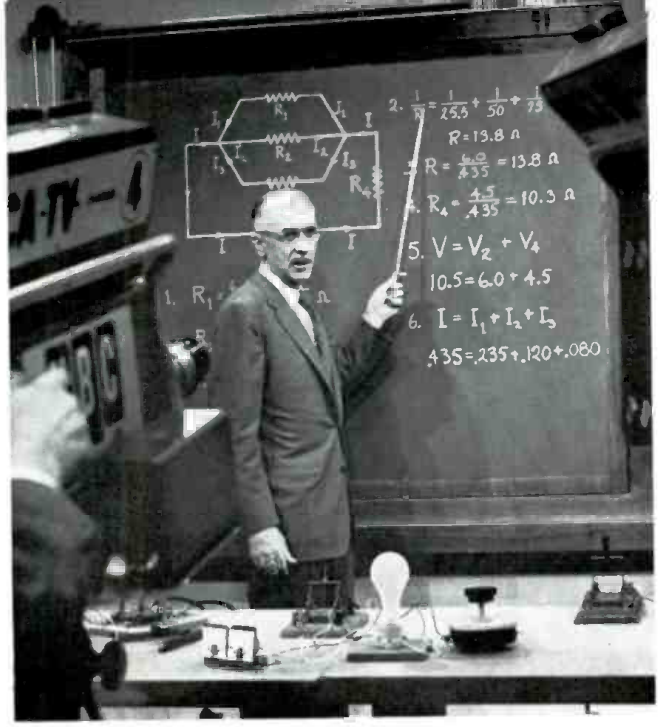
IN THE 33 years since the dawn of network broadcasting, the world has shrunk to the size of a television screen, and the average American can reach with his fingertips a breadth and wealth of experience — entertainment, news, culture, information, education — that never fell within the grasp of potentates.

Broadcasting's impact on America has been as widespread as the very air that carries its impulses. It is a vast and pervasive social force, ranging in its effects from launching hair styles to creating a golden age of music unmatched in history. As an economic force, its size as a billion-dollar industry is dwarfed by its unparalleled power to create demand and move goods through advertising. Politically, it has helped to create a single American community that cuts across barriers of space, time and old regional boundaries; it has amplified the democratic process by placing candidates for public office under a scrutiny unconceived by voters of generations past.

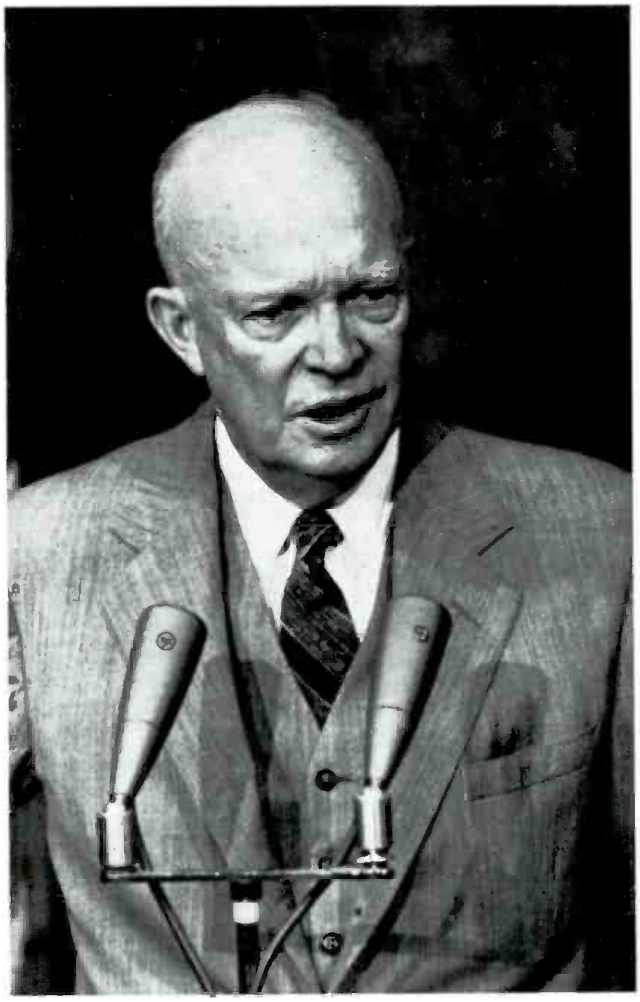
To an extraordinary degree, this communications revolution is the result not just of technical miracles but of the network system of broadcasting.

The first radio station, Pittsburgh's KDKA, went on the air in 1920, four years after a young American Marconi Company executive named David Sarnoff conceived the idea of using radio to bring music and information regularly into the home. By the end of 1924, 1400 stations had sprung up in the U. S. But their programming was makeshift, irregular and third-rate, and the stations lacked an economic basis for growth or even survival. By 1926, more than half of the country's radio stations had folded up, and 5,000,000 set owners were swiftly growing bored with the rest.

Then, on November 15, 1926, NBC went on the air. The first broadcast, a 4½-hour marathon with such stars as Will Rogers, Mary Garden and Walter Damrosch, was carried by 25 stations as far west as Kansas City. Within six weeks, NBC went transcontinental. Within a year, CBS was on the air, and then Mutual. Within five years, 5,000,000 radio sets had grown to



"Continental Classroom," conducted by Dr. Harvey E. White, is the first college-credit course televised on a national network. At left Dr. White explains a laboratory experiment on parallel resistances.



President Dwight D. Eisenhower *answers a reporter's question over RCA microphones.*

Broadcasting

THAT ARE CHANGING OUR WORLD

50,000,000. It was the networks that not only gave broadcasting its national character as a unifying force and an advertising medium but put together the resources and vision to fulfill the medium's potential as a balanced program service.

