RCA electronic age

In this issue . . .

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COVER: *The Tiros II weather satellite, shown here having its TV cameras calibrated with the aid of large "targets" at RCA's Space Center in Princeton, N. J., had its genesis in studies begun back in 1951. For the story of its development, see article beginning on Page 18.*

LOWELL FARLEY, *Editor*
BARBARA ZERRIEN, *Assistant Editor*
JOHN MAXIMUS, *Design Consultant*

RCA radio transmitter-receiver aids soldier with UN forces in the Congo.

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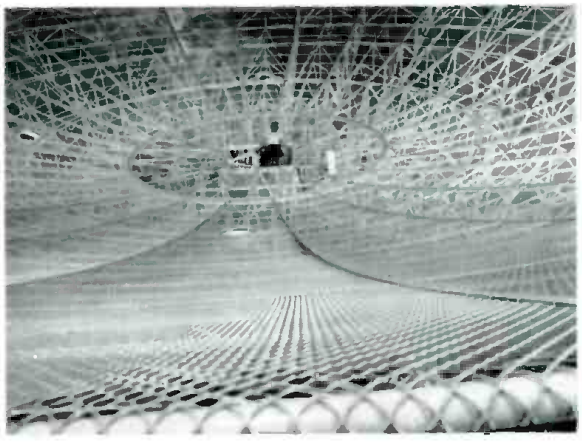
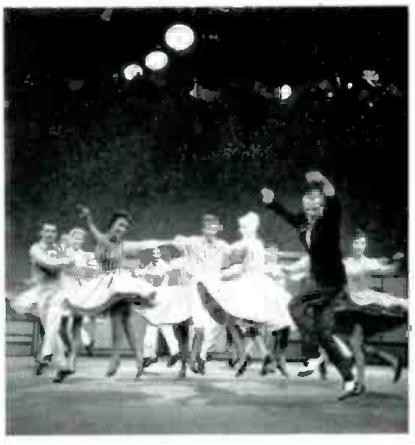




Despite the current softness of the economy recent basic advances in research and technology insure that the Decade of the Sixties will soar even higher than the most optimistic claims made for it

'A New Era of Discovery'

By **DAVID SARNOFF,**
Chairman of the Board,
Radio Corporation of America

IN 1960 THE Radio Corporation of America, like most major American industries, saw pressures on profits intensified. The generative forces by which the national economy is normally gauged did not move forward with the vigor anticipated by most economists as the year began.

Nevertheless, 1960 was in many ways the most significant and the most promising of the many years in which I have worked in electronics.

Superficially, the economic downturn of 1960 seemed to invalidate earlier forecasts of the "Soaring Sixties." Actually, in my view, 1960 insured that the decade ahead will soar even higher than the optimists of 1959 claimed and the pessimists of 1960 now disclaim. This belief rests on at least three developments which will influence greatly the shape of things to come during the rest of the decade:

1. Research and technological innovation received recognition, and financial support, on a breakthrough scale from both private industry and the Federal government. During 1960, a record $13 billion went into research and development – about two-and-a-half per cent of all the money spent in the United States; more research money was available in 1960 than in all the years from the Revolutionary War to World War II.

2. The year marked a turning point in the exploration of space. The bridge between exploration for scientific purposes and exploration for practical purposes was successfully spanned. In the Tiros satellites for weather forecasts, in Transit for navigation, in Courier and Echo for communications, the *primary* goal was to add new dimensions to our ability to do new things here on earth.

3. The pace of product innovation was enormously accelerated in 1960. In the United States, new products made their market debut at the rate of more than twenty-five daily. In RCA, four out of every five dollars of our record 1960 sales came from products that were researched and developed *after* World War II.

These elements of progress, in my judgment, are far more important than the temporary softness of the economy. I share the viewpoint of many economists that this softness will continue through the first half of 1961 and that an upturn will occur in the second half of the year. But the month-in, month-out fluctuations of the economic index must not obscure the underlying dynamism of research and technology. This is the enduring reality which guarantees economic growth in the years ahead. The fact that our nation's economy has paused for a breather is certainly no reason for despair. As Emerson reminded us, "This time, like all other times, is a very good one if we but know what to do with it."

RESEARCH AND THE CONQUEST OF SPACE

Nowhere is the quickening cadence of research more impressively exemplified than in outer space. In ideas as well as in hardware, we are already moving at near "escape velocity."

Out of the advances made during 1960, through

RCA engineer examines wafer-thin micromodule.
Inset (l. to r.): RCA 501's high-speed printer; prototype of BMEWS antenna at Moorestown, N. J.; Fred Astaire in color television feature.

NBC's election night coverage, featuring Chet Huntley and David Brinkley, rounded out a year of pace-setting news reporting.

the RCA-built Tiros and other satellite systems, we now have the technical capability of achieving goals previously regarded as fantasy. For instance:

1. Satellite systems for world-wide communications, including television and radio, will be ready for experimental use by 1965, and for extensive national and international commercial application by 1970. They will add speed, capacity, versatility and reliability to both domestic and intercontinental services, and will eventually reduce the cost of these services for the consumer.

2. Maneuverable satellites will soon be capable of detecting, identifying, and making rendezvous with other satellites. Such a capability opens the way to the construction of large space stations whose components may be steered precisely to any desired location for assembly in orbit.

3. Reconnaissance satellites, equipped with advanced television, infrared and radar techniques, will be able to take pictures of the earth from several hundred miles in space, even in total darkness. They may well constitute a "peace force" which, by furnishing dependable data that nations were not arming for war, could allay the fears of an uneasy world.

4. Missile-bearing satellites will be able to launch a retaliatory attack, at a moment's notice, against ground targets anywhere in the world. Such a weapons system could be orbited at the convenience of the military, then instructed from the ground as with our present satellites.

RESEARCH AND CONSUMER PRODUCTS

The mastery of energy and matter that characterizes our space efforts is being transfused into the American market place. Historically, our industries have competed for a market that seemed limited by consumer needs – needs which were so nearly filled, from time to time, that industrial activity slacked off. With the upsurge of research, however, industries compete constantly to create new needs, expand their markets, and increase production.

The emergence of color television is a timely example. In 1960, when industry sales of consumer durables eased off and black-and-white TV dropped 7 per cent, color television showed the sharpest rise of any major consumer product on the market – up 30 per cent over 1959. Scarcely six years away from the test tubes, color television achieved the status of a more than $100 million-a-year business.

RCA's own profit for 1960 on color receiver sales was measured in seven figures.

In addition to siring such new products, research is developing inventive offshoots of established products and thus broadening their market. Radio, for example, written off three years ago by some as a "saturated market," was reinvigorated by the devel-

opment of pocket-size transistor portables, and by 1960 the radio market had almost doubled.

High fidelity and stereophonic sound have provided similar growth injections for the phonograph and record industry. Industry-wide sales of records and tapes have increased more than 25 per cent in each of the past two years.

In today's fast moving and rapidly changing scientific and technological scene, the importance of developing new products and new services is not only basic to a company's growth, but is often indispensable to its survival. A recent survey showed that of the 100 leading brands a decade ago, only 40 retain their primacy today. Three out of four of those that lost their leadership did so because of failure to meet the competition of new products.

RESEARCH AND AUTOMATION

Research spurs economic growth in yet another way – in the creation of new processes for more efficient means of production. The pre-eminent example is automation.

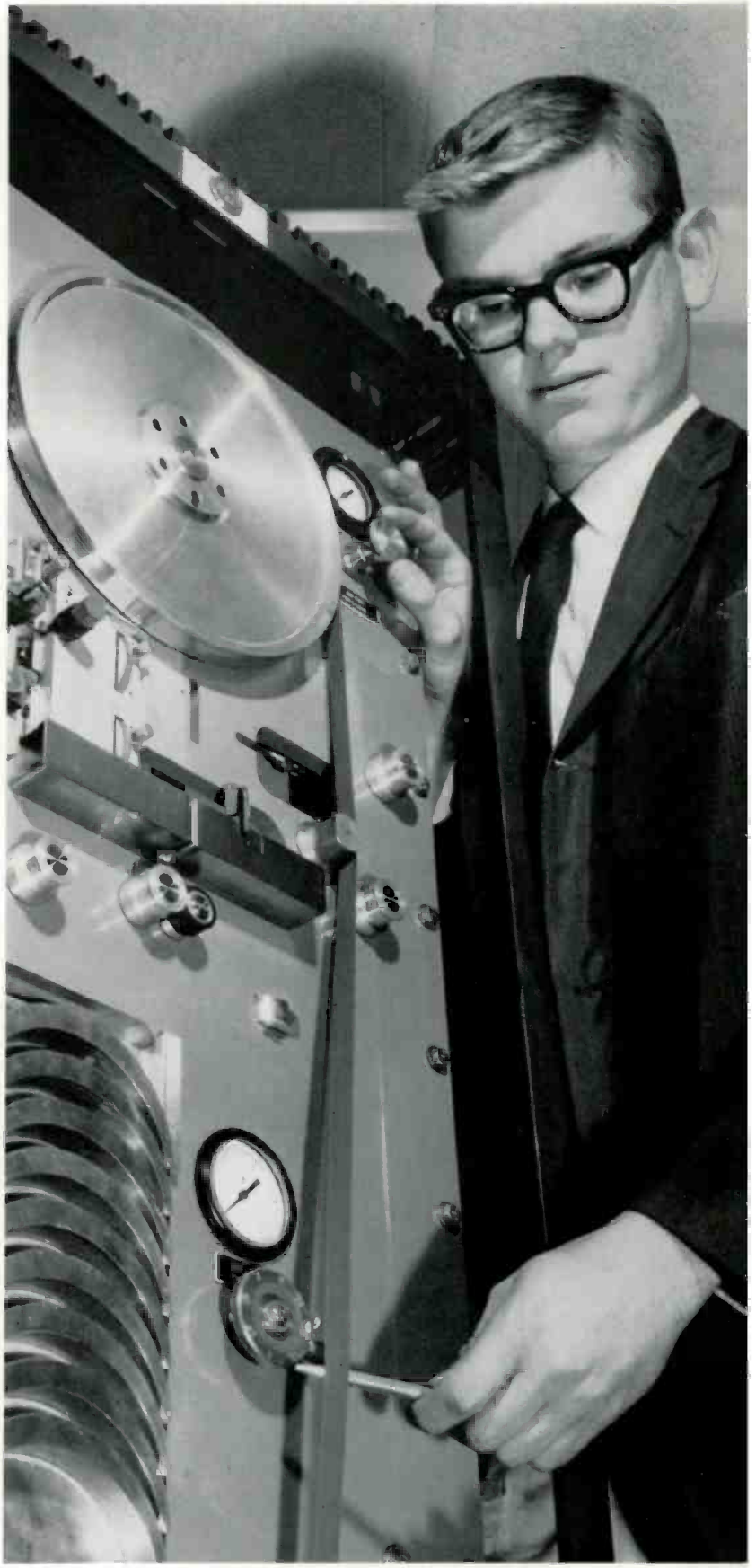
In business offices, 1960 saw electronic computers gain adult acceptance in the battle to curtail mounting paper work, to speed the collection and analysis of critical information, and to make easier and more efficient the pivotal processes of management decision.

The extent of that acceptance is mirrored in the range of companies now using or planning to use RCA computers: banks, utilities, insurance companies, industrial corporations, food chains, civilian government agencies and all three branches of the Armed Forces.

