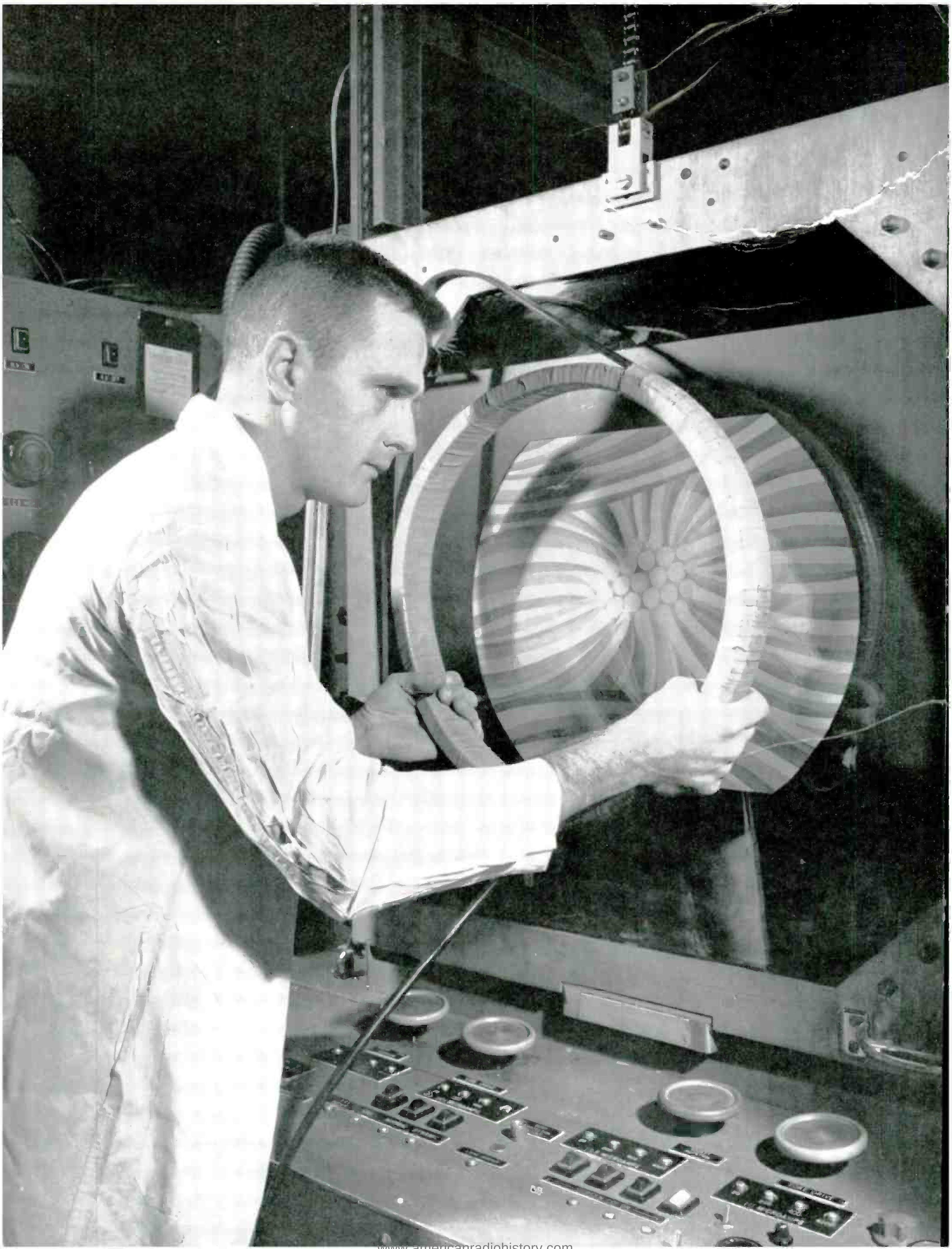
RCA

electronic age

SPRING 1961

OUR ELECTRONIC ARMY by General George H. Decker

CHIEF OF STAFF, UNITED STATES ARMY



electronic age

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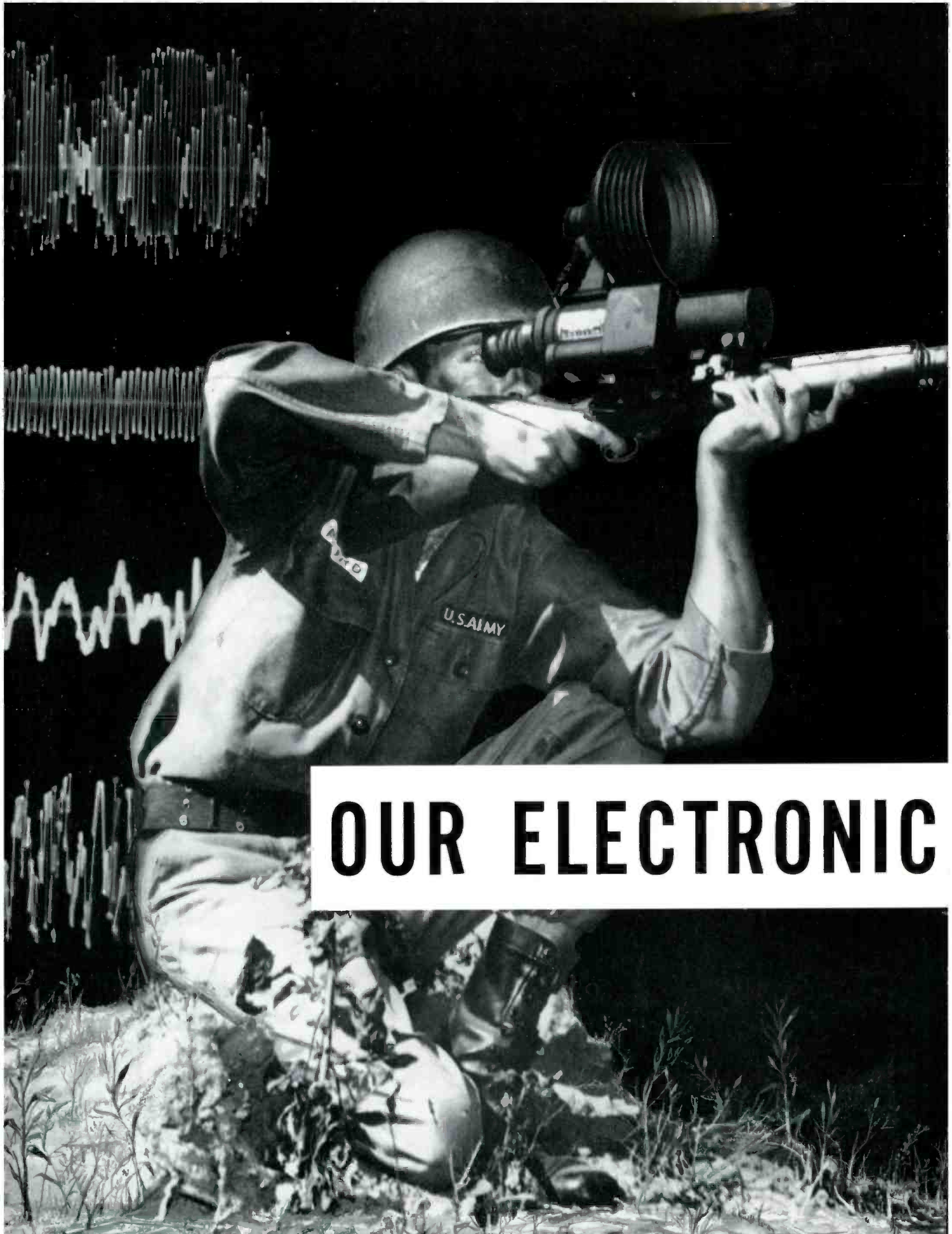
COVER: *Portable electronic computers and tiny helmet radios, like those shown, may be standard equipment for the soldier of the future. Both devices represent possible applications of RCA's micro-module concept for shrinking electronic components. Photo was made at U.S. Army Signal Corps Research and Development Laboratory, Fort Monmouth, New Jersey. See article beginning on Page 2.*