The early days produced problems that seem quaint in retrospect. Carbon microphones were allergic to sopranos who had a tendency to get too close and overload them with high C's; engineers had to erect barriers to keep the ladies and the mikes apart. Mary Pickford was petrified by the sight of a microphone, and it had to be concealed inside a globe. When NBC broadcast Sunday afternoon concerts from the Great Hall of New York's City College, the engineer hid in the choir loft because the organist refused to play if he were in sight.

But the networks rode a tide of mounting public acceptance. Stars and sponsors flocked to them. Such names as Rudy Vallee, Eddie Cantor, Jack Pearl, Al Jolson, Frank Black, Paul Whiteman, Fred Allen,

NBC-TV televises *the semi-final and final rounds of the National Singles Tennis Championship at Forest Hills, N. Y.*

Harry Horlick, Ben Bernie set habit patterns in households all over America. Popularity rose so high that "Amos 'n Andy," who introduced situation and character comedy to radio, received 2,400,000 letters and cards in response to a request for a child's name on their program.

The networks also made the living-room loudspeaker a cornucopia of serious music, drama, sports events, such public-service programs as "The National Farm and Home Hour" and "The National Radio Pulpit" — both still on NBC Radio — and the living history of political conventions, Presidential addresses and such memorable events as King Edward VIII's abdication speech. From Walter Damrosch's early "Music Appreciation Hour" through 17 years (1937-54) of broadcasting by Arturo Toscanini and the NBC Symphony Orchestra (much of it preserved on RCA-Victor records), network radio helped to turn the U.S. into a nation that spends more on concerts than on baseball games. During the war years, radio also came to full maturity as a news medium.

Meantime, television was aborning in the laboratory under the devoted labors of RCA and NBC engineers. In 1930, NBC transmitted the first experimental telecast, and in 1939 television became a public medium. In the next two years, until World War II sharply curtailed all TV activities, the handful of set owners saw major-league baseball, opera, championship boxing, the circus, political conventions.

After the war, television swiftly became one of the dominant features of American life. Today the time spent viewing television in the average home exceeds 37½ hours a week, making television-viewing America's No. 1 waking-hour activity after earning a living.

The phenomenal pace of television's growth confronted broadcasters with unprecedented challenges. Programming for television was far costlier than radio, and no entertainment medium in history had to fill demands for new material that were at once so insatiable and exacting. In a typical year, the three television networks alone must provide more than 10,000 hours of programming — more than 20 times as many hours as Hollywood produces for movie screens. To prepare schedules of such size and to keep planning ahead in the development of programs and talent meant, as television approached maturity, that a single network might have as much as $100,000,000 at risk at any time.

But the networks met the challenge in spirited competition for the viewer's favor. The medium demanded new forms, new adaptations, new concepts. Instead of clinging to the rigid time segments of regular radio scheduling, NBC also introduced longer, flexible formats, such as "Today" and "Tonight" (now "The Jack Paar Show") and put a change of pace into the weekly schedule by presenting such special programs as the memorable "Peter Pan," "Hamlet" and Britain's Royal Ballet. The network tapped the vast potential of educational television with such projects as "Continental Classroom," the first college-level course on national television. Launched with a course in Atomic Age Physics, the program will be expanded in the fall of 1959 with another in Modern Chemistry.

In 1954 broadcasting took a great technical leap forward with the advent of perfected color television after years of experimentation in the RCA laboratories. NBC brought color to the public in ever-increasing volume, from 68 hours in 1954 to 668 in 1958 — a tenfold increase in five years. In mid-1959, more than 300 U. S. television stations, including 168 NBC stations, are equipped to transmit color.

In the fall of 1959, to meet a new groundswell of popular interest in color, the network will offer its most comprehensive color schedule — seven-days-a-week programming totaling at least 250 hours in the year's fourth quarter, a gain of 30% over the same period in 1958. Other new color milestones in 1959 include the $1,000,000 conversion of two more West Coast NBC studios for color and the building of another $300,000 color mobile unit to handle expanded colorcasting of football, baseball and tennis.

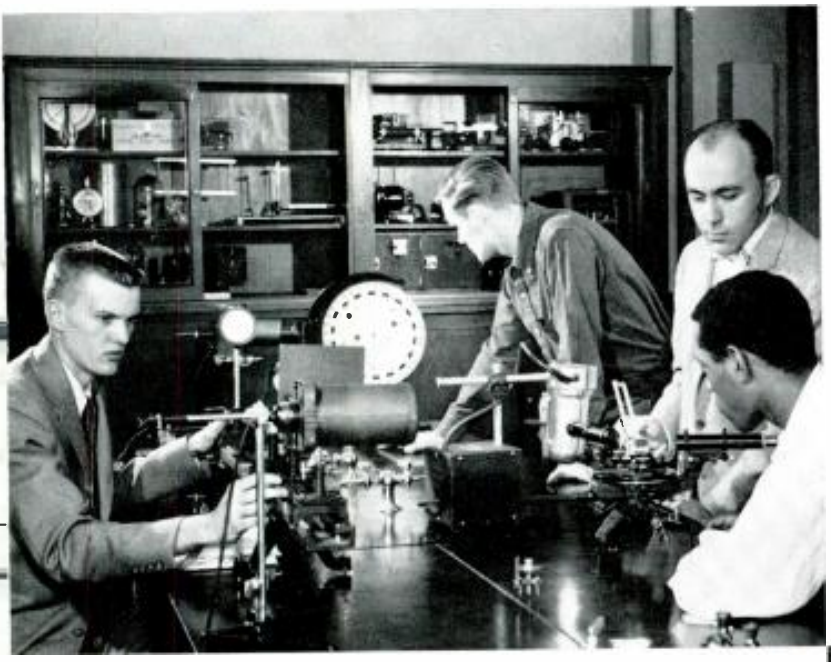
As it prepares for the 1959-60 season, television is also benefiting from the new flexibility and efficiency made possible by video tape. In another technical stride, foreshadowing eventual transatlantic television, BBC engineers have achieved the exchange of television news film clips through the telephone cable across the ocean.