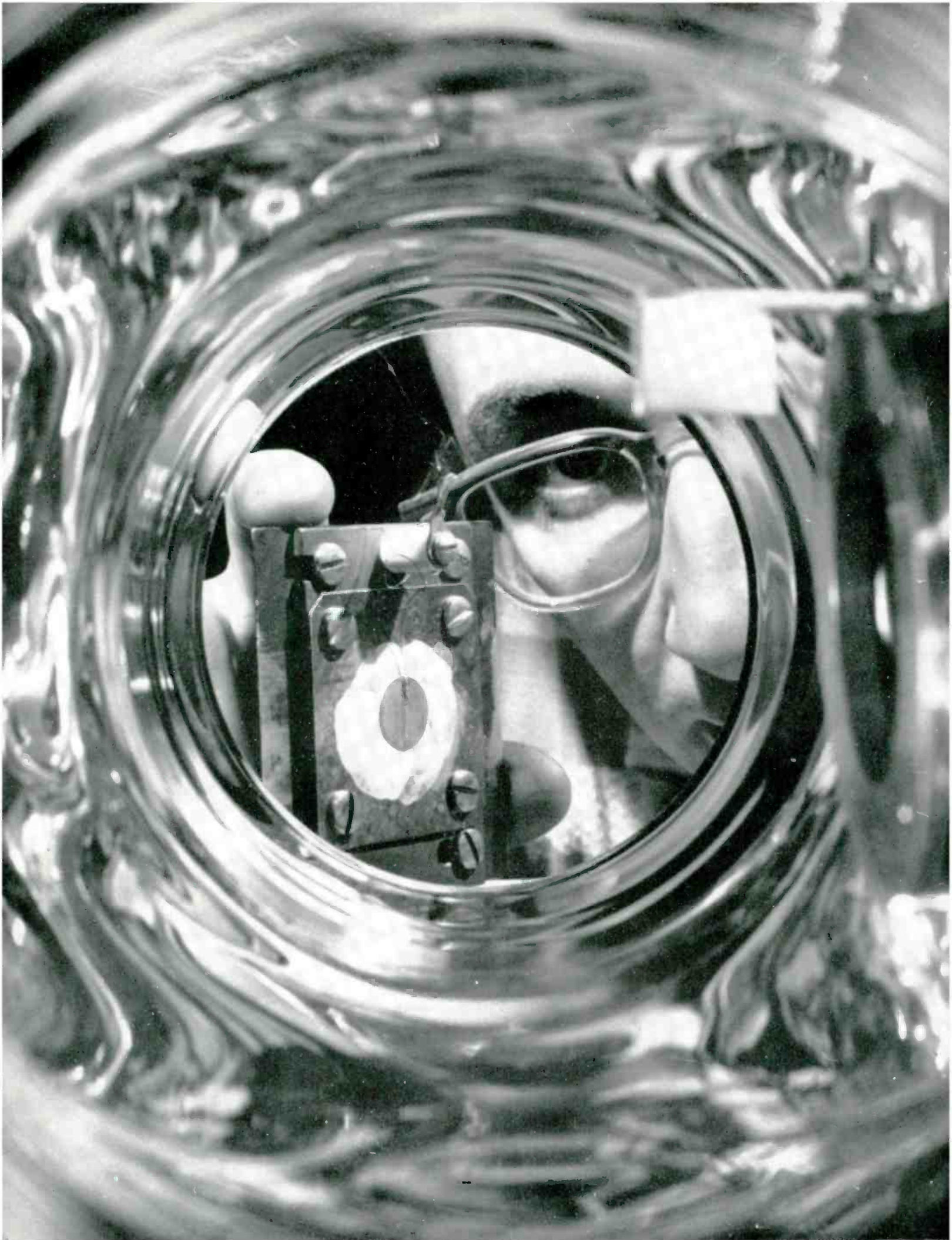
The potentialities of the computer for forecasting – in business and elsewhere – were dramatized on Election Night over NBC. With less than 5 per cent of the vote tallied at 8:23 p.m., the RCA 501 computer estimated the percentages for each Presidential candidate within approximately one per cent of the final two-party popular vote. Less than a month after the election, RCA was using these new computer techniques to forecast its own television receiver sales for 1961.

Designed originally as tools of research, computers continue to draw on the fruits of research. Improvements in basic circuitry are making them smaller, more specialized, speedier. Advances in programming techniques, notably the development of the RCA COBOL (Common Business Oriented Language) Narrator, have cut in half the time required to instruct the computer to do a specific job.

As automation techniques in factory and office continue their research-based advance, they will increasingly stimulate our national productivity and our



A developmental High Speed Tape Loop for gathering and recording data in military systems is put through a test.



capacity to deal with intensified foreign competition.

RESEARCH AND THE PRODUCT CYCLE

There is an inevitable time gap between research and product introduction. The full impact of 1960's achievements, and those of even earlier years, will come later.

The explosive expansion of research was not ignited until the mid-1950's. Half of the $85 billion spent on research and development in the United States since Pearl Harbor has been spent in just the last four years.

The normal laboratory-to-market place cycle is about seven years, so we can reasonably look for new developments to become a dominant factor in the mid-Sixties. The flow of new products and processes will accelerate sharply, just as research itself has accelerated. There will be heavy capital investment for "tooling up" in many industries – not more of the old, but of new and revolutionary kinds of equipment, much of it electronic.

The automobile industry, as a result of today's research, is moving toward a truly automated mass-production factory – with automatic machining, assembly and testing all controlled by electronic computers. The steel industry is counting on continuous automated casting as the base for its ambitious growth program in the Sixties.

Research, in its simplified definition, is the distance between the problem and the answer. The challenge facing us all is to continue to reduce that distance.

RESEARCH AND RCA

During 1960, RCA invested more money than ever before in developmental work, for the product thrusts of the future. Again, in 1961, we plan to invest heavily because we believe this is the only way we can continue to move along the crest of industry leadership.

As one whose professional life spans that of this industry, I can testify that research and product pioneering account, in primary measure, for the growth of RCA from $1 million to approximately $1½ billion a year. And I believe that the products of research – those in being now and those yet to come – will double RCA's sales volume before the 60's end.

In the past five years, RCA has applied substantial resources to the areas of color television, semiconductors and computers – all the latest products of electronics. These investments have strengthened our base for increased profits in the near future. Furthermore, bringing these new developments to the market place has enabled us not only to maintain but to increase employment in our organization.

I agree with Dr. Harrison Brown of the California Institute of Technology that "never before in history has society changed as rapidly as it is changing today." The nearest parallel in speed of change, he writes, "occurred about 7,000 years ago when our primitive food-gathering ancestors learned that they could cultivate plants and domesticate animals."

The advances coming in every sector of science – and especially in the young science of electronics – presage a new era of discovery that can give an unprecedented lift to the economy of the United States.

I am confident that RCA will make more product innovations and more scientific contributions in the decade ahead than at any time in its history.

I firmly believe that the prospects for the future are as vast as the reach of man's inquiring mind and his creative imagination. ■

Innovations in stereo phonographs reinforced RCA's position as a leader in styling and engineering of consumer products.

An experimental solar cell which can operate even under intense atomic radiation is placed in the chamber of a Van de Graaff particle accelerator for testing at RCA Laboratories.

THE PEACOCK GLOWS AT MIDNIGHT

By **BARBARA ZERRIEN**

"TAKE OUT DIMMER 11, patch 18 . . . that's fine, Bill, fine. No, wait a minute, you'd better take up 10; we want to get a lot of green out of that backdrop. This show's in color now, y'know." In one corner, two prop men argue about the placement of ashtrays. A voice booms from the control room: "Quiet, please, we're ready to roll on the 'intro' lines. Six . . . five . . . four . . . three . . . two . . . one . . ." Announcer Hugh Downs bends to the microphone to tape the words that will signal another appearance of the man whose show attracts some 30,000,000 different viewers a month — "And now, in living color, here's Jack!"

This scene has been reenacted regularly since September when "The Jack Paar Show" joined NBC's 30-hours-a-week color schedule. The shift to color raised a lot of old problems of costuming, sets and makeup, and brought to the fore some novel solutions.

As Norman Grant, NBC's Director of Color Coordination, explained: "This was a unique situation. For the first time, thanks to a new color camera tube, there was no need for extra lighting or air conditioning. Previously, the additional lights necessary for color-casts created a formidable heat problem. But for the Paar show, we needed only three new cameras and some new gear in the control room. Thus, the new tube saved us $100,000 and eliminated lots of planning

Color has added an exciting dimension to the zany happenings that take place each week night on "The Jack Paar Show"

"I kid you not!"

and work. The fact that we could stay in the same studio and not boost the electric power requirement was instrumental in our decision."

However, many phases of technical production have become more complex now that the show is colorcast. Backdrops, for example, are no longer a simple matter.

"In black-and-white," Mr. Grant explained, "it was possible to use gray or black backgrounds and white lights. In color, the scenery must be designed with as much care as that in a Broadway play. Colored lights are used to emphasize the backdrops and to create special effects that were never possible before, such as marking the passage of time from day to night visually rather than verbally."

It is little wonder that production numbers are bigger and more polished or that technicians in the control room call themselves "electronic Rembrandts."

Clothing, always a problem, is especially so on as impromptu a program as "The Jack Paar Show." The production staff has control over the apparel of the regular entertainers, but, in the case of guests, about all they can do is hope. Staff members recall with dismay a show taped in Nassau when Paar appeared wearing a red jacket, Peggy Cass dressed in shocking pink, Hermione Gingold sporting an orange print and Phyllis Diller clashing beautifully in fuchsia.

It's not feasible to keep complete auxiliary wardrobes on hand for such occasions, but an emergency supply of gray shirts is available for the men. Gray comes out white on the color screen, whereas the standard television blue is picked up as more blue than ever. A booklet of suggestions helps guests "appear your very best in living color." Sample advice to the women: "Wear clothes in the medium color range. Do not wear white, light pink or light yellow as it draws attention away from your face. Avoid very dark colors as they will appear black. If selecting between a light and a darker dress, choose the darker one."

There is no lack of cooperation with these directives of the color coordinators. In fact, during the first week of colorcasts, even the regulars were so fascinated at seeing themselves in color that they couldn't take their eyes off the monitors. Paar himself blossomed out in new sports jackets, vests and matching handkerchiefs. Peggy Cass lightened her hair, and all the women used the excuse to buy new dresses.

Producing the show has always been as casual as the program itself, and color hasn't changed that situation. Writers submit ideas or gimmicks to be used or not, depending on how things go. Anything like a formal script is frowned upon except for music and commercials. Guests are selected in an equally casual manner. Viewers suggest personalities who interest them; Jack or one of the staff sometimes hears of somebody who seems to fit into the show; or, often, celebrities call in themselves and ask to be on the program.

The free-wheeling atmosphere created by this casual approach has never bothered dyed-in-the-wool Paar fans. In fact, they feel that it lends a touch of reality and viewers tend to look upon the cast as personal friends. When they spot Paar or his associates on the street, their greeting invariably is, "Hi, Jack!" or "Hello there, Hugh," or "How are you, Hermione?"

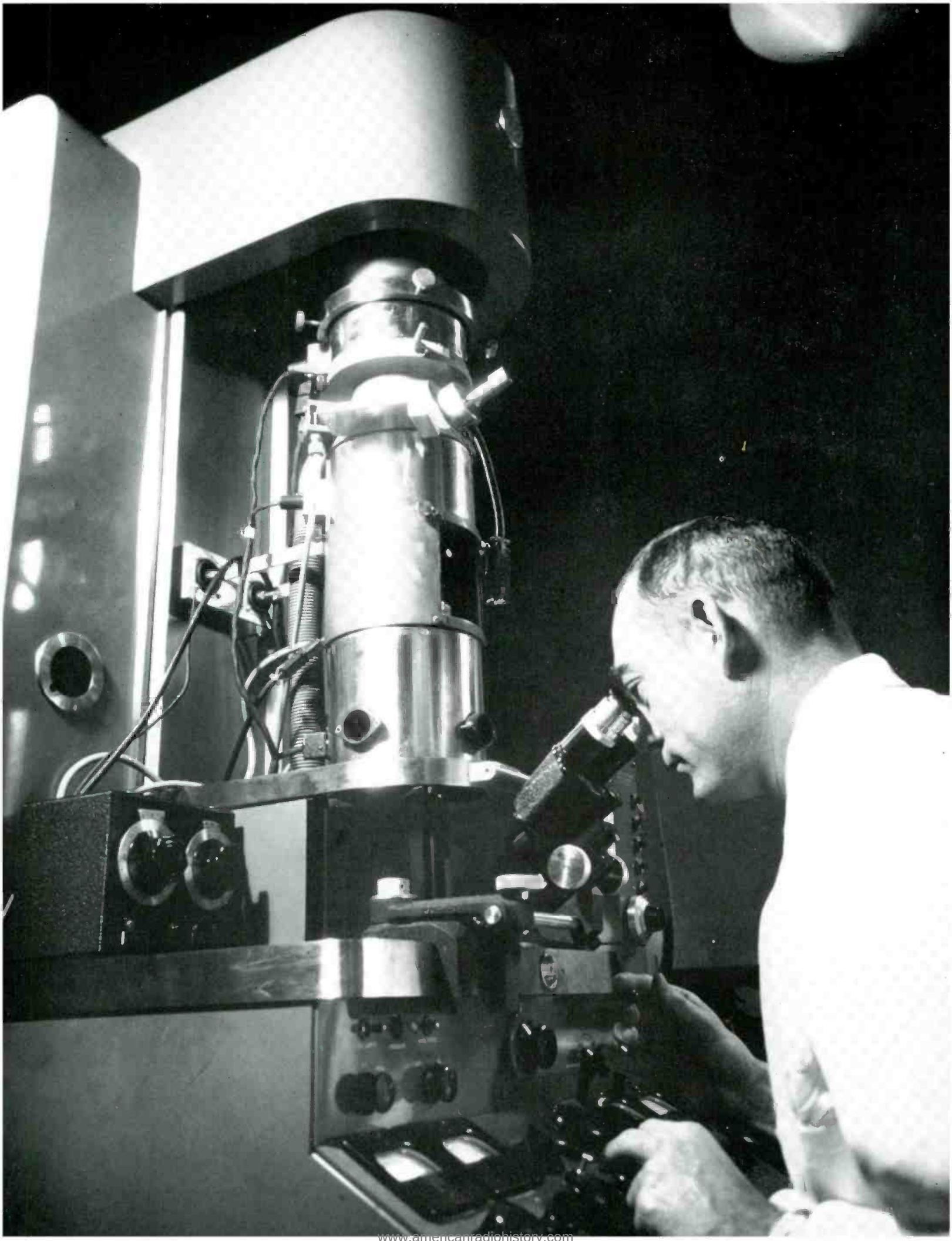
Such familiarity can breed embarrassment as Peggy Cass discovered when she tried to charge a purchase in a New York department store. Peggy is married to Carl Fisher, business manager of a Broadway production company, but on the show he's referred to as "Herbie." When Peggy signed the charge slip "Mrs. Carl Fisher," she was immediately challenged.