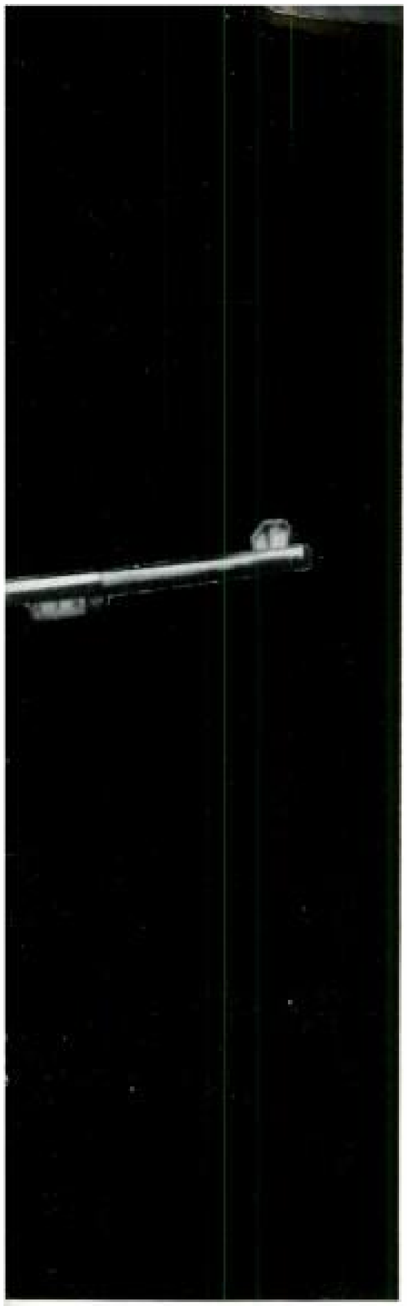
LOWELL FARLEY, *Editor*
BARBARA ZERRIEN, *Assistant Editor*
JOHN MAXIMUS, *Design Consultant*

One of RCA's new, brighter color TV tubes is checked at Lancaster plant.

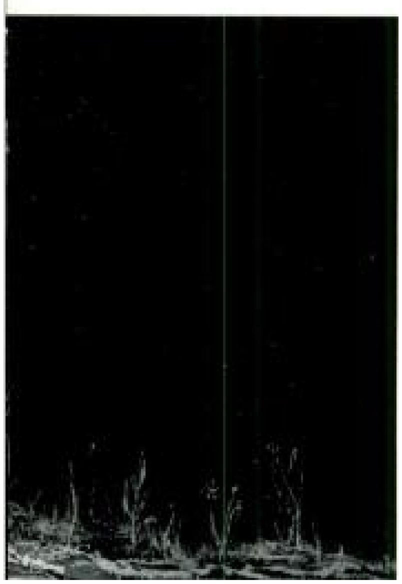
RADIO CORPORATION OF AMERICA
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.



OUR ELECTRONIC



ARMY



By **GENERAL GEORGE H. DECKER**
Chief of Staff
United States Army

The three essential ingredients of success in warfare—firepower, mobility, and command—are becoming increasingly "electronized"

IT HAPPENED ONE DAY at a command post up near the Siegfried Line during World War II. A small group of U.S. Army officers and enlisted men hovered anxiously over the radio operator.

A report had come through that one of our tank platoons further forward had unexpectedly come upon a German armored force of considerable size. Their tanks were thought to be "Tigers." Our forces there were outnumbered and artillery support was indicated.

However, the report had to be verified. The enemy was known to be not too far ahead, but latest intelligence reports had indicated that their presence in that particular sector was not likely. Enemy attempts at infiltration and intercept of radio messages, plus false reports from enemy agents trained to imitate American speech, had dictated strict communication security procedure. And the order of the day was "brevity in messages consistent with clarity."

Suddenly interrupting this comparatively slow and sometimes frustrating procedure, another voice broke in — desperately — "Tim! Joey needs you!"

This message needed no authentication. This second voice was clearly that of the Tank Battalion Commander, whom everyone knew. "Tim" commanded the Division Artillery.

Receipt of this message permitted the Division Artillery to go into action and provide the necessary fire support in time to save the day.

Such was the role — and the need — for communications in literally thousands of such situations during World War II. This story is representative of the importance of communications to our fighting men everywhere. It is strangely symbolic that the name of the man in distress in this instance was actually Joe.

This requirement for fast, reliable communications for our combat forces continues today in even greater measure. Three essential ingredients to success in future warfare are greater firepower, greater mobility, and effective command

Against a background of radar images of (top to bottom) a train, an automobile, a walking man and a walking girl, an Infantry sharpshooter sights through the Army's new lightweight infrared "sniperscope."

and control. Effective command and control mean effective communications. And communications is 99 per cent electronics.

Electronics, more than any other technological field, encompasses all the basic activities of combat. Communications, though perhaps the most essential function, is but one of these. By electronic communications we direct and control ground movement. Electronic navigational and directional aids also assist us in the effective employment of Army aircraft. We depend upon electronics for the acquisition of essential meteorological data. Electronic surveillance and intercept devices, such as radar, locate our targets. Practically all of the information necessary for making timely and intelligent decisions and for effective command and control of an Army in combat is provided to the Army commander by electronic means.

On the greatly expanded combat area envisioned in future warfare, more communications is needed for smaller units. The means provided must be capable of a greater range, greater mobility, and must be thoroughly reliable. They must likewise possess features which provide for greater security because of the greater danger of enemy infiltration which wider dispersion invites.

Some indication of the considered need for more communications by the Infantry, for example, is contained in the fact that a current Infantry Division is authorized 40 per cent more items of communications-electronics equipment than an Infantry Division in 1950. Authorization for radios of all types, for instance, was increased from 1,751 to 2,457. Authorization for radars was increased from three to 50.

The possibility that nuclear parity may, initially at least, restrict a future combat operation to the use of conventional firepower is little consolation. It imposes, rather, a need for dual capability in both conventional and nuclear weapons so long as a nuclear threat exists. This means that to be combat ready our forces must be equipped for both or any eventualities and capable of rapid adaptation to any environment.

Reorganization of Army Divisions into battle groups smaller than regiments, in accordance with what is known as the current organizations concept, was directed about four years ago to provide greater ease in deployment of forces and hence greater flexibility. There are five battle groups to a current organization. Greater firepower and greater mobility made this reorganization possible and also desirable. The current organizations concept placed top-level emphasis on communications-electronics. Prior to this time so much greater research and development emphasis had been placed upon firepower and mobility as to create a serious imbalance between these capabilities and command control. Consequently, it was necessary to do a bit of "double-timing" to develop a "New Look in Communications" by means of which the new advantages in firepower and mobility could be exploited.