The programmers are keeping up with the engineers. Like all entertainment media, television has run to popular cycles; comedians, live drama, situation comedies and Westerns have succeeded one another in vogue. But the popularity of any single program type has always been subordinated on the major networks to a balanced schedule designed for all tastes and interests. This concept of "Totality of Program Service," as NBC planners call it, will be reflected more than ever before in the diversity of NBC's 1959-60 schedule. The network will offer an unprecedented 150 specials ranging the whole spectrum of entertainment and information. Along with regular programs, this will make up a schedule — 60% new — covering original live drama, comedy, adventure, variety, serious music, audience participation shows, classics, Westerns, education, mysteries, opera, children's fare, dramatic anthologies, news and public affairs — including prime-time informational specials — and unmatched sports coverage. Together, all this adds up to Total Television. ■

NEEDED

TALENTED TECHNICIANS

RCA Institutes train men in many branches of science—from radio telegraphy to atomic physics



Class in Advanced Electronic Technology at RCA Institutes.

AMERICA'S PRIVATE TECHNICAL SCHOOLS have become a key factor in efforts to overcome the manpower shortage spotlighted by Russia's challenging scientific surge. The rising prestige of these schools is in direct proportion to their capacity to turn out qualified engineering technicians, a Space Age necessity.

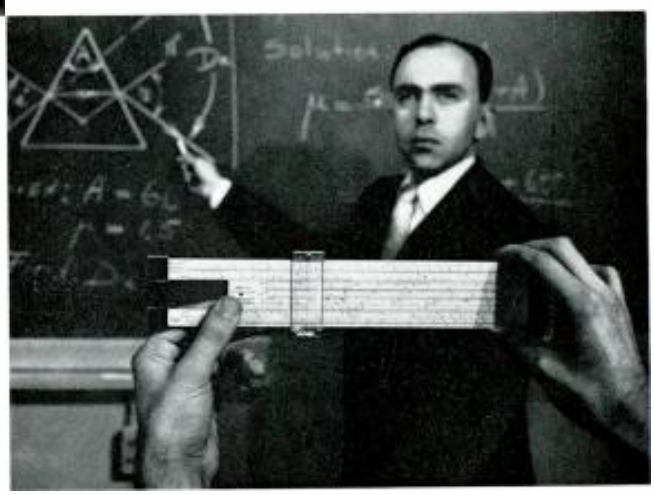
RCA Institutes — a service of the Radio Corporation of America — is an outstanding example among some fifty U.S. technical institutes accredited by the Engineer's Council for Professional Development.

The reputation of RCA Institutes is based on its long record of graduating highly trained personnel for the free world's electronics and communications industry. Formerly the Marconi Institute, it was founded in 1909 by the United Wireless Telegraph Company of America and acquired by RCA in 1919.

Students from practically every state and territory of the United States attend the school, as do an average of 100 students each year from some 20 nations, including Brazil, Burma, Chile, Formosa, Greece, India, Nigeria, Pakistan, Thailand, and Venezuela.

The school is housed in a modern nine-story building at 350 West Fourth Street, in New York. Its classrooms and laboratories are equipped with many thousands of dollars' worth of the latest electronic apparatus and test equipment for courses covering all branches of practical electronics.

This fall, the Institute's two resident schools — the Technical Institute and the Vocational School — will have an enrollment of about 3,000 students. This is double the figure of five years ago. In addition, some 12,000 students are now actively enrolled in the Home Study School's three correspondence courses, in which over 40,000 have been trained since 1951.

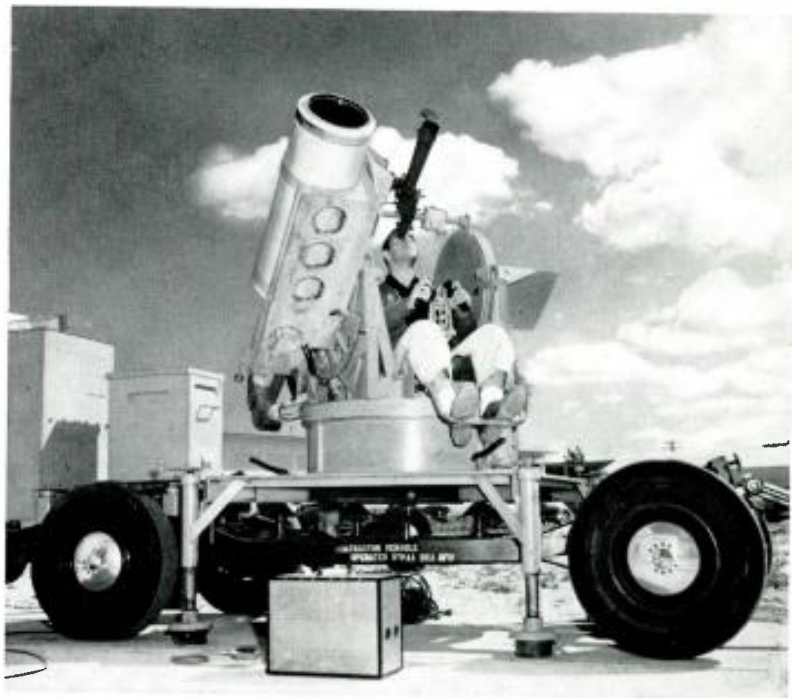


Student uses slide rule to solve a problem in optics class.