"I watch the show every night," protested the sales clerk, "and I know your husband's name is Herbie."

Only when the floor manager finally intervened would the clerk believe that Peggy wasn't trying to "get away with something."

Such evidence of the loyalty of Paar viewers is found everywhere. Virtually every state has been represented in the studio audience at one time or another. Some fans write as far as three months in advance for one of the 250 tickets available each show.

The story is told that an enterprising storekeeper in the Radio City area actually worked out an elaborate scheme to sell the free tickets for $5 apiece to tourists. The show is so popular, though, that the plan never got off the ground. He couldn't get tickets himself! ■



VIRUS-HUNTER EXTRAORDINARY

The electron microscope is playing a leading role in man's effort to understand and control viral diseases

By JULES KOSLOW

IF THE STATISTICAL pattern holds, during any one week of this winter some three to four million Americans will be sick in bed. More than twice this number will feel ill, but will manage to drag themselves listlessly to their jobs. At least two out of three of these normally healthy Americans will be suffering from respiratory infections such as influenza, grippe, and the common cold. In almost all cases, the causative agent of these ailments will be the same – a virus.

In addition to the misery suffered by this huge number of sniffler-sneezers and sweater-shiverers, the material damage resulting from these virus-induced ailments is staggering. It has been estimated that in the United States in any one year there are 550,000,000 cases of the common cold alone, causing industry to lose 150,000,000 workdays and employees $2,000,000,000 in wages. Production losses and medical and drug costs account for $3,000,000,000. Total cost of the annual common-cold binge – an estimated $5,000,000,000.

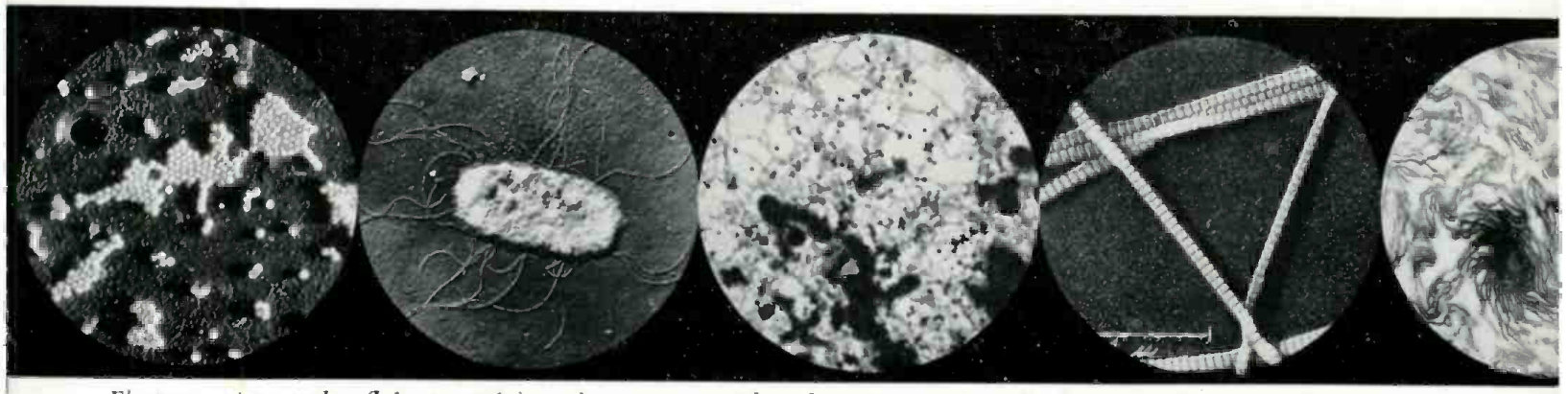
Viruses cause many more ailments than the ones already noted – ailments that include common measles, German measles, mumps, chickenpox and shingles (caused by the same virus), virus meningitis, virus encephalitis, virus pneumonia, rabies, yellow fever, poliomyelitis, and possibly, cancer.

By adding up the annual number of cases of these diseases, it becomes readily understandable why the tiny but hardy virus has been accused of causing "more sickness than any other class of parasites on earth." It is readily understandable, too, why one of the big pushes in present-day medical-research laboratories has been the identification, prevention, and cure of viral diseases.

Of immeasurable aid to the virus hunter has been the large arsenal of scientific instruments. One of the most significant – and one that is relatively little-known to the general public – is the electron microscope, which is capable of penetrating the hitherto mysterious world of the virus.

With it, scientists are able to see this tiniest of worlds, which had remained hidden from view even with the most advanced light microscopes. For the powerful electron microscope allows the scientist to make out individual particles as close together as 1/20,000,000 of an inch and magnifies them up to 200,000 times.

In other words, the electron microscope is able to magnify objects to such an extent that if one could see them in their entirety, a blood corpuscle would be the size of a four-foot sofa pillow, a dime would be



Electron micrographs (left to right): polio virus particles; bacteria; tumor cell; human collagen; snail sperm.

The unprecedented magnifications made possible by the electron microscope are important in cancer research.

more than two miles in diameter, a human hair would be twice as large as a giant California Redwood, and an ant would be a monster big enough to span half the island of Manhattan.

"The electron microscope is proving to be one of the most important research tools of modern science. By focusing a beam of electrons on a fluorescent screen, it paints pictures of a hitherto unseen universe of cells, molecules, colloids, and crystals," says Dr. James Hillier, Vice President of RCA Laboratories, who was recently named the recipient of a 1960 Albert Lasker Award by the American Public Health Association for his major role in the development of the electron microscope.

Though the purpose of an electron microscope is basically the same as the light microscope – namely, to achieve magnification of tiny objects that are not visible to the human eye – it has little outward resemblance to it.

The seven-foot-high modern electron microscope's trim, functional lines, characterized by a sleek cylinder centered on a flanged base, have led observers to compare it to a rocket on a launching pad. The electron microscopist, seated squarely in front of the viewing screen and operating a panel of buttons and switches within arm's reach on both sides of him, has been likened by one jocular observer to a head-down, lost-with-the-muses organist searching for a lost chord.

Each week, scores of researchers in dozens of laboratories take hundreds of pictures of viruses, which are then analyzed very carefully for size, consistency, density, and structure.

One of the prerequisites in achieving a satisfactory picture is the all-important preparation of the specimen. Among other things, the specimen must be unbelievably thin. A special machine, the ultra-thin sectioning microtome, had to be devised by scientists and engineers to cut slices from cells and other specimens. These slices are only 1/500,000 of an inch thick.

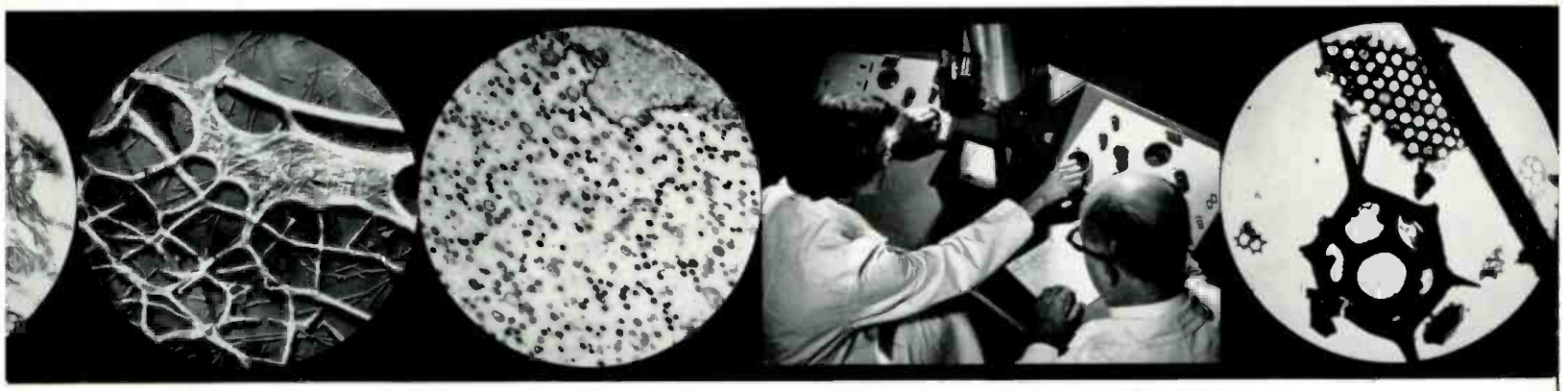
Once the specimen is properly prepared and mounted by the microscopist, it must be enlarged and focused on the viewing screen so that a picture can be made on a photographic plate.

The operation of the electron microscope – briefly and oversimplified – is as follows: A tungsten filament is at the top of a cylinder that is pumped to a high vacuum. When heated, the filament emits electrons that are accelerated to almost the speed of light. A series of magnets, which act as lenses, control the downward course of the electron beam. As the beam passes through the specimen, it is enlarged and focused on the viewing screen and photographic plate.

Complex? Perhaps. Possibly more complex are the many parts that must be assembled with a master watchmaker's skill and precision.

For instance, after twenty years of improvement and refinement to assure greater reliability and further simplicity of operation, the electron microscope manufactured by RCA (a pioneer in the scientific development and commercial production of the microscope and now its largest producer) contains almost 7,000 separate parts, 80 miles of wiring, and a variety of heat- and wear-resistant precious stones and metals. Some 3,000 blueprints guide its construction.

In the experimental stages of the electron microscope, the number of intricate parts and still-unresolved problems attending its development caused many a heartache. For instance, in 1937, Hillier, who was then a graduate student at the University of Toronto, was constructing an electron microscope as his Ph.D. project. At that time, there were little more than theoretical indications that an electron microscope could surpass a light microscope in resolution. He and a fellow-student used make-do equipment in assembling an odd-looking array of high-powered transformers, batteries, coils, and pumps for their



Electron micrographs (left to right): tobacco plant virus; mouse cancer virus; diatom (algae) fragments.

experiment. Using 50,000 volts of electricity, they teetered several times on the brink of success only to be forestalled by a blown fuse or a failure in some part of their improvised equipment. Their pioneering efforts were ultimately rewarded when they succeeded in taking a picture of a particle of carbon black magnified 40,000 times – about twenty times greater than the limits of a light microscope. This was the first successful work with a high-resolving-power electron microscope in the Western Hemisphere.

Three years later, in 1940, Dr. Vladimir K. Zworykin, the leading figure in the development of the electron microscope in the United States, brought Hillier, then 24, to the RCA Laboratories in Camden, New Jersey. With Arthur W. Vance, an electrical engineer, they produced in less than a year a new, safe, and practical electron microscope that could enlarge specimens up to 100,000 times.

The indispensability of this super microscope is nowhere more evident than in the virologist's laboratories, even though it is used extensively and most profitably in a score of industries.

Of the approximately 1,200 electron microscopes in the United States today (there are more than 2,000 throughout the world), 60 to 70 per cent are estimated to be in use in the life sciences. Of these, about 10 per cent are used almost exclusively in virology.

As one virologist recently commented: "In our search for viruses – those tough, stubborn, volatile, tricky little beasts – we'd be hamstrung without it."

The virologist's somewhat affectionate characterization of viruses was occasioned by their unusual makeup and complicated actions. For viruses are basically an extremely small bundle of chemical units that exist in the shadow world between the living and the nonliving. They cannot reproduce outside of a cell, but only with the help of the living cells that are both their hosts and their victims.

Though the existence of viruses was suspected for some time, the first purification of a virus in crystalline form was in 1935. Since then, some 300 viruses have been discovered. Today, partly because of new techniques, viruses are being found faster than scientists can digest the new information.