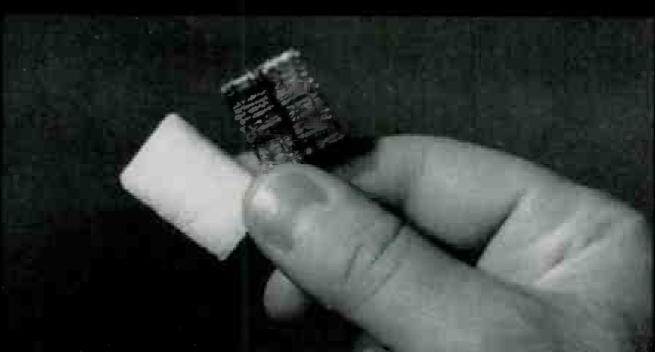
The Signal Corps is, of course, that branch of the Army charged with the responsibility for providing the means of communications and command control for our modern Army. It also provides the trained personnel necessary to operate and maintain all signal equipment and systems wherever used – from the Pentagon to the firing line. In this dual role, it is known as both a technical service and a combat arm – "the combat arm of command control."

The Signal Corps has often been described as "the nervous system of the Army." As the technical service which provides such a system for the acquisition and transmission of intelligence, and the coordination and control of the Army "body," its efforts are primarily directed toward the principal mission areas of *tactical* and *strategic communications, combat surveillance* and *target acquisition, electronic warfare, avionics for Army aircraft,* and the broadening field of *space* and *satellite electronics and communications.*

The impact of the growing use of electronics upon manpower and training requirements has been considerable. During the decade 1948-58, the total Army communications personnel authorized showed an increase of 18 per cent. Percentage-wise, authorized officer strength for the Signal Corps with relation to that for the entire Army has more than doubled since the end of World War II. In number of officers authorized, it leads all other technical services and is the third largest branch in the Army – being exceeded only by the Infantry and Artillery combat arms. The annual training load of the Signal Corps today is larger than the training load of any other branch of the Army. In order to meet the Army's needs for skilled communications-electronics manpower, the Signal School system trains between 25,000 and 35,000 individuals each year. Individual training is offered in some 60 to 70 different technical courses.

The courses offered must be combat-oriented. Men of the Signal Corps are required to consider themselves as soldiers first, and as technicians second. Training time versus time on the job, to insure a maximum return from our training investment and to insure a proper balance between training and requirements, presents a considerable dilemma.

Time was when one man could readily learn how to repair every piece of equipment the Signal Corps provided, and he could do so with a few simple tools. Now, a high degree of specialization is necessary. The complexity of modern equipment requires several specialized tools, and many special skills which re-



That electronics, more than any other technological field, encompasses all the basic activities of combat is illustrated in the panel above. Top picture shows Army's "Nike-Zeus" anti-intercontinental ballistic missile in action. Second picture shows how a miniature TV camera might be used for remote field observation. In third photo, tank corpsman wears noise-cancelling earphones which enable him to hear radio messages loud and clear. At bottom are micromodules, now under development by RCA to shrink size and weight of military electronic equipment.

quire more time to develop. Operation and maintenance of the Missile Master and Missile Monitor systems alone require breaking down the job into four separate specialized training classifications.

For training on the more costly Signal equipments, which may run as high as 10 million dollars each, training aids in the form of models or simulators are used, where feasible, in the interest of economy. But models and simulators also are sometimes costly.

The time element involved requires that preference must be given to career men. Our enlisted career training program is designed in multi-level stages, and on-the-job training is utilized to the maximum extent practicable. The most advantageous distribution of skills is attempted. For the smaller units we endeavor to place a man trained in as many of the required skills as possible. Also, we encourage a "do-it-yourself" capability to relieve the workload on specialists, where a high degree of specialization is not required.

In recruitment, and in selection of men for training, considerable emphasis is placed on aptitude testing. The number of men available to the Signal Corps who possess high-level aptitudes has steadily decreased because of the wider use of electronics throughout the military services, the Government and Industry. This is particularly true in automatic data processing. Potentially good programmers are hard to find, and once found, considerable time is required in their development. In programming, the output can only be as good as the input. It is interesting to note that good card-players often make good programmers.

A government study made some time ago has indicated that in the 1960-1970 time frame this country would not have sufficient skilled manpower to match the expected growth of the electronics industry.

The question logically arises as to what will be the role of military electronics in 1970 or 1975. What electronic tools will be needed, and what will these be like? I wish I knew. In knowing, my job and that of my successor would be a whole lot easier. The savings in time, and money, and effort could be tremendous.

I do not anticipate that my successor in this time frame will be an automatic computer. However, he will be a man with many electronic tools to assist him which will give him an infinitely greater capability of command control than is available today. These will give our Army infinitely greater combat capability.

In order that such tools will be available, it is imperative that we pursue today's challenge with unrelenting vigor. That challenge is dictated by the cold hard facts of development lead time and fund limitations. Barring some unforeseen major events which might free manpower and loosen purse strings, the command and control facilities for Army use in the '70's is largely that which must be under development within the immediate future. In view of the rapid changes in technology, it is difficult to develop firm operational concepts for our Army that far in advance. However, these concepts for that time must be completed now, and frozen, if we are to translate them into firm capabilities to match.

Present progress indicates that the electronics equipment available then will be more versatile, more responsive, possess a higher degree of automation, and will be considerably smaller in size and weight. A considerably higher degree of integration and compatibility between all systems and equipments will also have been achieved.

New miniaturization and micro-miniaturization techniques, for making equipments more compact, more transportable, and easier to maintain, have progressed from component densities of 50,000 parts per cubic foot to 700,000 parts per cubic foot. Through the development of solid-state devices, ultimate component densities of millions of parts per cubic foot will be achieved. By such means, nine-tenths of the soldier's equipment load can be eliminated. It has been said that the biggest single problem facing the post-1970 Army commander in using his radio is – finding it.

Through new techniques such as this, future electronics tools are sure to be more reliable, have a longer life, use less power, deliver higher performance, and be considerably simpler to repair and maintain than anything we have today. With these characteristics, plus present efforts at simplification and standardization of fewer types of versatile multi-purpose equipments, the expected percentage increase in the use of communications-electronics during the next ten to fifteen years should not require a corresponding percentage increase in full-time Army communications and electronics personnel.

Revolutionary changes in military operations and tactics that can be predicted range all the way from those affecting the procedure of the individual combat soldier to those affecting the actions of the Chief of Staff. It is not inconceivable that the Infantry squad may depend entirely on radios, because of generally having to operate under cover or beyond hand-signal distances. If so, the squad leader's traditional gesture which means "follow me", would become a legend.

Global communications by means of a system of satellites will undoubtedly be a reality. Materialization of such a system by that time is almost entirely a matter of funding. The necessary development and testing by which we hope to exploit this possible means most advantageously will take a few years more. However, this capability is, even now, practically within our technological reach.

The Army's COURIER 1B satellite launched last October demonstrated a transmittal capacity of 68,000 words a minute during the few minutes it remained within range of its ground stations. It could also receive and store the same amount simultaneously. These are technically known as "burst communications".

By "burst communications" and various other techniques we hope to conserve and make maximum utilization of allotted space on the radio frequency spectrum, the limits of which have become a matter of considerable concern in recent years.

Project ADVENT represents our developmental attempt and feasibility study of the possibilities for a system of "real-time" satellites as opposed to the "delayed repeater" concept of COURIER. A system of "real-time" satellites would represent the ultimate in global communications capability for quick reaction in this age when speed is so essential.