Past graduates of RCA Institutes currently are playing important roles in guided missile tracking, and in the development, operation and servicing of computers, data processing systems, television, and radar. Recent graduates of RCA Institutes now hold positions with leading firms throughout the country.

Approximately 40 per cent of the resident students are enrolled in the Technical Institutes' Advanced Electronics Technology Course, a 27-month college level curriculum which includes such subjects as calculus, analytic geometry, physics, and computers.

Thus an ever-growing number of talented technicians are being produced to meet the demand for semi-professional manpower. Today's technician is an honored member of the engineering team, playing an increasingly important role in industry and in the basic research on which scientific progress depends. ■



RCA Service Company personnel track missiles at Cape Canaveral.

SERVICE:

THE MODERN INSTALL A COMPUTER,

THE HOUSEWIFE knows the service man as the handy fellow who keeps the TV set, washer, dryer or phonograph in top running condition.

The theater owner depends on the service technician to maintain his motion picture equipment, and the beverage bottler calls on him to check his automatic inspection machines.

At the U.S. Air Force Missile Test Center in Florida, the RCA Service Company's engineers and technicians track missiles and process the complex data essential to America's Space Age defense program.

Historically, RCA has been a pioneer in the servicing of electronic home products as well as all types of electrical equipment.

Throughout the years, RCA has operated on a basis of full cooperation with the independent servicing profession, particularly in the field of consumer products. When RCA pioneered television in 1946, the Service Company inaugurated a comprehensive program of education and training for independent servicemen. The same policy was followed with the introduction of color TV in 1954. Its free lectures and clinics have been attended by nearly a quarter of a million service technicians, sales personnel, and others in 460 cities. These efforts have helped raise the general level of servicing to high professional standards.

More than 2,000 different editions of service data manuals on RCA Victor products have been distributed throughout the world and have been read by hundreds of thousands of technicians, who recognize their quality and value.

The Service Company now operates in every state of the Union and in 28 other countries. Its trained men install and maintain the electronic equipment on which great broadcasting and communication networks depend. Its technicians build radar installations in the far north and instruct armed forces personnel in the country's leading military training centers.

In the years since World War II, home servicing alone has grown into a multi-billion-dollar industry in order to keep up with the pace of electronic progress. It has been estimated that there are 1,500,000,000 tube sockets in the radios, television sets, phonographs, tape recorders, and other electronic equipment in America's homes. To keep them all glowing requires the attention of an army of 200,000 well-trained factory and independent technicians.

SERVICE FOR HOME, INDUSTRY, GOVERNMENT

The RCA Service Company operates in three major fields: consumer products, technical products, and government service.

The Technical Products Service Department has for many years kept the sound systems of American moving picture theaters in top working order. More recently, closed-circuit theater television has provided a new entertainment medium, and RCA now provides the largest group of trained specialists in the country to handle such telecasts.

Another group of specialists install and service radio and television transmitter and studio equipment, and these men have made important contributions to the growth of the broadcasting industry. For example, when the first TV transmitters were being installed after World War II, adjustments for best reception could only be made through long-drawn-out point-to-point measurements. An RCA Service engineer devised a way to provide an instantaneous picture of the transmitting antenna's performance on an oscilloscope screen. Better service and a huge saving in installation time resulted.

Other technical specialists take care of the servicing of electron microscopes for research laboratories and equipment such as metal detectors for automated production lines, and communications equipment for ships at sea and on inland waterways. The installation and servicing of RCA's 501 data processing system is a growing responsibility as this new and compact elec-

Trained service man quickly adjusts a color TV set for home installation.

Technicians check 501 data processing system.

AROUND THE HOUSE, AROUND THE WORLD

SERVICEMAN CAN REPAIR A TELEVISION SET, OR TRACK A MISSILE THROUGH SPACE

tronic "brain" takes over the filing and processing of information in offices and plants.

A rapidly-growing activity is that of the mobile, microwave and marine communications groups, whose technicians install and maintain vital radio, radar and other equipment for police and fire departments, public utilities, turnpikes, trucking firms, and small and large marine craft throughout the world.

The number of lives depending upon good communications equipment, and the millions of dollars of investment represented, give major importance to the electronic technician.