High on the list of these new techniques in many aspects of virus hunting have been improved methods of specimen preparation and the further improvement of the electron microscope with regard to reliability, flexibility, and simplicity of operation.

Today, with the development and improvement of many kinds of scientific instruments, the problem is not primarily technical, but interpretive. For example, the electron microscope allows the scientist to see objects he previously could not, but it remains for man's inspiration, imagination, and experience to understand all the ramifications of *what* he sees.

The very nature of the virus has made the researcher's task a most difficult one, but the successes have been most significant. The best known is the research battle against the polio virus culminating in the successful development of the anti-polio vaccine.

During recent years, the electron microscope has performed yeoman service in virus-hunting endeavors that range from the discovery and analysis of the tobacco-mosaic virus, the first classic study of a virus, to the influenza virus and the Coxsackie viruses (named after a town in New York state where they were first found). The latter viruses may cause inflammation of the muscular part of the heart wall and have caused the death of a number of children.

Today, the electron microscope, which helps researchers in revealing new structures of cells and enables them to investigate and compare the detailed structures of normal and cancerous cells, is being used widely in the dramatic struggle being waged by medical researchers to conquer the mass-killer cancer, which annually takes the lives of 250,000 Americans.

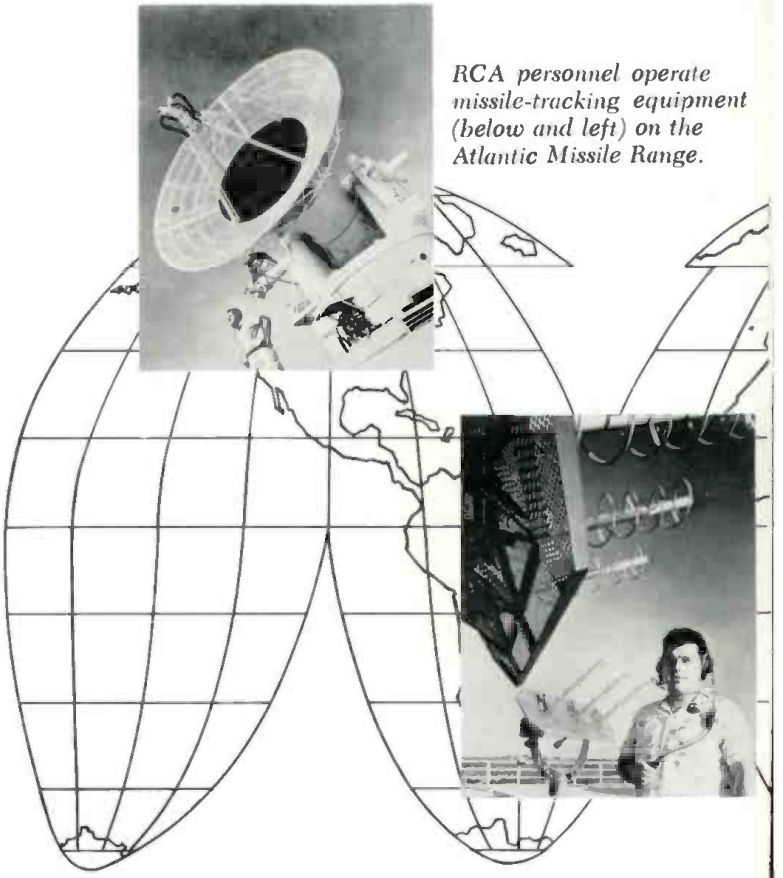
Only a few months ago added impetus was provided in the fight against cancer. This was a hope-giving report by the Sloan-Kettering Institute for Cancer Research which announced that "a virus has been linked with eight human cancers. The virus was isolated from transplanted tumors of the mouth, muscle, ovary, and other tissues, and from the noncancerous livers and spleens of cancer patients . . . The new report adds considerable weight to the growing speculation that a wide range of human cancers may be virus-caused."

Of less immediate concern to the layman but of pulse-throbbing interest to the scientist is the experimental work now being done with the aid of the electron microscope and other scientific instruments on nucleic acid. This is a complex chemical that exists in all cells. Nucleic acid controls the cell's growth and has a bearing on, among other things, heredity. A virus, too, contains nucleic acid. Once it enters the cell, a virus has a direct effect on the life and death of its host. Scientists speculate that by understanding the composition and actions of nucleic acid a key may be found to the secret of life itself.

Thus the time may not be too distant when the accumulated knowledge of the ages, man's restless imagination, and science and engineering's ability to supply vital tools such as the electron microscope may yet add up to a future in which mankind will be not only relatively free from disease but will be further enlightened by a fundamental understanding of existence. ■

Johnny on the Spot

Round the globe, round the clock, civilian service technicians help G.I.'s keep intricate defense gear in top working order



RCA personnel operate missile-tracking equipment (below and left) on the Atlantic Missile Range.

DEEP IN THE INTERIOR of Alaska, parka-clad men battle 100-mile-an-hour winds, swirling snow and 70 degree-below-zero cold to keep the "White Alice" communications network in full operation.

Off the exotic Black Sea coast of eastern Turkey, a technician advises American naval personnel on electronic countermeasures as a Soviet destroyer doggedly trails an American ship on a training cruise.

On islands in the Caribbean, sun-bronzed men manipulate delicate equipment receiving data from test missiles fired from Cape Canaveral.

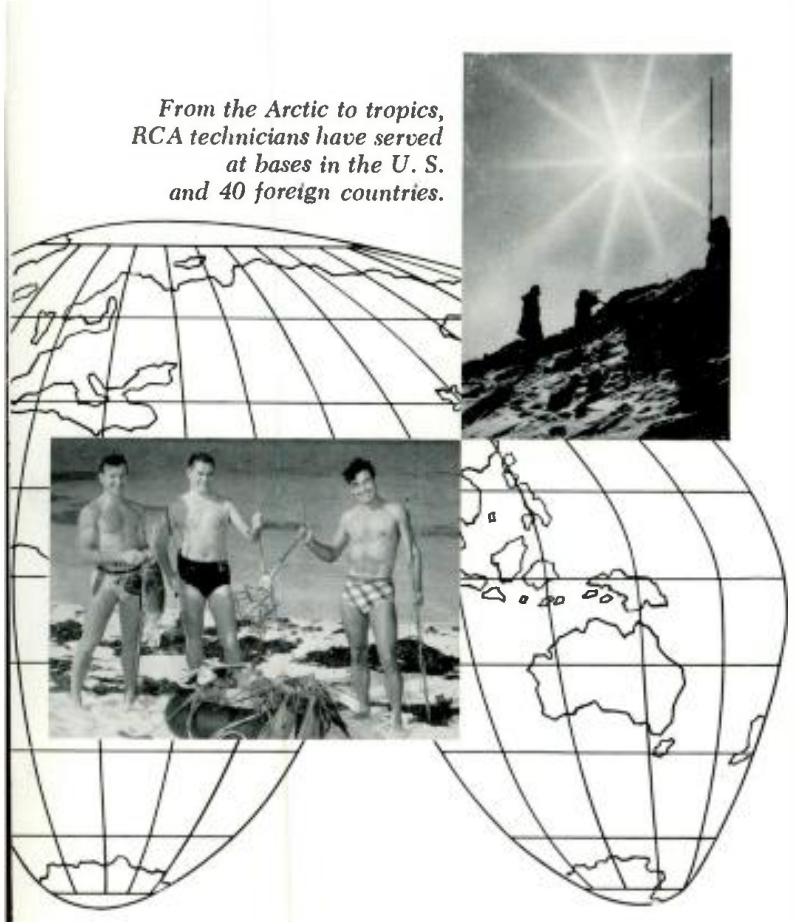
All these men have something in common. All are electronics field engineers and technicians for the Government Services Division of the RCA Service Company, a division of the Radio Corporation of America. Their job takes them to the far corners of the earth, wherever the United States and its allies have need of them. Their job: to assist the armed forces in installing, maintaining, operating and teaching others to use the electronic equipment increasingly relied upon for the Free World's defense.

The growing importance of electronics in military systems is strikingly illustrated by a few examples. At least 25 per cent of the cost of a modern jet fighter plane is for electronics, compared with less than 10 per cent a few years ago. As much as 35 per cent of the cost of some missile-firing ships is for electronics, while nearly 50 per cent of the cost of a missile is in its electronic systems and components. In dollars and cents, the estimated $4.7 billion spent on military purchases of electronic products during 1959 was more than nine times the amount spent on military electronic purchases in 1950.

The Government Services Division was organized by the RCA Service Company in 1950 to handle the mushrooming demands from Government agencies for field engineering assistance and services from defense contractors. The Division has grown with the steady demand for increased field service until today it includes almost 9,000 men and women – scientists, field engineers, technicians and specialists – who work with

Government agencies and military organizations of the United States and 40 other nations.

A partial list of the Division's activities includes providing skilled engineers and technicians for construction and operation of the Ballistic Missile Early Warning System sites in Greenland and Alaska; operation of the Air Force Alaskan Long Lines Communications System known as "White Alice"; operation and maintenance of the missile tracking, safety and communications systems of the Atlantic Missile Range; manning the Down-Range Anti-Missile Measurement Program (DAMP) ship in the South Atlantic; and field engineering and service around the world for the Army, Navy and Air Force as well as some civilian Government agencies.



From the Arctic to tropics, RCA technicians have served at bases in the U. S. and 40 foreign countries.

"It takes a rare breed of man for this kind of work," says Charles L. Basney, Manager, Air Force Services. He must be ready and willing to move fast as well as being intelligent, skilled, and experienced.

Basney cited the example of RCA Field Engineer Walt Patterson, winner of an Air Force Scroll of Appreciation—the service's highest award to a civilian.

Walt received a call in the middle of the night at his home near Bergstrom Air Force Base, Texas, and reported to the base. The next his wife heard from him, he was in Formosa.

The Air Force awarded him its Scroll for his round-the-clock work in modifying some electronic equipment on Voodoo jet fighters to get them ready for combat in the event of a Red Chinese attack.

Another typical example of field engineers on the move is Paul Katz. Paul joined the Government Services Division in 1954 and was assigned to the Subic Point Communications Project in the Philippines. Next, he served as a technical advisor to the Korean Army Training Command, then as a radar engineer in Japan, followed by a stint as a telecommunications engineer in a Middle East nation. Reassigned to the United States, Paul first served as an RCA liaison engineer to the U. S. Air Force on airborne fire control. Now he is assigned as an RCA Service Company field engineer to assist Bell Laboratories on a classified project.

The average field engineer is 34 years old and married, and has served two years in the Armed Forces in an electronics capacity. He possesses a minimum of two years' specialized technical training, plus another four and one-half years of civilian and industrial electronics experience. Nearly half of the men have college degrees, while the remainder have the equivalent in the form of specialized training and experience.

Indicative of the highly sensitive work many field engineers perform is the fact that, until recently, few people—even at the Government Services Division headquarters at Cherry Hill, New Jersey—knew RCA Service Company engineers are assigned to security services at the base of Peshawar, Pakistan, where the ill-fated U-2 flight began last May 1.

Few field engineers have to search far for adventure in their work—whether it involves being snowbound for days on end at an isolated radar site in Montana, or fishing for sharks in off-duty hours in tropical waters. Moreover, there's no such thing as "office hours." Engineers and technicians on the DAMP ship have spent 36 hours at a stretch at their duty stations, waiting to track a missile.

Even so, few field engineers refuse assignments without compelling reasons. For, as Basney observed:

"Our men knew what it would be like. So now when an assignment comes through they merely ask if there's time to pick up a clean shirt, or to say goodbye to the wife." ■

TOPS

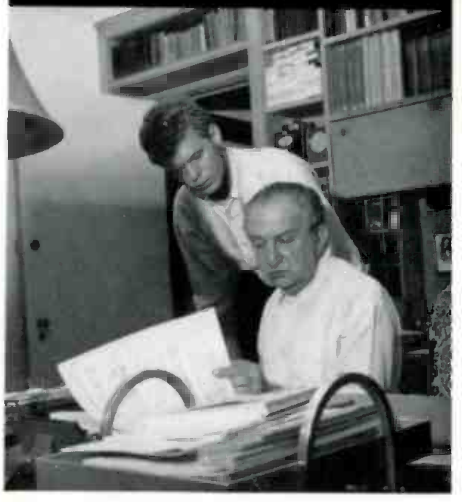
Each month record companies release an average of 330 new long-playing records, bringing the most diversified entertainment to the industry's most varied public.

More than 100,000,000 copies of these records are sold during the year, grossing over $325 million.

Of these new releases, only about 2 per cent sell enough copies to boost them, at any time during the year, into the "Top Fifty" list – the industry's measure of a "hit."