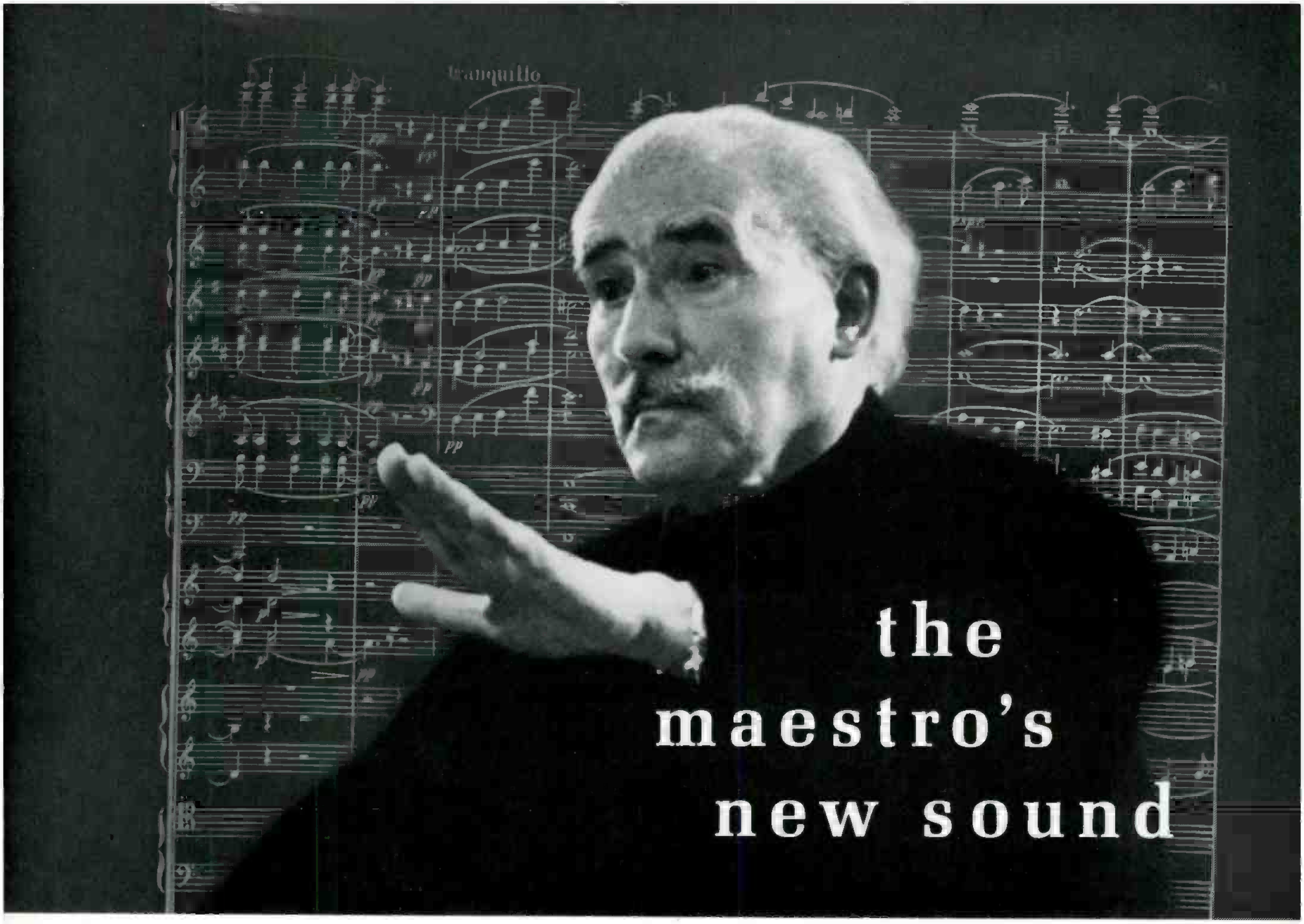
Satellites, generally, offer promise of a greatly increased communications traffic capacity which would relieve the congestion on existing facilities and could amply handle all foreseen requirements for even low priority message traffic over major intercontinental trunks for the next several years.

Two thorny problems in Army communications-electronics efforts currently haunt us. One is that the density of communications-electronics equipment authorized for the combat area is increasing at an alarming rate. Based upon present known requirements, we have found that a type field Army of the 1960's will be equipped with approximately 75,000 Army-operated electronic devices – as compared with approximately 30,000 electronic devices at the end of World War II. There is danger that the electronic environment in the field Army will contain so many electronic radiators that we will jam ourselves out of business. We are seeking to guard against this eventuality through a broad program of electronic environmental research and testing.

The other problem which is currently of paramount concern to us is that of the ever-increasing cost of equipping our combat forces. Cost-Risk-Benefit relationships are subjected to continuous review to insure that we get the most equipment for the dollar and to preclude the possibility that we might be pricing ourselves out of business.

Through the cooperative teamwork of the Army and Industry, upon whom we are so vitally dependent, I am sure these problems will be contained and costs kept within reasonable limits.

Whatever the future may hold, we are firmly resolved not only to help our combat men avoid such a predicament as "Joey" faced, if we can – but to help them to be masters of the situation if they do. ■



the maestro's new sound

A unique process developed by RCA Victor Records lends the realism of stereo to three of Toscanini's greatest recordings.

It was a gray, overcast day last January. A group of men seated themselves on the staircase in a home in Riverdale, N. Y., and looked across the room to twin speakers flanking a portrait of Arturo Toscanini.

What the assembled music experts and critics heard next was a pleasant surprise. For three celebrated monophonic recordings made by the great Maestro before his death in this very house four years previously now had the characteristics of true stereophonic performances. The music had depth and direction, as well as fidelity. Indeed, the sound seemed spread out as if the entire NBC Symphony Orchestra were there, playing.

What, in fact, they were hearing was the debut of a project begun by RCA Victor Records more than two years previously – in August 1958 – to reprocess in electronic stereo the old monaural master tapes of some of the greatest musical performances Toscanini ever recorded. It was hoped that by doing so, successfully, the attention of the public could once more be channeled to some of the late, great conductor's most electrifying performances.

The response of the experts to the first three Toscanini recordings to be released in "electronic stereo reprocessing" – Respighi's "Pines of Rome" and "Fountains of Rome"; Mussorgsky's "Pictures At An Exhibition"; and Dvorak's "Symphony From The New World" – was immediate and affirmative.

Billboard Music Week hailed them as closely approaching true stereo. *High Fidelity* magazine said they were "comparable to the average of the real thing . . ." *The New York Herald Tribune* reported ". . . the recordings offer sharper and cleaner sound than any previous Toscanini discs . . ." And *The Re-*

porter magazine commented ". . . they come appreciably closer to the vibrance and impact of a Toscanini performance than anything hitherto available."

The electronic stereo reprocessing technique which the critics hailed was perfected by a young RCA Victor engineer-musician, Jack A. Somer. Basis for the technique is the assumption that two essential elements produce the stereo effect – direct and reverberant sound.

In a true stereo recording, Somer explains, the microphone on the left where higher-pitched instru-

Jack Somer points out a filter setting to Richard B. Gardner.

ments are located also picks up some direct signals from the lower-pitched instruments on the right, as well as some reverberant sound, or "echo". The same is true, in reverse, of the microphone on the right.

By dividing the sound spectrum with the use of variable filters into high and low frequency bands to correspond to left and right channels respectively, a sense of sound direction is produced – violins on the left; violas, cellos and string bass on the right; and brass and woodwinds centered between. The addition of some direct signal and some reverberant sound to each channel produces tonal balance and spatial effect.

The complicating elements in the system are the facts that the recording engineer must: be able to read music, have a knowledge of the score, and be able to translate the conductor's interpretation of the music electronically by manipulating the variable filter, direct signal and "echo" controls of the recording console.

In creating an electronic stereo recording, Somer first spends hours listening to the original tape.