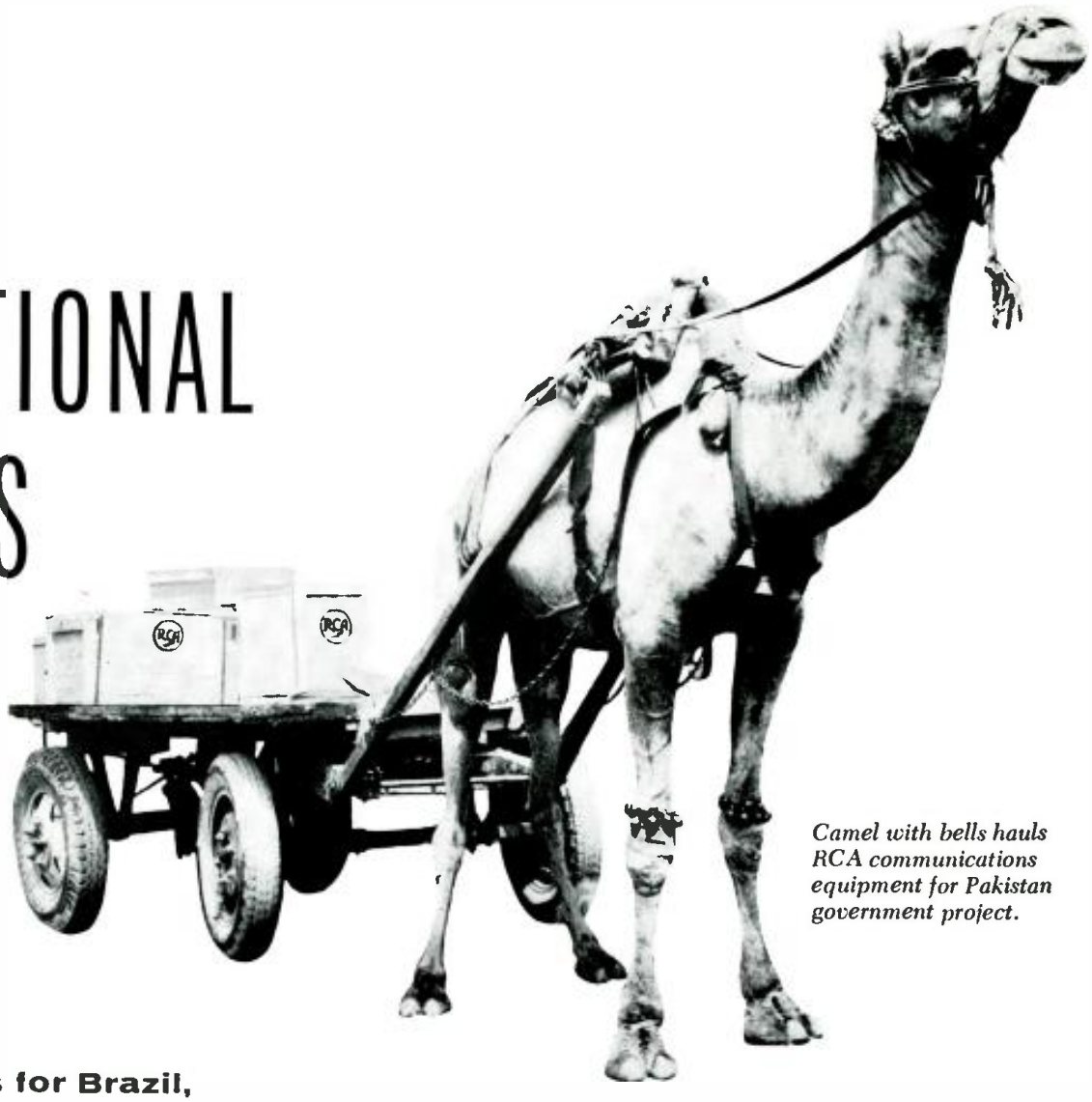
The Government Service activity of the RCA Service Company has seen its greatest growth since 1950. A major responsibility in this field is the Missile Test Project at Patrick Air Force Base and Cape Canaveral, and on the down-range islands and picket ships where America's Space Age weapons are fired and their performance evaluated.

The Atlantic Missile Range has been called "the free world's biggest coordinated electronic measuring system." RCA Service Company personnel — numbering nearly 3,000 — operate the complex electronic equipment which tracks missiles in flight by means of radar, telemetry, and optical instruments. The information is then collected and processed so that missile designers will be able to study every aspect of a weapon's performance. An RCA "data reduction report" gives a complete picture of every missile test and provides the basis for design changes and improvements. Photographs of missile flights are processed in one of the largest motion picture film laboratories in the world.

In 1958 the RCA Government Service Department was awarded a contract to install, maintain, and operate one of the nation's major defense installations — the Ballistic Missile Early Warning System (BMEWS). When completed its long-range radar net will be linked with the North American Defense Command headquarters at Colorado Springs, Colo., and will become a vital bulwark of continental defense. The work is now advancing on schedule.

Every advance in electronics — whether in the field of home instruments, computers and controls for industry, or inter-continental defense systems — adds to the responsibility of the service technician. Along with the research scientist, the engineer, and the astronaut, he is the man of tomorrow. ■

RCA INTERNATIONAL COVERS THE GLOBE



Camel with bells hauls RCA communications equipment for Pakistan government project.

TV transmitters for Brazil, radar for Norway, radiotelephone for Indonesia

ELECTRONICS TODAY plays a vital role, all around the globe, in strengthening the free world. American-built electronic defense equipment guards NATO and other free nations from attack. Communications systems vault once-impenetrable mountains and jungles to tie entire nations together. Electron microscopes aid industry and medicine. Television and radio are being pressed into the battle against illiteracy and ignorance. The fruits of American electronics research and industry recognize no geographical boundary.

A leader in the international field is RCA, whose name and trademark are carried abroad by a network of fourteen associated companies and by more than 200 major distributors in 145 countries. To the people in International Division, exotic-sounding names such as Angola, Bahrein, Nyasaland, Fiji, Vietnam, and Mozambique are as real as Kansas City, Atlanta, Boston or San Francisco.

RCA International performs three major functions:

1. It is engaged in international marketing or the direct export of finished products to foreign nations.

2. It administers the licensing of RCA foreign patents to manufacturers abroad and furnishes licensees and foreign governments with assistance in solving technical problems in communications and electronics.

3. It supervises RCA's fourteen active associated companies overseas.

The Division's headquarters are in the RCA Building in New York and its operating activities are carried out in Clark, New Jersey, where a staff of about 500 people handle marketing, traffic, advertising, and engineering activities. The personnel includes a cross-section of nationalities — Europeans, Latin Americans, Japanese, Chinese, and North Americans.

RCA first entered international marketing in 1929 with the purchase of the Victor Talking Machine Company. Today International Division's far-flung network of distributors market RCA products ranging from the

tiniest electron tubes to the most complex radio communications systems for an entire nation.

RCA International has sold and installed, either completely or in part, scores of television broadcasting facilities in twenty-nine nations outside the continental U.S.A. Latest U.S. Government and industry figures indicate there now are more than 26,000,000 TV sets

American-equipped film studio in Bombay, India.

in use outside the United States, with the number expected to surpass the U.S. total within five years.

RCA has led the way in marketing other electronic products as well. Major airlines use RCA's airborne all-weather radar. RCA marine radar is installed on the fleets of leading maritime nations.