During 1960, RCA Victor had a significant share of that 2 per cent as evidenced by the sampling on these pages. Never fewer than seven of the top ten classical albums and many of the strongest hit albums in other categories carried the RCA Victor label.

ELVIS PRESLEY: Since his return from Army service, he has cut two albums and three singles; one– "Are You Lonesome Tonight?"– sold 1,000,000 copies in 12 days.

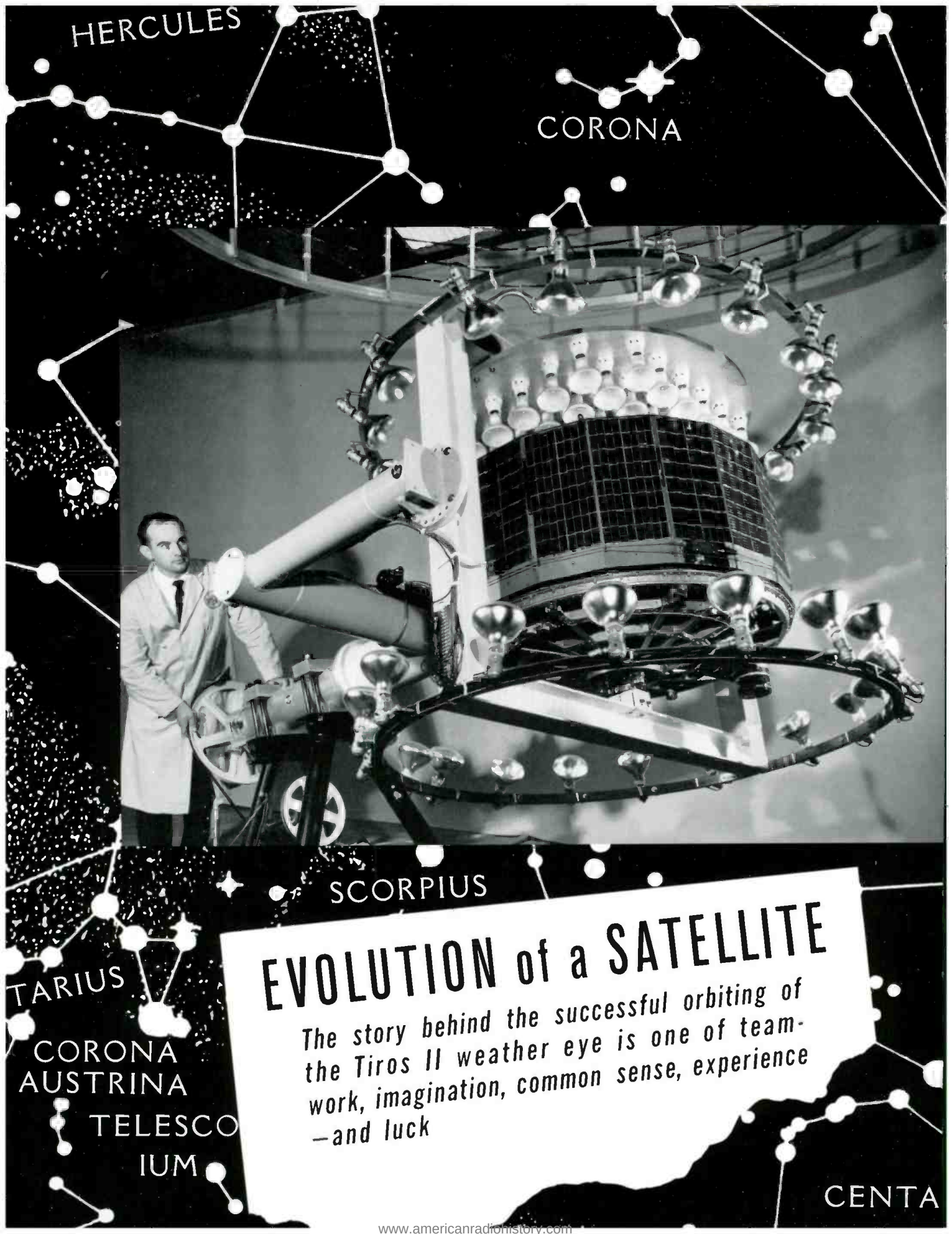


VAN CLIBURN: The success of his "Tchaikovsky Piano Concerto," his "Rachmaninoff Third Concerto" and his "Schumann Piano Concerto" marked the first time that a classical artist has had three best-selling LP's on the lists at the same time.

DAVE GARDNER: His off-beat Southern humor made a hit with record fans who are showing increased interest in new comedians.

HARRY BELAFONTE: "Belafonte Returns to Carnegie Hall" follows his first recording there, which hit the top of the chart in two weeks.

DELLA REESE: One of America's great song stylists, her first RCA Victor record, "Don't You Know?" sold 1,000,000 copies. She ranks among the nation's top pop singers.



EVOLUTION of a SATELLITE

The story behind the successful orbiting of the Tiros II weather eye is one of team-work, imagination, common sense, experience —and luck

By KENYON KILBON

IN THE GRAY DAWN of November 23, 1960, a graceful white Thor Delta rocket lifted its 88-foot length thunderously from a concrete slab at Cape Canaveral, Florida, and arched purposefully out over the Atlantic.

Sealed within a streamlined fairing at the rocket's elongated nose was a drum-shaped package of television cameras, TV tape recorders, infrared sensors, control devices, and transmitters, ingeniously linked in a system known as Tiros II, the nation's second and most advanced weather observation satellite.

Fourteen minutes later, 435 miles above the North Atlantic, the 280-pound Tiros was freed from its protective fairing and pushed into orbit at more than 16,800 miles an hour by a powerful third-stage rocket. Within 100 minutes, the satellite passed over the east coast of the United States to complete its first trip around the world, transmitting to the ground televised pictures of cloud formations and measurements of heat levels in the earth's atmosphere — new data to aid weather scientists in drafting accurate forecasts of tomorrow's weather.

MOMENTS OF TRUTH

To the world at large, Tiros II and its equally illustrious predecessor Tiros I — launched last April 1 — leaped full-blown from the sands of Cape Canaveral to achieve resounding success in a matter of minutes, ably assisted by a fine rocket vehicle and a remarkable guidance system. But a somewhat different view occurred each time to a large body of engineering specialists standing by in oddly-mingled confidence and hope, awaiting the achievement of orbit and the first successful returns from the Tiros satellites. For these men, many of them engineers of RCA's Astro-Electronics Division in Princeton, New Jersey, the launchings were moments of truth — the climax of months and years spent in the development of the two satellites and their associated ground systems of communication, computing and control.

"Every big electronic system calls for a heavy dose of imagination, perspiration, and faith, along with good solid engineering," says Sidney Sternberg, Chief Engineer, RCA Astro-Electronics Division. "When the system is to be thrown out into space, you will find all of these ingredients present in concentrated form, along with a certain finality that has no counterpart in work on systems which will stay within our reach on the ground."

"With a space mission, you know that every piece in the system is going to encounter more stress and shock in a few minutes of launching than most ground systems face during years of operation. You know, too, that the space environment will expose your handiwork to greater extremes of temperature, vacuum and radiation than anything normally found on earth. Then, when you mount the package on the rocket and seal it up, you've had your very last look at it. If any one of the 20,000 or more parts gives out — even a conventional transistor — no service man is going to be around to slip in a replacement."

Viewed in this light, the Tiros satellites are classic examples of space technology at its present-day best. And, in classic fashion, their course from inception to completion was liberally strewn with headaches, brainstorms, frustrations, compromises, triumphs — and a degree of plain good luck.

ANCIENT BEGINNINGS

In the chronology of the Space Age, the Tiros story has truly ancient beginnings. Says Barton Kreuzer, Division Vice President and General Manager of the Astro-Electronics Division:

"We started off with a study of television satellite techniques for the Government back in 1951 — an era when, if anybody happened to mention a satellite in ordinary conversation, he was probably talking about one of the Eastern European Communist countries.

"That early work led eventually to contracts for development of hardware by the RCA engineering groups. Through much of the 1950's, the matters of jurisdiction and objectives in the nation's space program remained rather fluid. It was mid-1958 before a get-together among Government, university, and RCA people finally focused the program on a meteorological satellite and produced the specific mission requirements that made it possible to go ahead with the Tiros system."

In the meantime, the RCA engineering staff had gained priceless experience in developing techniques for meeting the new requirements of space flight, including construction of a prototype 20-pound television satellite. By early 1958, however, advances in missile technology had made it possible to proceed with development of a larger and heavier satellite — the one which ultimately took form as Tiros.

A PRESCRIPTION TO FILL

Translating a set of mission requirements into an operating satellite system is unquestionably near the top of the list of major technical challenges of our time. In the case of Tiros, this is how it appeared to Edwin A. Goldberg, who shared with Vernon D. Landon the engineering management of the Tiros project for RCA through the successful launching of the initial model:

"We had a nice clear prescription to fill — a system that would look at cloud formations, photograph them, store the pictures, and transmit them to the

ground on command. We had a lot of good ideas for doing the job. But it's still a little frightening to contemplate in one sitting all of the detailed technical and operating requirements that had to be met.

"To consider just one aspect, we had to work within weight and size limits set by the launching rocket, which permitted us a package of 270 pounds on the first shot. Into this total we had to design two TV systems including cameras, tape recorders and transmitters; controls programming their operation; tracking and telemetry equipment; power supplies, and dynamic control devices for the desired spin and attitude. There's nothing basically strange to us about any of these techniques – but getting them all into a 270-pound package is perhaps a little like the initial job of tailoring a nuclear reactor to fit into the 'Nautilus'."

Ingenious engineering designed and produced the components to fit the package – items such as rugged little television cameras weighing only 4½ pounds, for taking still pictures as Tiros circled the earth, and 12½-pound video tape recorders for storing up to 32 pictures from each camera during each orbit. At the same time, other groups of Astro-Electronics Division engineers worked out the complex ground station equipment needed to communicate with the satellite, sending its operating instructions aloft, and receiving back the pictures and other information.

THE BRUTAL ENVIRONMENT

The knottiest problems arose, however, in blending the components in a system capable of reliable operation in the brutal environment of space where, as one of the RCA engineers points out, "there are plenty of rules – but they're not ground rules."

Odd things happen in the space environment. Ordinary lubricants evaporate, for example, in the high vacuum hundreds of miles above the atmosphere. Objects become weightless, meaning that a slight impetus of the wrong kind will cause them to tumble or spin almost indefinitely unless special means are devised to control their motion. The absence of any atmosphere to level off extremes of temperature results in great heat on surfaces facing the sun, and extreme cold on those in the shade.

"It's not what you'd call a paradise for machines or men," says Abraham Schnapf, who was RCA's Project Manager for Tiros II. "And not only that – but the equipment can't even get out there without taking almost as much of a beating as if it had been shot from a cannon."

For this reason, much of the critical development work called for special test equipment and methods to simulate the shock and stress of launching, and the natural forces that would work on the complete satellite system in outer space. Cameras, tape recorders, transmitters, electronic control "clocks", infrared sensors and other items were buffeted on shock and vibration machines, baked and frozen in vacuum chambers, and rechecked again and again to see whether their operation had been affected. Equipment bought from subcontractors and the infrared system developed for Tiros II by the National Aeronautics and Space Administration went through the same rigorous testing.

WEAKNESSES CORRECTED

Weak spots were brought to light. The effect of high vacuum upon lubricants was observed, and the decision was made to maintain a degree of atmospheric pressure for the moving elements in the TV tape recorders and electronic clocks by enclosing them in pressurized cases. Storage batteries, tightly sealed beyond the requirements of any earthbound application, were found to need redesigning to withstand the vacuum, temperature extremes, and radiation in space.

Engineers labored over the dynamic problems of keeping Tiros stabilized in orbit. During the final stage of its journey into orbit, the satellite and its third-stage rocket would be spinning at about 120 revolutions per minute to keep them on an even keel, and there was also a chance that Tiros might acquire a side-to-side wobble during the separation from the third stage. With the help of slide rules, computers, and special test rigs, the RCA engineers calculated the various effects. They designed a system of sliding weights inside the satellite to absorb the wobble, and "yo-yo" weights at the end of long cables to slow the spin rate to the 10-to-12 rpm needed to maintain stability without hindering picture-taking.

"You had to be careful about sticking your head into rooms around here," Goldberg recalls. "There were some spots where you stood a good chance of being flailed by flying weights. You can still see some dents in the walls."

THE FINAL STAGES

The final steps in engineering Tiros called for the same kind of testing for the complete satellite with all of its electronic contents. In a large vacuum tank at the Astro-Electronic Space Center, the whole package was carefully maneuvered into place and operated for long periods in a high vacuum, exposed at the same time to extremes of heat and cold.