Next, he follows the monophonic version with the score of the music in front of him, and makes notes on what the probable variable filter settings should be.

Then the two-track re-recording is begun, with Somer making changes and adjustments in the various controls as the music progresses.

Finally, when Somer achieves a tape he is satisfied with, it is submitted to a committee of RCA Victor experts for evaluation. Changes in interpretation, emphasis, and the like are discussed, and, if necessary, a new tape is made to incorporate the suggestions.

"This wonderful process," says George R. Marek, Vice President and General Manager, RCA Victor Record Division, "could not have been done merely by pushing buttons and soldering wires and adding columns of figures. That might have created a certain type of record – but what we had in mind was the recreation of Toscanini's great music. For that we needed a man who is both a musician and an engineer."

In conceiving the project, Mr. Marek had emphasized that the musical integrity of the Maestro's performances must be preserved in any reprocessed recording. After careful screening, RCA Victor officials decided that Somer – then 23 and assigned to RCA Victor's Indianapolis laboratories – was the man to handle the assignment.

Now assigned to RCA Victor's New York headquarters with the title of Administrator, Audio Coordination, Somer admits that his first experiments with the reprocessing system in Indianapolis were "pure groping" on his part.

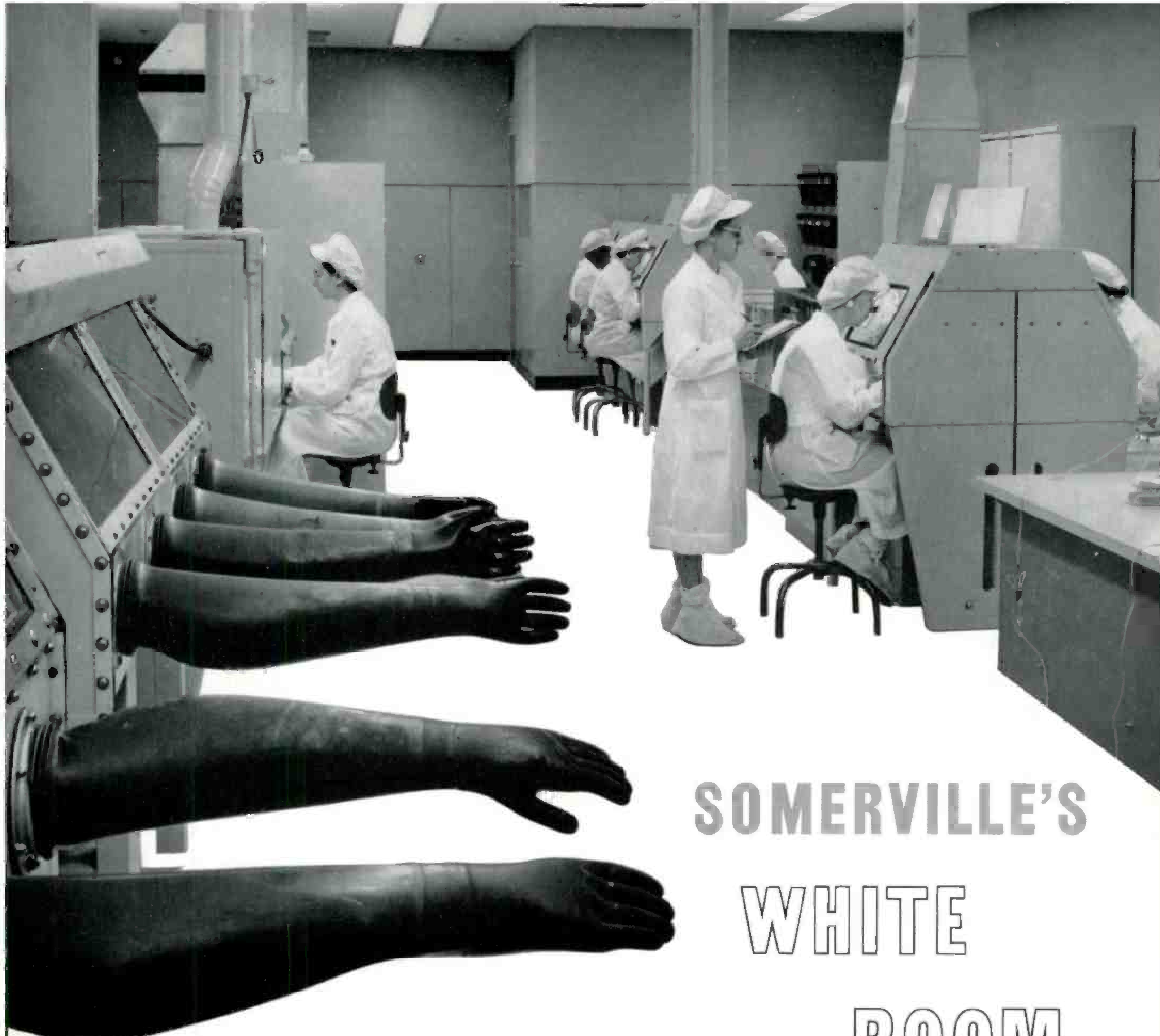
By May, 1959, it was decided that Somer should be transferred to New York to continue the project.

Also brought into the project then were the services, guidance and friendly criticism of Richard B. Gardner, an RCA Victor recording engineer who formerly was with NBC and who later was one of Toscanini's engineers during his years with RCA Victor.

For sentimental and symbolic reasons, Mr. Marek had specified that he wanted the first reprocessed recording to be the famous Toscanini Beethoven Ninth. Regretfully, after a year and a half, it was decided that the technique was not yet suitable for the Beethoven piece, and that the Mussorgsky, Respighi and Dvorak works would be released first instead.

With the first three reprocessed Toscanini records now meeting with warm public acceptance, Somer is busy working on others. However, the possibility that old masterworks, such as those of Caruso, will ever be reprocessed is highly questionable. For, as Somer points out:

"We need a good original to work from to get satisfactory results, and that usually means a tape. Even such relatively recent favorites as Glenn Miller made their master recordings on wax discs, which now have deteriorated and are noisy in contrast with tape." ■



SOMERVILLE'S WHITE ROOM

Hospital-clean conditions reflect the care required in producing "ultra-reliable" transistors for the nation's first solid-fueled ICBM

By BRUCE SHORE

A TRANSISTOR SO RELIABLE that it has a theoretical operating life of from 1,100 to 11,000 years!

A transistor so reliable that not more than one in every 100,000 would be liable to fail in 1,000 hours of continuous operation!

That's the assignment given the electronics industry by the builders of the Minuteman ICBM.

That's the assignment being met by a carefully-picked team of scientists, engineers, technicians and production workers at the RCA Semiconductor and Materials Division plant at Somerville, N. J.

The nation's first solid-fueled ICBM, Minuteman is a second generation missile, smaller, lighter and less expensive to build and maintain than the liquid-fueled Atlas and Titan on which America's defense currently relies. Minuteman is designed for firing from underground silos and from specially-built railroad cars now under construction. When deployed in 1964, in squadrons of fifty missiles each, it will be virtually invulnerable to enemy knock-out.

The Minuteman made history last February 1, when the first test model ever assembled performed perfectly on its first flight – its nose cone landing squarely on target 4,300 miles downrange from Cape Canaveral. What astonished the Air Force and the entire missile industry about the flight was that its complete success had depended upon the flawless performance of tens of thousands of electronic components and sub-systems never before tested together.

The RCA division became part of the Minuteman Program last June, when it received a contract to develop a transistor for the Minuteman communications network.