Not only does RCA market products, but it designs and builds entire systems to fit a customer's particular needs through its Systems Marketing and Engineering Operation at Clark. Typical is the first of two contracts recently completed for the installation of a nation-wide radiotelephone system in Colombia. Work on the second contract is scheduled for completion by the end of 1960.

Other communications systems completed or being installed now by RCA International engineers include that for the Orinoco Mining project of the U.S. Steel Company in Venezuela, Cuba's nation-wide microwave system, the Dominican Republic's telephone and telegraph system, a telephone and telegraph network for East Pakistan, and a TV relay system in Brazil.

RCA International engineers have aided many other nations in modernizing their communications, including Canada, Mexico, Turkey, Bolivia, Burma, Indonesia, The Philippines, Puerto Rico, Union of South Africa and the Belgian Congo.

The list of RCA's associated companies abroad has grown from five to fourteen since the first one was incorporated in 1929. Today, these fourteen companies — which are either wholly-owned by RCA or for which RCA has management responsibility — employ more than 4,000 persons.

Nine of the fourteen manufacture or assemble such items as tubes, radios, phonographs, radio-phonograph combinations, records, theater and film studio equipment, 16 mm projectors, sound equipment, tape recorders, and various types of communications and engineering products.

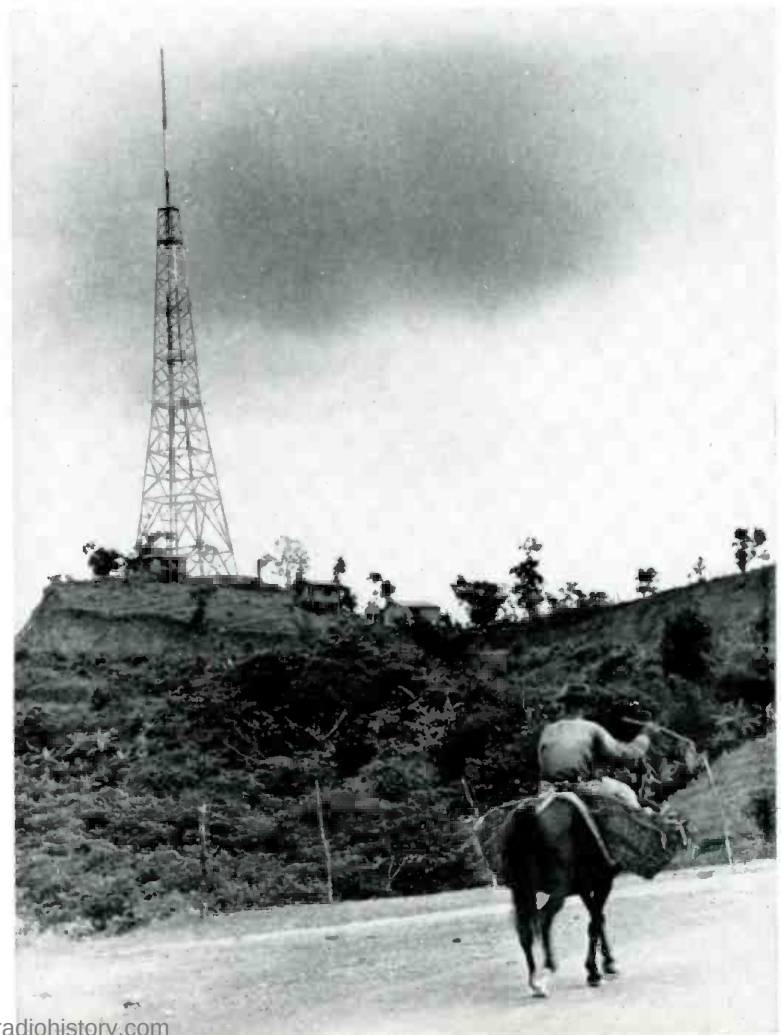
Direct exports of RCA Records are made to many nations. Licensing and distribution agreements are maintained with record manufacturers in many nations for the right to use the RCA trademark and to press and distribute the RCA catalog in their respective countries. This local pressing of RCA records has increased over 250 per cent in the past two years.

In addition, RCA's associated companies in Argentina, Australia, Brazil, Chile, Italy, Mexico and Spain produce records.

New developments in manufacturing and distribution have made it possible for a hit record in America to become an overseas favorite at virtually the same time.

RCA International Division is constantly alert to the needs of a world striving for a peaceful solution to its demands for a better life. In this quest electronics plays an ever more important role. ■

Transmitting antenna for educational TV in Puerto Rico.



Forty Years of Electronics—Historic Highlights

1919 Radio Corporation of America incorporated on October 17.

1920 World-wide radio communications inaugurated by RCA, providing first independent American-owned international service.

1921 Dempsey-Carpentier heavyweight bout in Jersey City—first radio program broadcast to a mass audience.

1923 Dr. V. K. Zworykin, now Honorary Vice President of RCA, applies for patent on the iconoscope, first TV camera tube.

1924 First transatlantic radio-photo transmitted by RCA from New York to London.

1925 President Calvin Coolidge's inaugural on 24-station hook-up — the first event of its kind on the air.

1926 World Series baseball games broadcast for the first time by WJZ.

1928 Sound motion pictures successfully demonstrated by RCA.

1929 All-electronic television receiver, using kinescope picture tube, demonstrated by Dr. Zworykin.

1930 Theater television on a 6-by-eight-foot screen shown by RCA in New York.

1931 RCA perfected velocity microphone, which became standard with broadcasting stations.

1932 NBC begins television experiments with live talent from W2XBS, New York.

1934 RCA introduces unidirectional microphone, used in film and phonograph recording, broadcasting and TV.

RCA begins development work on sonar submarine detection system for U. S. Navy.