"We couldn't actually trot it up to 450 miles in space to see how it worked, but the vacuum chamber gave us a pretty good approximation," says Stern-

Alignment of the wide-angle television camera for Tiros II is checked by engineers at the RCA Space Center, Princeton.

berg. "Considering that the payload by this time added up to nearly 20,000 separate pieces that had to work smoothly together, we found that amazingly few changes had to be made – and none amounted to much in the way of additional engineering."

The final stages brought a few spine-chilling adventures. To make sure that Tiros would survive its launching in good working order, NASA requested that it be subjected to a force of 30G – thirty times the force of gravity. The RCA engineers scouted through the northeastern United States and found laboratories having centrifuges large enough to hold a Tiros satellite and spin it up to 30G. On two successive tries, the satellite was whirled nearly up to the required speed when the centrifuge broke. On the first test, a flying weight from the broken machine crashed through the satellite – fortunately without causing major damage. It was repaired in three days of around-the-clock surgery by the RCA Tiros team.

"After that, NASA and we both decided that Tiros could stand the force without proving it on a machine," Goldberg recalls.

In a satellite project, the drama does not end with the shipment of the completed payload to Cape Canaveral in its vibration-proof container. There remain the tasks of wedding it to the rocket – the Douglas-built Thor has carried Tiros twice into space – and the testing of all operating parts during the final countdown.

HISTORY IS MADE

Tiros II experienced one of the most flawless countdown and launching sequences on record at the Air Force launching center at Cape Canaveral. With Tiros I, the outcome was triumphant, but the last few hours before takeoff brought complications that will remain forever fresh in the memories of those who were there.

"Just a few hours before the scheduled launch, the electronic clocks inadvertently began to operate," recalls Schnapf. "We tracked down the cause and found that a passing plane had been transmitting on a frequency very close to our command frequency. Then, a while later, the second-stage guidance system began to act strangely. This time, it turned out to be a ship off the coast operating a radar set on the same frequency. During the final hour, a lox (liquid oxygen) filling valve sprang a leak. Luckily, it was reachable. Somebody ran out to the pad and wrapped a rag around the leak, soaking it with water to seal the leak by freezing.

"The bird got off the ground with only about four minutes to spare before the cutoff time for postponing the shot – and the rest is history." ■

Business Forecasting by

Projection techniques successfully demonstrated by the RCA 501 on Election Night have immediate applications in commerce and industry

RCA 501: projecting votes or markets.

By **HAROLD QUEEN**

As THE 1960 Presidential election sped toward the final count-down last November, a television news commentator, wearily sipping a cup of coffee, was overheard to remark: "We could have gone to bed at midnight. It outsmarted us, it outpaced us and it outlasted us."

"It" was an RCA 501 electronic computer, installed in its own "Election Headquarters" in the downtown financial district of New York. At 8:23 PM, on Election Night, as the earliest returns began to trickle in, the 501 gave the nation its first definitive computer projection of the final outcome – Kennedy over Nixon by a popular vote margin of 51.1 to 48.9 per cent.

Through the night of November 8 and far into the next morning, the 501 continued its electronic pulse taking, varying by less than one per cent from its early evening forecast. Weeks later, when the last ballots had been counted, the 501's original projection differed from the final tally of election returns by the same margin of one per cent.

According to one expert who worked on the project: "It would have taken 600 men feeding data to a newscaster to accomplish the same results – provided the newscaster could have absorbed all the facts thrown at him."

"Operation Ballot" as the RCA-NBC computer exercise was titled, did more than establish electronic data processing as the most accurate instrument of election forecasting ever devised. By its extraordinary capacity to correlate instantly millions of bits of data and give meaningful direction to scattered trends, it opened wide a new era of economic forecasting for business and industry.

The techniques which enabled the RCA 501 to

Computers now guide the delivery of telephone directories in New York City from information stored on magnetic tape.

Electronics

How much will be bought next year?

What should production rates be?

What about goals for the future?

forecast the election outcome with pinpoint accuracy can also determine total sales for an entire industry over the coming year. They may guide a manufacturer in deciding which items in his line will sell best. For the long pull, comparable techniques may be utilized to establish the most feasible means for a business to achieve the highest sales and profits five to ten years in the future. The RCA 501 computer also is being employed to demonstrate public health trends, to allocate sales personnel, and to achieve the most effective deployment of working manpower and talents.

In preparing for the election, an RCA team of top-flight mathematicians, statisticians, computer and communications specialists, political analysts and others, correlated the public's voting behavior in past Presidential elections with such factors as population increases, personal income, age, education, the rate of business failures. Each of these factors was measured for its importance in determining how the public might vote. These factors were translated into computer equations and tested again and again, in different combinations.

What finally emerged was a "mathematical model" – a statistical composite of the nation's voting characteristics – balancing mathematical factors, economic and social considerations, and the hard political "facts of life."

This model was pre-tested repeatedly against earlier elections. The results proved that the forecasting formula had achieved phenomenal accuracy.

When Election Night finally came, as one member of the "Operation Ballot" team put it: "It was like using one of those ready-mix preparations to which you just add water.

"We had the full ingredients for an election forecast, in the right proportions. All that was necessary was to supply the missing item – a few key early election returns. When these came in, we were certain of the final outcome."

The same formula is available today for the vital task of business forecasting. Whether it deals with automobiles, television receivers, or electric toasters, a mathematical model fed into the computer, can project, within very few percentage points, sales for an industry over the months or years to come. For a major RCA product, in one instance, a 501 forecast for 1960, made in February last year, has proven out to within two per cent of actual month-by-month industry sales.

In the case of automobiles, for example, market researchers might feed into the machine past records of automobile sales.

To these statistics would be added such economic factors as new households, consumer personal income, market saturation and the like. Each of these would be measured for its effect on earlier purchases. They would then be tried in combination, with new factors being added and less significant ones deleted as the mathematical model took form.

To compute the smallest kind of forecasting problem for such a model would require a week of hand calculation. The 501 does it in two minutes. Problems that take the computer more than two minutes to calculate probably would never be tried by hand because of the time and lack of guarantee of success.

By doing the same job at one tenth of the cost and in one thousandth of the time, the computer makes it possible to try a variety of approaches to an

The 501 forecasts sales for a whole year in two minutes.

effective forecasting model. It would take at least six months to evaluate the same model by hand calculations, and by then, of course, the findings would have lost their utility.

For a company seeking to estimate future industry sales, the value of such timely accuracy is incalculable. With only a scattering of current sales figures to work with, it can calculate what its rate of production should be for the entire year, how large an inventory to maintain, what supplies to purchase and in what quantities. Depending upon the product, the savings and efficiencies could contribute substantially to a company's success.

The computer's functions, moreover, go beyond forecasting industry-wide sales. A manufacturer, for example, would still have no way of knowing which particular models of a product line had struck the public's fancy – in what styles, colors and quantities. Lacking such detailed current information, additional millions of dollars might be lost in producing goods that would gather dust in warehouses, ultimately to be disposed of at a loss.

As it receives detailed information on current sales, the computer can instantly assemble the data into a meaningful pattern of consumer buying habits, and project it into the months ahead. Armed with these facts, a manufacturer immediately can organize his production so that the right goods will get to the right place at the right time.

"We are straightening out the big question mark in product manufacturing," one RCA computer expert observed, "and getting it to look more like an exclamation point."

Looking far into the future, the RCA 501 computer opens equally dramatic opportunities for vast long-range projections that affect the basic operations of an entire business.

Given a set of corporate objectives to be achieved within five or ten years, the computer will relate such factors as capital expenditures, sales levels, cost of manufacturing, the period in which to achieve a profit return on the investment, administrative and other costs. With all pertinent factors built into the mathematical model, the 501 computer will present a series of alternative plans for management to choose from. Moreover, as circumstances change, the computer instantly will come up with new projections, plans and alternative choices.

This program has been in successful working operation over the past three years in RCA's own Electronic Data Processing Division. What it does is to enable a company's top management to make more effective long-range allocations of funds, establish the most efficient production and sales schedules, and assign other resources and manpower in the proper place and at the proper time. In effect, with the aid of computer techniques, management is achieving finer control over all phases of the business operation.

The RCA 501 also is being employed for manpower analysis, to eliminate overlapping and duplication of functions. Where special talents are required for a new assignment, the computer will run through thousands of job descriptions in one hour and come up with the men possessing the necessary qualifications. In another instance, the 501 has been put to work developing a sales allocation program to determine how and where sales staffs will achieve improved results for the corporation.

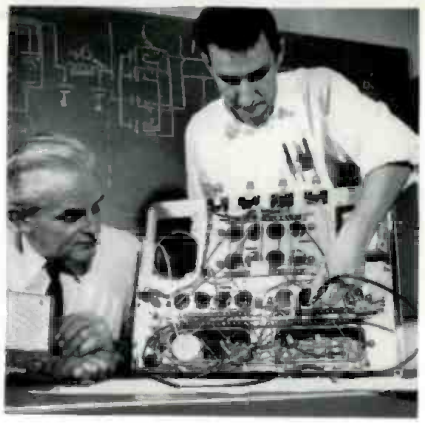
From the solution of complex equations to high-speed processing of paperwork, the electronic computer has broadened its horizons to encompass an area hitherto closed to the human mind – an accurate projection into the future.

Although, its beginnings are as yet small and limited, this exciting new dimension in electronic data processing opens wide the possibility that government and business may soon be able to plan more intelligently today for what they must do tomorrow. ■

Picture Report

RCA INSTITUTES IN LOS ANGELES

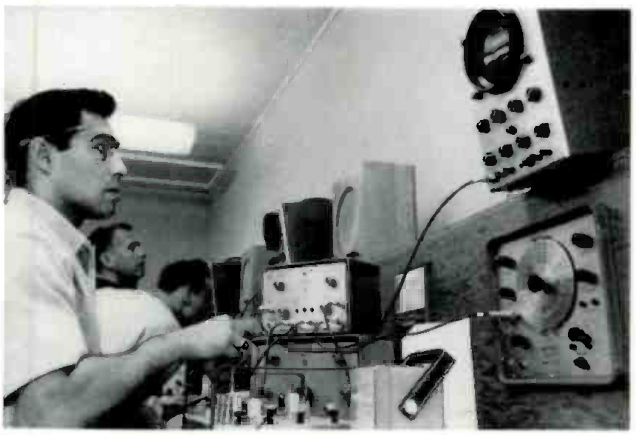
The first RCA Institutes resident school outside New York City opened last March in downtown Los Angeles. Now firmly established, the new Institute—like the students it trains—is confidently making plans for a bright future.



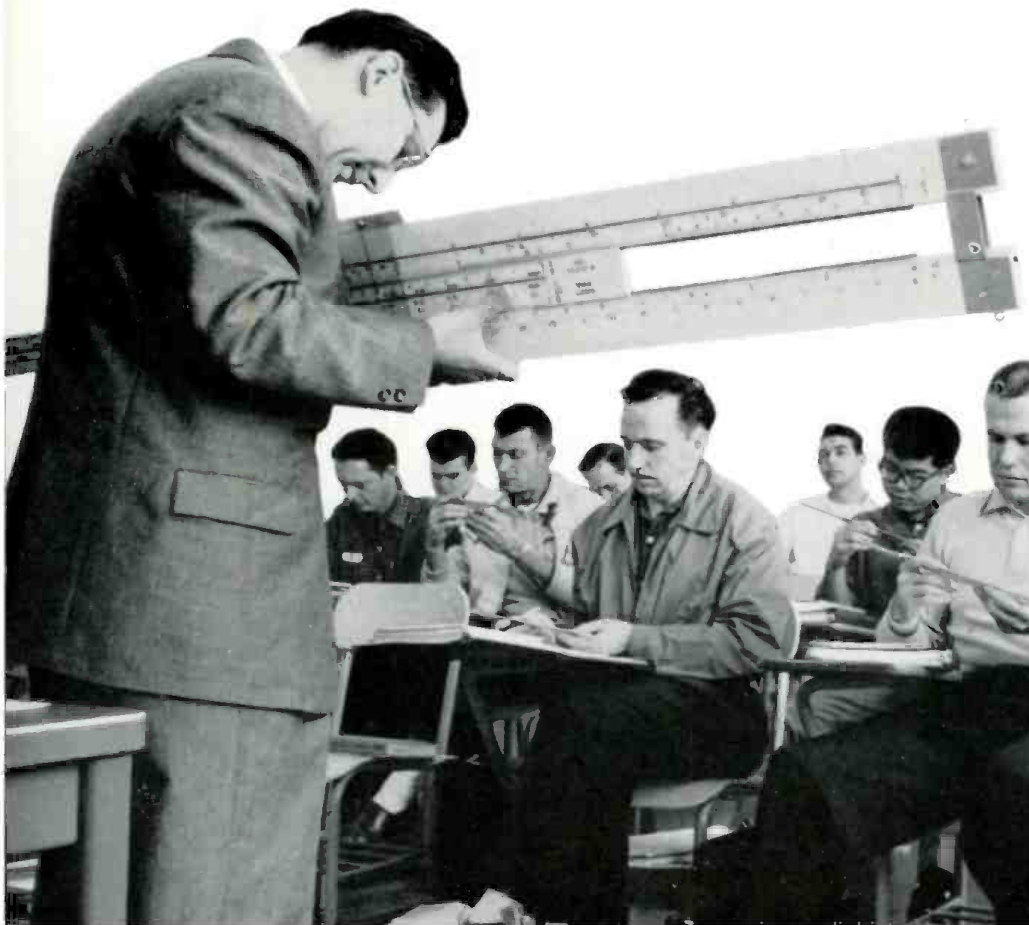
Instruction and practice in techniques of circuit analysis prepare students for more advanced units which deal with circuits of specific purpose and with commercial equipment.