"What is called for," says Parker T. Valentine, Manager of the Minuteman project at Somerville, "is a transistor at least 10 times more reliable than the best available today – one that has a theoretical operating life of from 10 million to 100 million hours!"

Following receipt of the contract, Mr. Valentine began building his staff. In his selections, he laid great stress on experience and proven skills. Weeks of indoctrination including films, lectures and informative get-togethers were held. Reliability became a dogma.

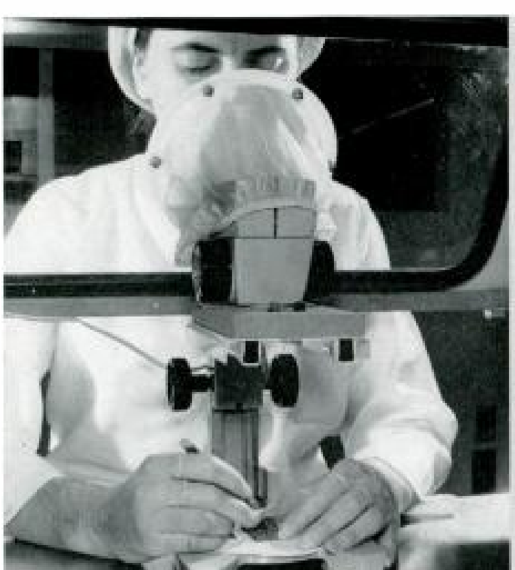
In the meantime, a decision was made not to start from scratch in building the Minuteman transistor but to re-design and improve a transistor already in existence. Chosen was the USAF 2N404, a computer switching transistor introduced by RCA in 1957. Since its introduction, over 9 million 2N404's have been manufactured by RCA and its electrical, mechanical and operating characteristics as well as its reliability are well understood and fully documented.

One final decision had to be made. Where the improved transistor would be produced.

In the months following June, a special Minuteman room enclosing 3,000 square feet was built. Known today as the "White Room" because of its incredible cleanliness, this area is completely enclosed and separated from the main plant by an "air-lock."

"There are four different atmospheric pressures involved in this room," according to Martin Geller, Manager of Reliability and Product Assurance for Minuteman. "The highest pressure is in the processing 'tunnels,' reached through an air curtain, where the production workers put the Minuteman transistors together. At slightly less pressure is the manufacturing area in which they work. Next comes the testing area where the finished transistors are electrically evaluated, and then the 'air-lock' or vestibule between the outer plant and the inner manufacturing area. Finally, there is a pressure difference between the vestibule and the outer plant itself. Effectively, this series of staggered pressure levels prevents the general plant atmosphere – already clean and temperature controlled – from penetrating into the Minuteman room. If a door is opened, the flow of air is always out, never in."

Temperature in the room, he said, is controlled to



within plus or minus 1.5°C. In addition, he explained, the dust count is held to one-fourteenth that of the general plant and the atmosphere at the point where the transistors are sealed is kept 200 times drier than that of the Sahara Desert.

To make sure this atmosphere is rigorously maintained, all production workers as well as visitors are required to remove their street clothes in the "air-lock" and to don white smocks, snoods to cover their hair and white shoe coverings. The impression of a hospital operating room is inevitable and striking.

The "White Room" was completed in November of last year and production began in earnest.

Commenting on the magnitude of the task, Richard R. Painter, Engineering Manager, disclosed that, while the USAF 2N404 has retained its electrical personality intact, every process and every basic component that goes into its manufacture was changed or modified.

"From a mechanical point of view," he stated, "we have designed a device that literally approaches perfection. We have improved the strength of some of the transistor's internal connections by 50 per cent and its ability to take external stress, such as the centrifuge test, by 400 per cent."

It is in the area of electrical testing, however, that the Minuteman group is doing some of its most challenging and creative work. Proving that a transistor has only a .001 per cent chance of failing in 1,000 hours of operation can be not only difficult but extremely expensive and time consuming.

"The easiest way to do it, of course, is to spend six months producing 100,000 transistors, tie up all test facilities for a few more months to check them and see what you get," according to Abe Okun, Division Administrator of Product Assurance. "The only hitch is, suppose more than one fails? Then, you have to spend several more months determining what went wrong, correcting for it with a new design and starting out to manufacture another 100,000 for testing. Even the U.S. Treasury probably could not stand this kind of strain too long."

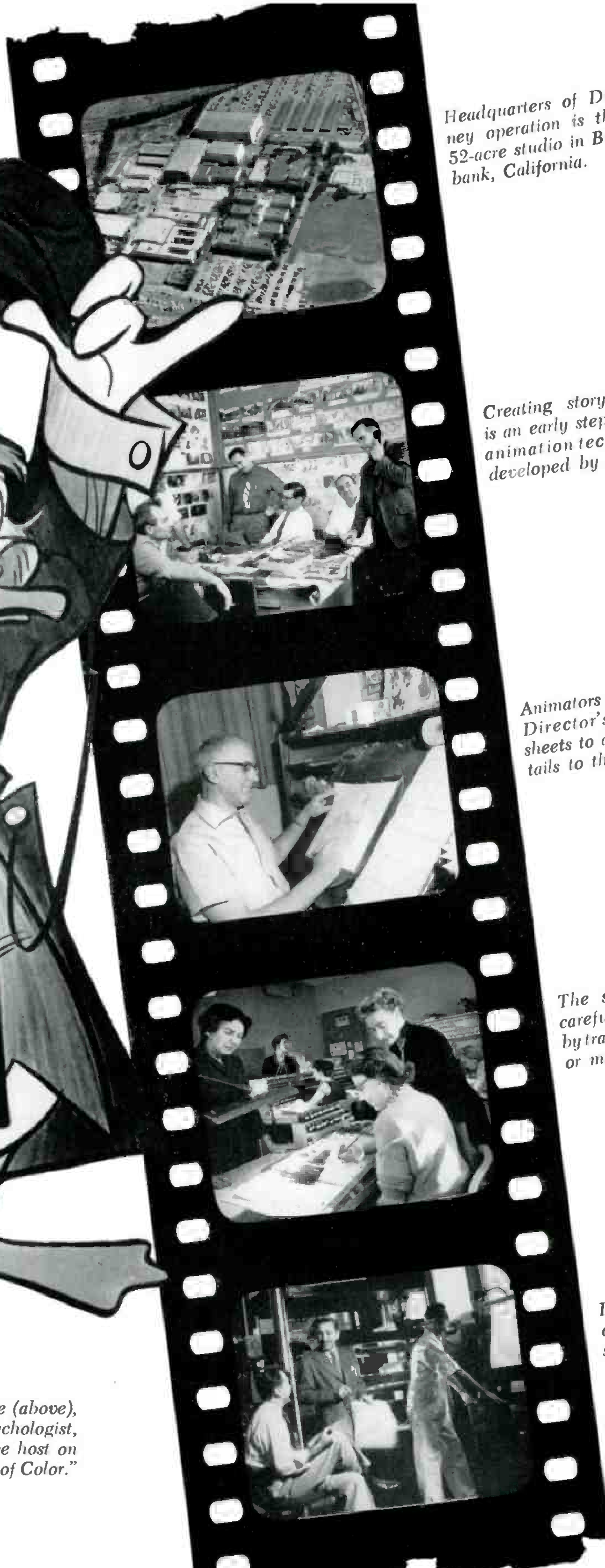
First deliveries of the ultra-reliable Minuteman transistors are scheduled for May of this year, he said, and much work needs still to be done.