1935 Automatic SOS alarm for ships introduced by RCA.

1937 First full-size symphony orchestra organized for broadcasting by NBC with Maestro Arturo Toscanini as conductor.

1938 RCA builds U. S. Navy's first seagoing radar system for Battleship New York.

1939 RCA and NBC introduce television as a service to the public at opening of New York World's Fair.

1940 RCA demonstrates a TV receiver producing images in color by electronic and optical means.

Coaxial cable used for first time in TV program service by NBC.

First RCA electron microscope completed.

1941 Ground broken at Princeton, N. J., for RCA laboratories, leading electronics research center.

1941-'45 RCA halts civilian production and devotes its facilities to the war effort. Outstanding advances achieved in radar, loran, shoran, radio communications, and other military systems.

1945 Supersensitive RCA image-orthicon tube for television studio and outdoor pickups introduced.

1946 RCA introduces first post-war television sets.

Color television pictures on 15 by 20-inch screen produced by all-electronic means.

1947 Color TV projected on 10-foot theater screen.

Televised pictures of surgical operations transmitted through the air for the first time by RCA from New York hospital.

1948 Republican and Democratic National Conventions in Philadelphia telecast by NBC.

1949 New all-electronic, high-definition, fully-compatible color television system announced by RCA.

New 45-rpm record and fast-changing player introduced as an entirely new system of home music reproduction.

First permanent installation of large-screen theater television projection equipment.

1950 RCA develops analogue computer for the Navy to evaluate performance of missiles, ships, airplanes and submarines.

A new system of industrial television is designed by RCA using a small pickup tube, the Vidicon.

1952 Development of point-contact transistors announced by RCA.

1953 First transcontinental color television transmission via radio relay from New York to Burbank, Calif.

Standards for commercial color television, based on compatible system, approved by FCC.

Most powerful military radio transmitter in the world, built by RCA in cooperation with the U. S. Navy, put into operation at Jim Creek Valley, Washington.

1954 RCA produces first commercial color TV sets.

New large-size RCA color picture tube and simplified color TV receiver demonstrated at the David Sarnoff Research Center.

Tournament of Roses Parade at Pasadena, Calif., telecast in color by 21 stations of NBC's coast-to-coast network.

Use of television in military combat demonstrated for the first time at Fort Meade, Md.

1955 Electronic music synthesizer, cooling system, light amplifier, and TV magnetic tape recorder announced by RCA.

Color TV program recorded on magnetic tape is ransmitted over commercial network facilities for the first time.

1956 Stereophonic sound demonstrated as a major advance in phonograph recordings and instruments.

1957 Talos Defense Unit, first completely automatic base for firing and guiding missiles, developed by RCA.

First pocket-size two-way radio "Personalfone" for mobile communications service tested by New York police.

RCA introduces the most precise radar ever built for guided missile range tracking.

1958 RCA becomes prime contractor to design and build Air Force Ballistic Missile Early Warning System (BMEWS) in Far North.

First tape cartridge developed for use in recorder-players.

RCA introduces transistorized 501 data processing system.

In cooperation with U. S. Army Signal Corps, RCA began developing micromodule concept as revolutionary advance in miniaturization.

RCA supplied radio equipment used in the Atlas, world's first "talking satellite."

1959 RCA reveals the "Nuvistor" — thimble-size electron tube — for Space Age functions.

Advanced television tape recorder developed by RCA for both color and black-and-white broadcasting.

A new concept of "integrated electronics" enables RCA scientists to create a logic circuit element — basic building block of computers — so compact that up to 100,000,000 of them might be crammed into one cubic foot.

United States and International Operations

RCA Manufacturing Plants

Bloomington, Ind.
Burlington, Mass.
Cambridge, Ohio
Camden, N. J.
Canonsburg, Pa.
Cincinnati, Ohio
Croydon, Pa.
Detroit, Mich.
Findlay, Ohio
Harrison, N. Y.
Hollywood, Calif.
Indianapolis, Ind.
Lancaster, Pa.
Los Angeles, Calif.
Marion, Ind.
Monticello, Ind.
Moorestown, N. J.
Needham, Mass.
Princeton, N. J.
Rockaway, N. J.
Somerville, N. J.
Van Nuys, Calif.
Woodbridge, N. J.

NBC Owned and Operated Stations

RADIO

New York, N. Y. (WRCA & WRCA-FM)
Chicago, Ill. (WMAQ & WMAQ-FM)
San Francisco, Calif. (KNBC & KNBC-FM)
Washington, D. C. (WRC & WRC-FM)
Philadelphia, Pa. (WRCV)
Pittsburgh, Pa. (WAMP & WFMP)

TELEVISION

New York, N. Y. (WRCA-TV)
Chicago, Ill. (WNBQ)
Philadelphia, Pa. (WRCV-TV)
Hollywood, Calif. (KRCA)
Washington, D. C. (WRC-TV)

RCA Laboratories

Newcastle, Del.
Princeton, N. J.
Riverhead, L. I., N. Y.
Rocky Point, L. I., N. Y.
Tokyo, Japan
Tucson, Ariz.
Zurich, Switzerland

Radiomarine Stations

Bolinas, Calif.
Buffalo, N. Y.
Chatham, Mass.
Lantana, Fla.
New York, N. Y.
Pittsburgh, Pa.
Port Arthur, Texas
St. Louis, Mo.
Savannah, Ga.
Torrance, Calif.
Tuckerton, N. Y.

RCA Communications Stations

Bolinas, Calif.
Point Reyes, Calif.
Riverhead, L. I., N. Y.
Rocky Point, L. I., N. Y.

RCA Victor Distributing Corp.