Sights on Tomorrow

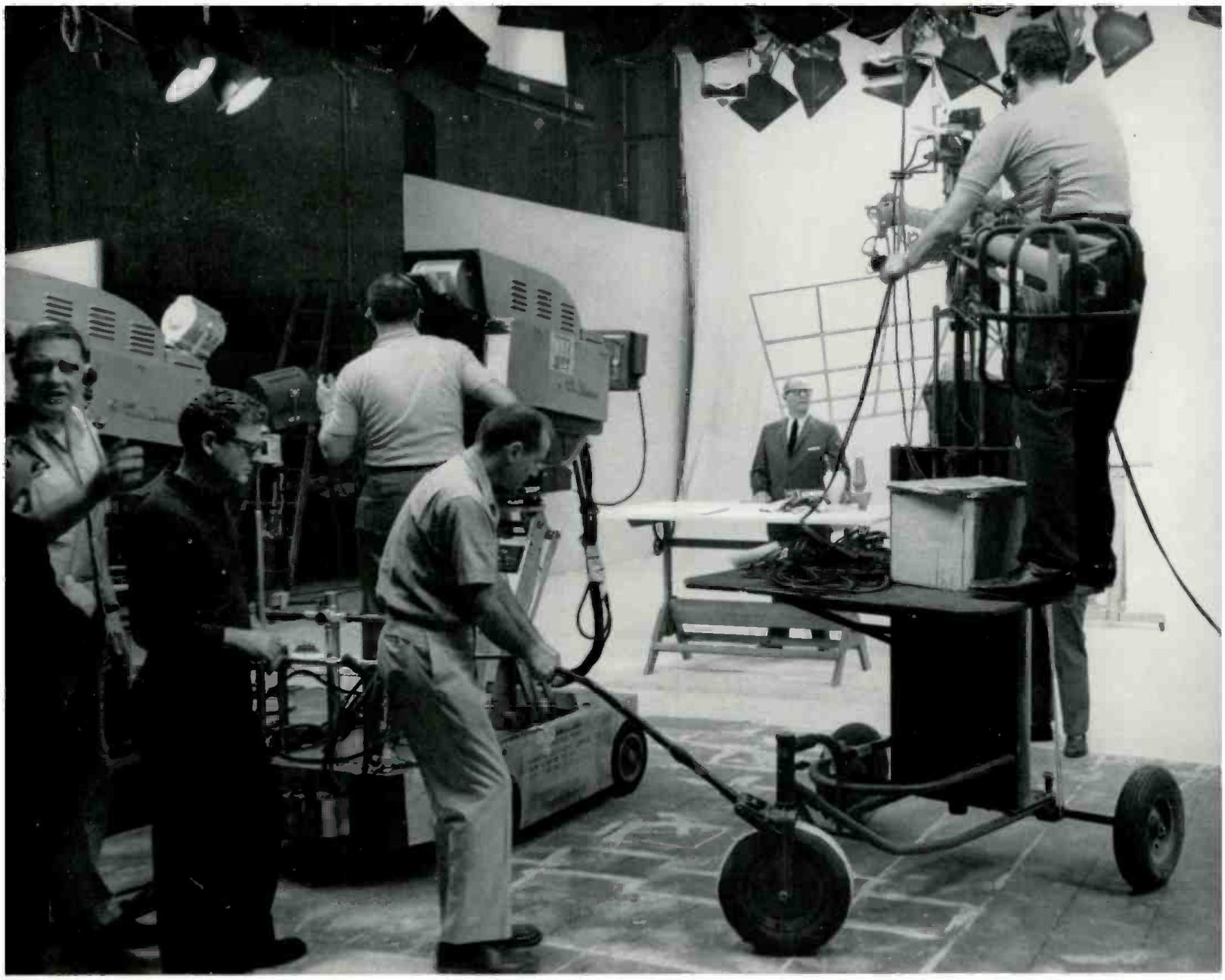
Basic theories are put to test in well-equipped laboratories.



Students soon advance to more complicated equipment.



A classroom scene at RCA Institutes in Los Angeles, where the college-level Advanced Electronics Technology Course stresses training in broad general principles and practical applications in communications and industry.



Celanese Fibers Company used a closed-circuit colorcast to introduce a new synthetic fiber to 10,000 retailers across the nation.

CLOSED-CIRCUIT TV:

New uses and markets for closed-circuit are uncovered almost daily and feeling rises in the field that "this is just the beginning"

An 'open sesame' for industry and business

By LOWELL FARLEY

IN AUDITORIUMS and hotel ballrooms in 34 major cities across the nation, 10,000 officials of leading retail stores recently watched a large screen come alive with vivid colors as a manufacturer introduced a new synthetic fiber to prospective customers.

"Oh, isn't that striking!" enthused one buyer.

"I've never seen anything like it!" said another.

And, indeed, they hadn't, for they were watching the first use of big-screen projection color closed-circuit television on a national commercial scale.

The closed-circuit colorcast, produced by NBC TeleSales, and using viewing facilities supplied by Theatre Network Television, Inc., introduced Celanese Fibers Company's new polyester fiber "Fortrel" to retailers, and stirred wide interest as an industry "first." For the first time, retailers were able to see the brilliant colors, patterns and textures of the fabrics as well as the handsome design of the clothes cut from them.

The event is indicative of the whole broad field of closed-circuit TV—wherein audio and video signals are sent to special audiences in specific locations rather than being broadcast to the general public by a directional antenna. Wherever one looks—in business, in industry, in education, in the military, in marketing—new applications are being found almost daily for closed-circuit television.

Art patrons in New York, Chicago, Dallas and Los Angeles recently engaged, via closed-circuit TV in lively intercity bidding at an auction of 50 masterpieces of art and sculpture which raised $871,000 for New York's Museum of Modern Art.

In classrooms at Fort Monmouth, New Jersey, student instructors at the U.S. Army Signal School learn from television tape playbacks of practice lessons they delivered to their class a few moments before.

At Christian Theological Seminary in Indianapolis, seminarians practice writing, producing and directing religious TV programs on the school's new closed-circuit system.

At Cape Canaveral, Florida, the first American astronaut soon to be fired into space will be kept under constant observation by closed-circuit TV.

At an Army proving ground in New Mexico, a commander observes the accuracy of a ballistic missile via closed-circuit from a television camera couched in the missile's nose.

In conversations with manufacturers, marketing men and customers, two themes keep recurring:

"We're just beginning to learn how to use closed-circuit TV effectively," and "Its potential applications are limitless."

Industry experts estimate that factory sales of closed-circuit equipment reached the $17.6 million level in 1960, an increase of $12 million in five years. Actually, closed-circuit TV volume for the year is far greater, since that does not include components such as cables, microwave gear, home receivers used as monitors and display units, or installation and servicing costs.

By far the best customer for closed-circuit TV to date has been the Armed Forces.

At the Omaha headquarters of the Strategic Air Command, four live color television cameras and a complete closed-circuit color TV system, installed in

Industry has found that closed-circuit TV can be used efficiently and economically in many production processes.

More than 1,000 school systems with over a million students enrolled are currently using television as a teaching aid.

SAC's underground command post, provide instantaneous briefings for key staff officers, enabling them to make immediate decisions without going to the several display rooms to collect information.

Cameras are positioned in the SAC operations map room, the intelligence air room and the global weather central. They are trained on two-story-high panels showing deployment of SAC forces throughout the world, status of aircraft and missiles, training exercises, and weather information. Five briefings can be telecast over the system simultaneously.

One of the largest educational closed-circuit TV installations in the world is that at the Army Signal School at Fort Monmouth.

Approximately 9,000 officers and enlisted men annually receive some of their training in the school's 468 RCA-equipped classrooms and five theaters. In operation since February, 1959, the seven-channel system is estimated to have saved the school 75,000 man-hours in fiscal year 1960 alone.

"Instead of marching an entire class out to a field to see how a microwave tower is erected," says Walt Whitaker, Television Coordinator of the Signal Corps School, "we tape the procedure, edit the repetitious steps, and show the same tape to many classes. That way, we're not concerned with bad weather either."

The closed-circuit system at Fort Monmouth is used for a variety of things besides Signal School classes: character guidance, world news, base announcements and indoctrination courses. Recently, it was used to broadcast a dental seminar.

"We told the dental surgeons they'd have to complete their operation in 30 minutes, since that's the capacity of our kinescope film reels," said Whitaker. "So they proceeded to pull six of the patient's teeth and install temporary dentures – all in the allotted time! The patient lived, but the cameraman got a little woozy watching it."

Whitaker observed that despite advances made so far, the Signal School still hasn't realized the system's full potential.

"We've been going through a period of growing pains – training crews, learning the best techniques to use with certain presentations, and building a backlog of kinescopes and tapes. As a matter of fact, we've just begun to scratch the surface."

One novel use of closed-circuit with which the Signal School is experimenting is in training teachers.

A camera concealed in a practice-teaching room records, on TV tape, five, ten and 30-minute presentations of instructors. The tapes then are played back and the presentations are evaluated by supervisors.

"By this method," says Dr. Joseph Frank, Chief Instructor, Training Branch, "we hope to use television to make better instructors, not to replace them."

Besides using it for staff and training functions, the Armed Forces have found a variety of other applications for closed-circuit TV.

One of the most unusual was the recording on television tape of the underside of the Arctic ice cap by the nuclear submarine Sea Dragon during its recent trip across the top of the world. The Navy plans to use the tapes – made on a specially-designed RCA TV tape recorder–in preparing other crews to navigate under the Arctic.

Another area in which closed-circuit TV has proved invaluable is space and missile research. At Cape Canaveral, each missile launching pad is equipped with four remote-control cameras linked to the blockhouse to permit technicians to observe and record the countdown and first seconds of each test firing.

During one test not long ago, a missile blew up on the launching pad, tore the closed-circuit camera from its mooring, and threw it several yards away against a concrete retaining wall. Investigators later discovered the camera to be in perfect working order. Another time, an entire pad was destroyed when a missile exploded. The glass on the camera housing was crystalized by the heat of the explosion – but the camera worked as well as new.

Although the Armed Forces remain the biggest single customer for closed-circuit systems, there has been a marked increase in orders from business and industry.

"The major stumbling block for industrial television was that industry thought of closed-circuit TV as a toy rather than a tool," says John H. Cassidy, Manager, RCA Industrial Television Marketing. "We've had a big job of education on our hands to convince them otherwise, but we're making headway."

Cassidy explained that in order for management to be convinced that closed-circuit TV is a tool, they must be shown that TV has two advantages: It can do a more efficient job than the method presently used, and it can do the job more economically.

"If you can't prove those two points, you might as well forget the sale," says Cassidy.

Obviously the points have been proved often, for the industrial customers for closed-circuit TV are as varied as the listing in a telephone directory. Prominent closed-circuit users include the steel and other metals industries, oil companies, railroads, banks, airlines and airports, hospitals, hotels and public utilities.

One of the brightest stars of the closed-circuit TV firmament has been educational TV. Currently, more than 1,000 school systems with over a million students are making use of television – either closed or "open" circuit – as a teaching aid.

The largest closed-circuit system is the Washington

County school system in Maryland, where 16,500 students receive televised instruction in 37 different buildings. Closed-circuit TV also is playing a leading role in a state-wide educational system now being installed in South Carolina.

At the higher educational level, closed-circuit has gained increasingly wider acceptance. The University of Akron, for example, has installed a system linking 35 classrooms and will begin transmitting five credit courses ranging from mathematics and science to public speaking at the start of the next semester. The Council on Medical Television reports that 26 medical schools now have closed-circuit installations and use them to varying degrees to teach courses ranging from basic science to the most advanced types of surgery.