To solve the dilemma of proven reliability without testing 100,000 transistors first, the Minuteman group has devised an ingenious series of tests which involve running the Minuteman transistors at their maximum ratings, the ratings required of them in the Minuteman system and at ratings calculated to destroy them. From the wealth of data thus accumulating, very precise mathematical extrapolations are being made which tend to show the reliability the transistor can be expected to have under normal operating conditions. Relatively small samples are being used and as fast as structural or electrical defects are pin-pointed, design changes are made and the tests run again. Eventually, a near perfect transistor should result.

To speed up this thorough search for reliability, the Semiconductor & Materials Division has assigned its equipment development group to build a special automatic test set to check out the Minuteman transistors as they are made. This set, nearing completion, will test 5,000 electrical characteristics an hour.

"Unquestionably, one of the key elements in the success of Minuteman's first test flight is to be found in the very high standards being set by the Air Force for all components going into it," commented Dr. Alan M. Glover, Vice President and General Manager of the Semiconductor and Materials Division. ■

The exacting standards of cleanliness necessary in the assembly of Minuteman transistors at RCA's Somerville plant are reflected here. Operator, far left, assembles active semiconductor elements in stainless steel jig for trip through alloying furnace. In middle photo, parts for the transistors are passed from outside plant into White Room's preparation area for cleaning and inspection. At right, technicians insert completed transistors into power-aging racks to test maximum rated capability.



Headquarters of Disney operation is this 52-acre studio in Burbank, California.

Creating storyboards is an early step in the animation technique developed by Disney.

Animators work from Director's exposure sheets to add final details to the sketches.

The scenes then are carefully hand-painted by trained artists in color model department.

Disney visits camera crews as they film scenes for an animated cartoon production.

Professor Ludwig von Drake (above), renowned scientist, lecturer, psychologist, and world-traveler, will be host on "Walt Disney's Wonderful World of Color."

Walt Disney's

Wonderful World of Color

A FAR-RANGING SERIES OF WEEKLY FULL-HOUR COLOR TV PROGRAMS THIS FALL WILL MARK THE LATEST MILESTONE IN THE FABULOUS CAREER OF HOLLYWOOD'S DEDICATED CHAMPION OF WHOLESOME ENTERTAINMENT

By ROLF GOMPERTZ

The primary purpose of entertainment is to dedelight. . . .

Its incidental function is to inform. . . .

The greatest creative satisfaction comes from wholesome entertainment that brings pleasure to everyone – from children to adults. . . .

The ultimate in visual entertainment is the use of color which gives full meaning to the world around us. . . .

THESE ARE THE GUIDING PRINCIPLES which have motivated Walt Disney since he drew a neighbor's horse – his first "character" – in colored pencil at the age of eight, until now as he prepares to produce and host "Walt Disney's Wonderful World of Color," an unprecedented series of weekly color television shows over the NBC-TV Network beginning this Fall, co-sponsored by the Radio Corporation of America.

Thus two of the nation's principal pioneers in the field of entertainment join forces to give color television one of its greatest boosts since its commercial introduction seven years ago.

Disney was one of the earliest users of color in motion pictures and has remained its dedicated champion, while RCA pioneered color in television.

"Color," says Disney, who has made virtually all of his productions in color for the last thirty years, "gives infinitely more meaning to an image or a scene. Only with the hues that Nature provides can you achieve the maximum in entertainment, whether it be drama or comedy, in cartoons or in filmed stories of real people in real settings and situations."

Disney will bring to the new series of full-hour color programs the wizardry which characterizes the Disney production of color motion pictures.

These programs will be produced especially for color television and will range over a wide field of subjects and treatments, from true-to-life nature stories to animated cartoons, from tales of adventure to the world of outer space.

The special programs will reflect a number of spectacular themes and treatments which Disney has been developing especially for color television over the past several years.

"This is a breakthrough that I have anticipated for years because I feel that color adds an all-important dimension for which we are thoroughly equipped," Disney stated. "Planning our entrance into this broader field of television, we had camera crews traveling extensively for many months photographing shows around the globe. We hope to weave a magic carpet of color to include people, places, nature, music, dancing, cartoons, the human and the fantastic drama of the universe."

One of the keys to Disney's fabulous success over the years is that he has always believed in wholesome entertainment which the whole family can enjoy.

He holds title to many "firsts" and many honors. He has won 29 Academy Awards, four Emmys, several University honors and literally hundreds of other citations and honors from all over the world. These are but outward signs of an underlying reality.

What truly singles him out in this kaleidoscopic industry of highs and lows is a consistent policy of excellence and originality.

He made his first bid for creative independence after only two months with an advertising company in Kansas City. His first free lance jobs were designing letterheads and theatre ads. His "office" consisted of free desk space on a small newspaper in return for free advertising drawings.

It was at this time that he met Ub Iwerks, another young apprentice artist out of a job. They formed a partnership, with Disney as contact man and artist, while Iwerks did the lettering and took care of the office detail.

The first month the two made $125, but when a Kansas City slide company advertised for a cartoonist, Walt got the job at a phenomenal $35 a week.

"I know I wasn't worth it," he says, "but I decided to try it. I turned the commercial art business over to Iwerks, and it was at the slide company that I got my start in the animated cartoon game. That was around February 1920. Two months later my partner was working there with me. We made animated advertising films, and my boss let me take home an old camera that was lying around. I rigged up a studio in a garage and started experimenting in my spare time."

Walt's efforts led to a new method of animation.

"At the slide company we used the old cut-out method of animation, joining arms and legs together with pins and moving them under the camera," he explained. "I found a new method of animation in a book from the library, tried it out, and convinced my boss it was a better system. He installed it."

Walt was 19 and impatient. He wanted to carry his experiments in animation further and invited several prospective young cartoonists to work with him evenings on a new idea — the animation of fairy tales. In return, he offered to train them and promised them a job if the venture proved successful.

His group spent six months working on a short subject called "Little Red Riding Hood." Upon its completion, Disney quit his job and formed the Laugh-O-Grams Corporation, capitalized at $15,000, to produce modernized fairy tales. He made seven films which were sold to a distributing firm in New York, which went into bankruptcy shortly. Disney's resourcefulness was put to the test once more.

Cartoon characters had already been used in films featuring real people.

"I'll reverse the process," Disney decided, pioneering a technique for which he became noted. "I'll put human beings into films featuring cartoon characters."

The result was "Alice in Cartoonland."

Disney headed West in 1923 with a worn-out suit, a sweater, some drawing materials, a sample reel of

Disney's production, "Fantasia," was a color milestone.

"Alice in Cartoonland" and $40, and set up shop in Hollywood with his brother, Roy (now president of Walt Disney Productions). It was tough getting financial backing but suddenly they received an order for an "Alice" series from an independent New York distributor. Walt rented the back end of a real estate office, hired two secretaries (one of whom, Lillian Bounds, became his wife), and eventually sent for his old friend, Ub Iwerks.

After a while, "Alice" was discontinued and Walt created "Oswald the Rabbit." The new series proved highly successful.

Characteristically, Walt wanted to keep improving it, but the distributor wasn't interested in improvement. And, characteristically Walt refused to compromise his creative integrity and severed his relationship with the company.

The only answer was to create a new character and make pictures himself. He remembered the friendly little mice which used to scamper around in his office in Kansas City. Mickey Mouse was born!

The first reel didn't make a ripple, largely because everyone was excited about sound which had just been born. Recognizing the importance of sound, Disney worked out his own method of synchronization, patented it, and convinced a sound company to use it. The result was "Steamboat Willie," the first Mickey Mouse cartoon with sound. The system is still used today at Disney's and by the cartoon industry.