OFFICES

Atlanta, Ga.
Buffalo, N. Y.
Chicago, Ill.
Davenport, Iowa
Detroit, Mich.
Kansas City, Kans.
Los Angeles, Calif.
Wichita, Kans.

RCA Service Company

PRINCIPAL OFFICES

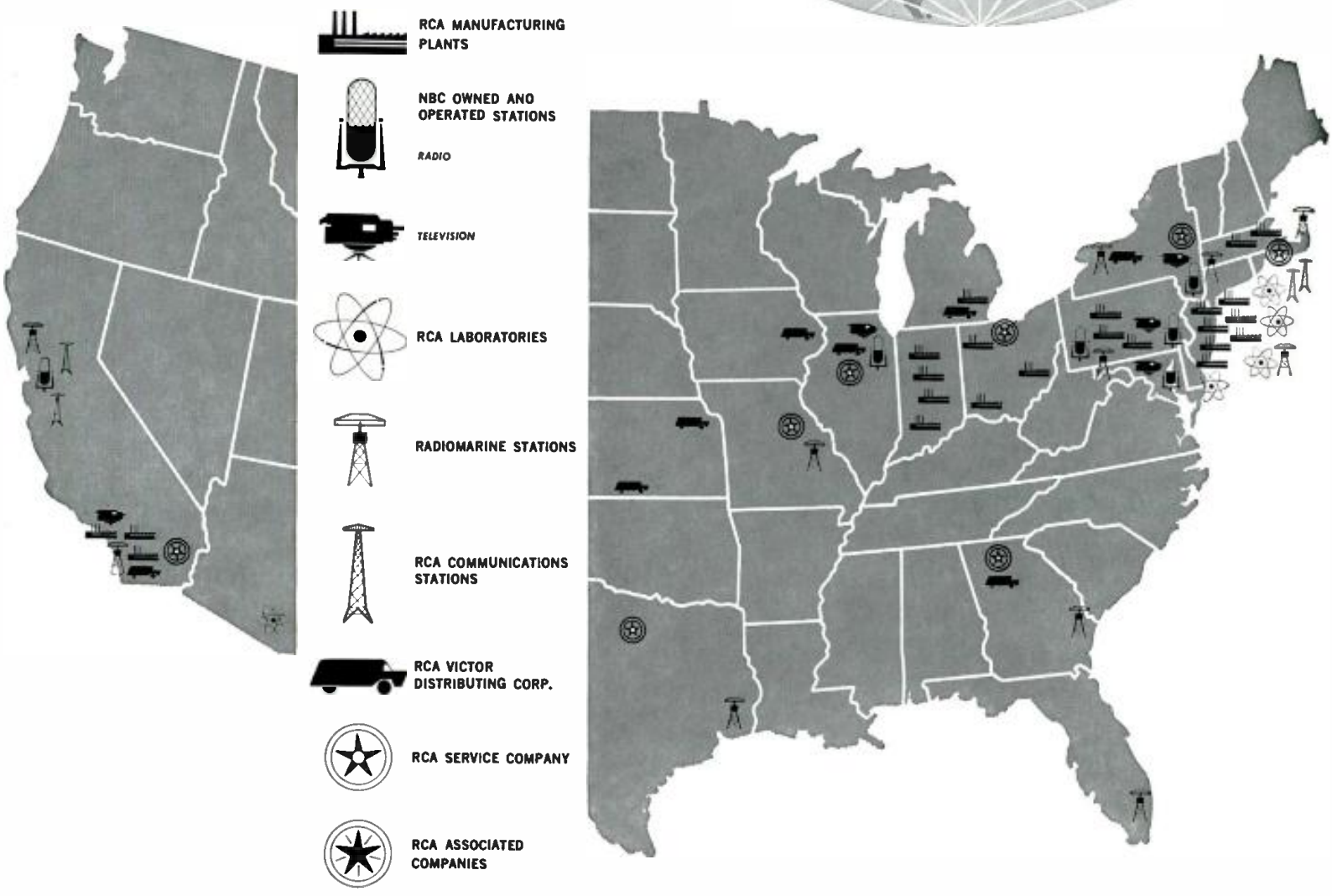
Atlanta, Ga.
Boston, Mass.
Chicago, Ill.
Cleveland, Ohio
Dallas, Texas
Los Angeles, Calif.
New York, N. Y.
St. Louis, Mo.

RCA Associated Companies

Argentina
Australia
Brazil
Canada
Chile
England
Germany
India
Italy
Japan
Mexico
Spain
Switzerland
Venezuela

RCA at a Glance

Map symbols indicate plant locations and other facilities of the Radio Corporation of America in the U.S.A. and throughout the world.



My second most prized possession

There is a great temptation to address George Preston Marshall as "Chief." That's because his most prized possession is the *Redskins*, Washington's professional football team—symbolized here by a professional wooden Indian.

Being a sportsman, Mr. Marshall thrives on action, excitement and spectacle. The same reasons why he picks RCA Victor Color TV as his second most prized possession. It's the most exciting way to enjoy television, and the only way to appreciate the many fine color programs. Without question, Color TV is the best television there is. That is why it keeps making a place for itself with more and more people like George Preston Marshall. People who lead the colorful life.

RCA Victor offers a wide selection of Color TV models. Some—like Mr. Marshall's *Grenoble* model, above—come equipped with remote control push-button tuning. Your dealer will be glad to arrange a demonstration for you. RCA Victor Color TV as low as $495.

ON THE 5TH ANNIVERSARY OF COLOR TV, SEE THE DIFFERENCE COLOR TV MAKES

RCA VICTOR
Trademarks ® RADIO CORPORATION OF AMERICA

For expert service and installation, RCA Factory Service is available in most TV areas. Nat'ly adv'd list price shown, opt. with dealer. UHF opt., extra. Prices, specs subject to change without notice.