Perhaps the most spectacular use of closed-circuit television has been in the realm of marketing and entertainment, particularly sports events.

According to Jerry Madden, Director, NBC TeleSales, closed-circuit sales or business presentations range "from a man behind a desk to the most elaborate type of Hollywood production, complete with top entertainment stars." Costs also vary widely, anywhere from $1,000 to more than $100,000 for production alone. To this must be added the telephone company line charges, cost of viewing facilities, and service costs.

NBC TeleSales is in the dual role of producing entire closed-circuit packages and leasing studio facilities and equipment to other producers. The Technical Services Division of the RCA Service Company, a nation-wide organization equipped to install and service large-scale closed-circuit telecasts, also figures prominently in the field.

Biggest closed-circuit telecast on record was the last Floyd Patterson-Ingemar Johannsen heavyweight boxing match, which was watched by 500,000 persons in 136 cities simultaneously.

One of the most involved closed-circuit telecasts was done by NBC for an automotive manufacturer to introduce a new farm tractor.

The show's producers first had to locate a spot where the growing season was long enough to permit them to plant corn at four different times to demonstrate the new tractor's versatility at various stages of the growing season. Other crops to be planted included cotton, tobacco, lettuce, and barley. The only spot in the U. S. which could qualify was Yuma, Arizona. The producers then had to get workers to tend the crops and irrigate them. By the time it was ready to "shoot" the telecast four months later, the NBC production team knew nearly as much about farming as they did about television. Asked by his head office in New York where the corn was planted, the director wired back: "South of the barley, down Mexico way." ■

Technicians scan monitors of the Strategic Air Command's closed-circuit color TV system.

New Horizons for Transistors

Breakthrough in consumer applications prompts RCA to convert entire output of Findlay plant to home-instrument devices

By JACK O'BRINE

BIG AND GETTING BIGGER is the role of the tiny transistor – that remarkable device which, by demonstrating a new way to control and amplify electrical signals, has radically altered the shape and direction of a major segment of the electronics industry.

In military and space electronics, the transistor has come to fill a paramount need, because of its small size, dependable performance, long life, low-power requirements and ruggedness.

In the burgeoning field of electronic computers and data processing, the tiny wonder worker has introduced characteristics of speed, coolness and flexibility that have led to creation of systems and centers of undreamed of capabilities in handling the flood of paperwork engulfing business and government.

Now one of the most promising possibilities of the transistor has been thrust open by a carefully planned breakthrough in production methods.

As a pioneer in developing and making transistors, the Radio Corporation of America has advanced manufacturing techniques to a point where, for the first time, costs are reduced to the pocket-book desires of the highly competitive home instrument industry.

Before the breakthrough, manufacturers in this lively realm of sound reproduction had to seek their transistors through the purchase of so-called "fall-outs" from devices built and beamed to military or computer outlets.

Not a single manufacturer had succeeded, previously, in producing transistors specifically for the home entertainment field, despite the growing demands of radio, television, hi-fi and stereo instrument makers for special consideration.

RCA engineers and manufacturing specialists believed this could and should be done. The goal was set by Dr. Alan Glover, Vice President and General Manager of the Semiconductor & Materials Division, with headquarters at Somerville, New Jersey.

The plan crystalized in February, 1959, when RCA's reconverted electronic components plant at Findlay, Ohio, became the only American production center to turn out transistors exclusively for the home instrument industry.

In the past two years, this streamlined and "hospital clean" manufacturing facility not only has exceeded expectations in the quantity and the quality of its transistor production, but has introduced techniques and innovations looking toward bigger and better achievements in the future.

The plant, a paragon of precision, has some 129,000 square feet of floor space in a one-story modern structure, just off Route 12, in a bustling Ohio farming area. R. J. Hall, the energetic Manager, heads a staff whose membership averages more than twelve years each in the service of RCA.

An intricate manufacturing "orchestration" of mechanized and hand-labor production prevails. Nearly all of the workers are women. They number about 518, and are on the job in two shifts. Working largely with tweezers and microscopes, their nimble fingers never falter in the repetitive chore of transistor assembly. Men have tried to match them and failed. One plant official explained it this way: "Once these women employees have been properly trained, some inner mechanism appears to take over, making it possible for them to do a perfect job, while at the same time showing by their conversation with nearby workers that their thoughts are

on matters far removed from our plant. Thus they never are bored or become victims of monotony."

Convincing testimony to the efficiency of these and other members of the Findlay plant population is the fact that since they began turning out the first transistors specifically designed for the home entertainment industry not one customer has raised a major complaint.

Findlay production, in all of its varied phases, follows the same high standard of manufacturing and quality assurance that is regarded as a prime necessity at RCA's Somerville plant, and other major centers of the industry devoted to supplying transistors for military and data processing applications.

Despite the dedication of the Findlay operation to only "one master" – namely, the cost-conscious home instrument industry – the staff developed a system of high quality assurance that provides hourly production monitoring and process control of each step of the complicated manufacturing procedure.

According to J. W. Ritcey, Manager of Production Engineering and Manufacturing, every single one of the 1,800,000 transistors and rectifiers being produced each month is subjected to as many as thirty separate checks for operational characteristics and quality.

Some of these checks are conducted by the sharp eyes of the testers. Others are achieved with a minimum of human intervention through use of RCA's automatic test set. This consists of a strange race-track shaped mechanical electronic instrument, that can spy and divert to proper classifications some fourteen different types of transistors.

Underscoring the growing importance of the family of transistors known as the "drift-field" type, Findlay plant engineers have developed what they call a "poly-gain test set." This weird-looking electronic console has both radio frequency (RF) and intermediate frequency (IF) feed-ins for detecting transistor characteristics. Neither circuit affects the other, and the operation by the tester is not only automatic, but a built-in color chart on each meter gives the predetermined type of the transistor.

Methods of production at the Findlay plant undergo frequent changes – as many as two in a single day – to improve efficiency and lower costs.

At the present time, production is devoted to eight "families" of semiconductors – designed and built for the unaltering purpose of meeting the needs of the home instrument industry.

These families are divided into types identified by letters and numbers. For instance, the first transistor type produced when the plant opened in 1959 and still a big factor in sales is known as the RCA-2N217. One of the newest of the families is the RCA-TA1817, a "drift-field" power type that represents a major breakthrough in home-instrument transistors.

This unusual transistor makes possible for the first time production of all-transistor hi-fi and stereo sound equipment on an economically practical basis, since it is expected to sell for less than $2, as compared with so-called fall-outs from the computer market and industrial market that sell for as much as $9.

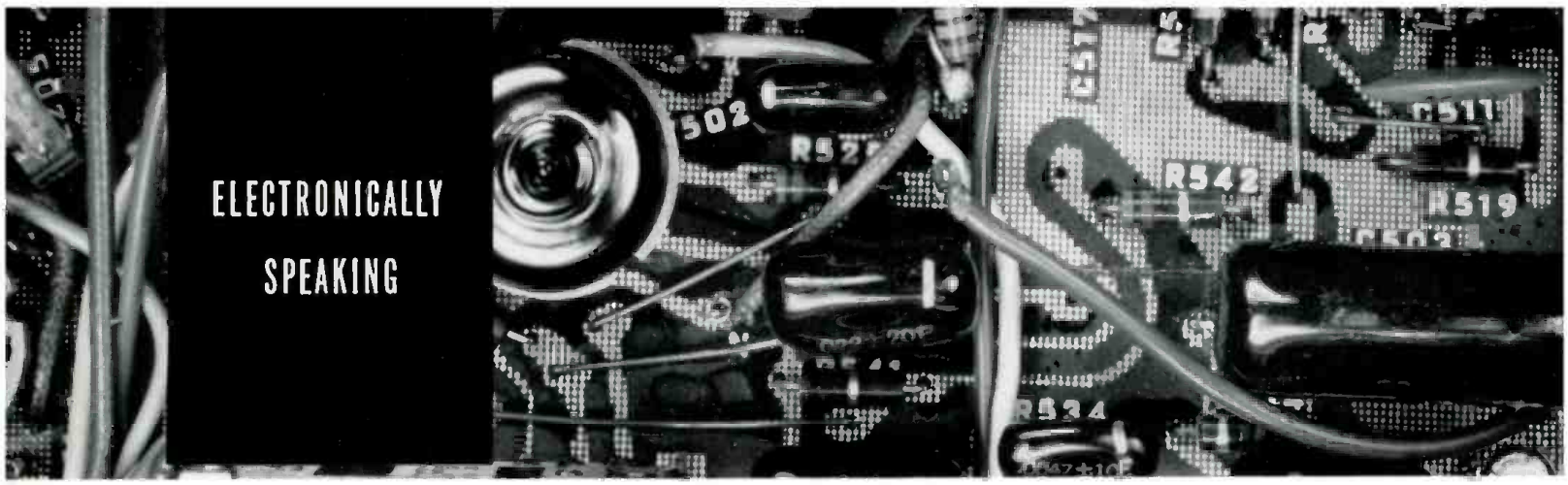
Additional semiconductors that extend the importance of the Findlay plant in its service to the home entertainment industry include the RCA-2N408, an audio component for portable radios; the RCA-2N406, a valuable unit for electronic circuitry, and the RCA-1763 for the rectifier field, which is already servicing more than 20% of the potential TV market.

Building a transistor requires an average of fifteen days. This dates from the moment that technicians begin "growing" germanium crystals in a vacuum and proceeds through such major steps as preparing a pellet of the crystal, adding an alloy (or so-called impurity) to affect characteristics, making miniature parts, assembling and, finally, passing the product through extensive performance and quality tests.

This automatic test set can classify fourteen transistor capabilities on the basis of electronic characteristics.

An overall appraisal of the Findlay operation by its staff lifts a fascinating fact into view. That is that the plant, while attractive in its modern streamlining, airconditioning, water-purification and humidity control, is completely functional.

"You might say," one staff member commented, "that we have applied the principles of one of the most successful clothing chains – fine facilities at low cost for fine products." ■



REBORN BOUNTY

HMS Bounty, which sailed for Tahiti in 1787 and one of the most famous sea sagas of all time, lives again in basically its original form. But it's just about the best-equipped square-rigger afloat.

The first ship ever built from the keel up for a motion picture, the $600,000 "Bounty" is the central set in the $8,000,000 re-make of "Mutiny on the Bounty" now being filmed in the South Pacific for re-

lease early in 1962 by Metro-Goldwyn-Mayer.

Outwardly, the new "Bounty" is a replica of the old. Below deck, it's a different story. Navigational equipment supplied by RCA Victor Company, Ltd., of Montreal, includes radar, the "Atair" depth recorder, direction finder, radio-telephone, transmitters and communications receivers, and emergency stand-by facilities.

STAGE PRESENCE

Buttercup, the cow, knows a thing or two about acting – as well as upstaging.

One of the live "props" used in the original opera "Golden Girl" colorcast by NBC on December 16, Buttercup took things in her stride during the taping at NBC's color studios in Brooklyn. She sat in her stall, chewed her straw, and peered out through sleepy lids at the people who cooed at her.

But when it came time for 13-year-old Judy Sanford to sing a solo in the third act, Buttercup let out with a loud moo. Little Judy, a trooper herself, never batted an eye, but went right on singing.

Buttercup is a stage veteran. She spent six months mooing her way through the musical comedy "Greenwillow" on Broadway.

SHORT-CIRCUITED MESSENGER

The recent outbreak of bombings in public places in New York City temporarily slowed the efforts by RCA Communications, Inc., to speed its message pick-up service.

During a test in the use of "walkie-talkie" radios, a radio-equipped messenger was sent on a pick-up, near Pennsylvania Station. Within minutes, he was back – accompanied by a policeman – who demanded an explanation of the equipment. Satisfied that the messenger was not the "mad bomber," the patrolman allowed him to continue his run. This time, the messenger was stopped by two Military Policemen. Fortunately, this time he had a letter explaining the experiment and its purpose, so the MP's let him continue his run.

ADVANCE PLANNERS

The study and development of new design and styling concepts for television sets, stereophonic phonographs, radios and other home instruments for introduction as far away as 1970 is the function of the newly appointed Advisory Board to the RCA Advanced Design and Styling Center (right).

Members of the Board include (seated, l to r) Joseph Carreiro, Director of the Industrial Design Department, Philadelphia Museum College of Art; Melanie Kahane, a leading interior designer; Paul Rudolph, Chairman of the Yale University Department of Architecture; (rear, left) John Vassos, founder of the Industrial Designers Institute and long associated with trends in the home entertainment industry, and (rear, right) Leonard Outhwaite, noted author and anthropologist. The Center will operate under the direction of Tucker P. Madawick (rear, center), Manager of Industrial Design for RCA Victor Television Products. ■

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