"Steamboat Willie" was the first sound film in the animated cartoon field," Disney stated. "Now, the whole world of music could serve as a creative inspiration for our stories. And so, in 1929, the 'Silly Symphony' was born. However, one vital dimension was still missing — color."

Disney met this need when Technicolor made the breakthrough with the first three-color process. In 1932 he created the first color cartoon short, "Flowers and Trees," which also became the first cartoon to win an Academy Award.

Shortly, everything produced by Disney's studio was photographed in color.

"Snow White and the Seven Dwarfs" became the first feature-length cartoon in color, representing two years of planning and three years in production. It was the first time, too, that color was used dramatically to heighten the emotional effect of the story.

Another color milestone was established in 1941 with "Fantasia," a musical interpretation in terms of color and design.

The step-by-step operation for a Disney cartoon involves a vast pool of creative talent. A six-minute cartoon short requires nearly 15,000 pictures and takes about six months altogether. Obviously, feature-length cartoons are years in the making.

Whenever a new character is created — such as the comical Professor Ludwig von Drake, renowned scientist, lecturer, psychologist, and world-traveler who will present the Wonderful World of Color — it is up to the Story Department at the Disney Studios to come up with the basic story idea and a suggestion of the character. Here artists make a series of rough sketches which illustrate a story, somewhat like a newspaper comic strip.

This device is known as a "story-board." (In the case of Ludwig, it was not only necessary to make a cartoon character out of a duck, but to make him different enough from his famous American relative, Donald.) Following story approval and dialogue recording, the story-boards are turned over to a Director.

The Director now plans the entire picture and makes out exposure sheets containing detailed information about the timing of all action, music, sound effects and dialogue. The work then goes to the animator.

The animator considers the feeling of the scene, the idea to be "put over", the personality of the character, and proceeds to make a series of pencil drawings, which will bring these principles to life.

The assistant animator supplies additional drawings to carry the action and the scene moves to test camera. The test film is then viewed by the director and the animator, and, if approved, moves to the "touch up" stage. In this stage the lines are connected, incidental items such as buttons are added and the scene is ready for the Xerox process.

Xerox is a new process developed by Haloid Xerox Inc., of Rochester, N. Y., and specially adapted by the Disney studios for the animation medium. It can be described as a fast, electrostatic copying process by which the animator's pencil drawing is transferred to an acetate sheet (called "cels"). The process eliminates the need for inking and also has the advantage of retaining the subtleties of the animator's drawing.

The Disney studio has made several shorts and television shows with this process, but "One Hundred and One Dalmatians", Disney's recently released full-length feature cartoon, is the first feature to be done entirely by the Xerox process.

While the animators are busy with the characters, the Layout and Background artists go to work on the backgrounds or "sets".

At this point, the production moves to the Painting Department, where the color is added to the character "cels" in accordance with the color models already determined. A unique feature of the Painting Department is the Paint Lab, where Disney has developed 1001 different color shades over the years by means of a secret color process.

Walt Disney Productions is housed today on a 53-acre property in Burbank, Calif. containing four sound stages — two of which are among the largest and the most modern in the industry.

Many individuals think of Disney in terms of the cartoon characters he had made famous. However, Disney has many highly successful live-action feature motion pictures to his credit, including "20,000 Leagues Under the Sea," "The Shaggy Dog," "Old Yeller," "Swiss Family Robinson," and True-Life Adventure films such as his famed "The Living Desert" and "The Vanishing Prairie."

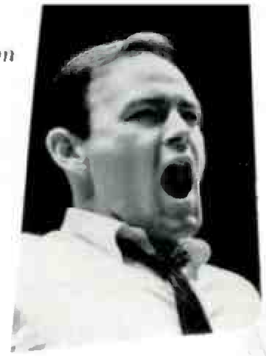
Consequently, variety will be the keynote of "Walt Disney's Wonderful World of Color." There will be at least fifty weekly colorcasts, each an hour or more in length, covering a broad range of subjects and stories, both live-action and cartoon.

Half of the shows will be entirely new productions, and the rest will be selected from Disney's vast library of color film, much of it never shown to the television audience before.

With the world for his province, and color television as his medium, Disney says,

"The possibilities are absolutely unlimited." ■

One of the high spots of "Do Re Mi" occurs when Phil Silvers shows his hired orchestra how to play a song and then remarks: "You hang around, you learn!"



John Reardon

Caught discussing some of the fine points of the score with RCA Victor officials are (second, third and fourth from left) Lehman Engel, conductor; Jule Styne, composer; and Phil Silvers.

First a hit Broadway musical, and now a best-selling LP album in both stereo and monaural, is Do Re Mi – a fast, loud and funny spoof of the recording industry. Star of the show and original cast album is Phil Silvers, as the "fall guy" who dreams of being "Mr. Big" in the record industry. Supporting Silvers is Nancy Walker, as his wife, and a top-notch cast headed by John Reardon and Nancy Dussault as the young romantic leads. With a book by Garson Kanin, music by Jule Styne, and lyrics by Betty Comden and Adolph Greene, Do Re Mi is packing-in the customers at the St. James Theater in New York and is doing equally well at record counters across the country. Pictured here are a few of the scenes taken during the recording of the album shortly after the show opened.

Adolph Greene

do re mi

Phil Silvers' hit Broadway spoof of the record industry is captured on RCA Victor's original cast recording

Lehman Engel

Phil Silvers and Nancy Walker

Nancy Dussault


40
30

Without human brains to guide it, the genius of the computer would be largely unrealized.

Minds Behind the Electronic "Brains"

Whole new job categories with bright employment prospects are springing up around the burgeoning computer industry

By JULES KOSLOW

THE REMARKABLE VIRTUOSITY of the computer — the quasi-human prima donna *extraordinaire* of the electronic age — has almost succeeded in stealing the spotlight from the human performers in the exciting drama of man's effort to increase his analytical powers by harnessing the electron.

Yet it is these performers — programmers, methods analysts, operators — who help supply the human brains that give "intelligence" to the electronic "brains" of the computer. Without these "computer people," the computer's genius would be largely unrealized.

"The inventors and scientists discovered her and made her a star," a methods analyst recently remarked, "but you might say we put the show on the road and keep it going by clarifying and improving her role to the satisfaction of the paying customers."

Continuing the theater analogy, it should be noted that it is the programmer who supplies the leading lady with her lines and the operator who push-buttons her to perform on cue according to a well-defined, carefully prepared script.

A composite picture of the programmer and methods analyst reveals that, by and large, he is a man in his 20's or 30's. Seventy per cent of computer people are under 37, 40 per cent under 32.

He has a college degree in any of a number of fields ranging from business administration and the physical sciences to English or psychology.

An electronic data processing operation creates jobs and job responsibilities that are new to most businesses. With little precedent to go by, early users of electronic computers improvised new titles and established job descriptions that appeared to meet their needs best. Selection of personnel has similarly been a matter of experimentation. While companies still seek employees with a good educational background, they no longer feel that a high order of mathematical or electronic ability is required for ordinary business electronic data processing.

Men dominate the field, though women programmers and analysts at all levels are not a rarity.

The number of persons on the staff of a computer installation varies according to the scope and size of the operation. Small-scale operations may employ only a handful while large-scale computer operations may employ hundreds. The government, for instance, which is one of the largest computer users in the country, made a survey of 236 of its computer installations and reported that 3,742 employees were required to operate them. Out of this total, two-thirds were engaged in planning and programming, one-fourth were operators, and eight per cent were administrators.

In addition to the thousands of men and women employed in staffing computer installations, there is a huge army of production workers, sales personnel, specialists in industry applications and in applied

That computers are a "young man's" industry is borne out by the fact that 70 per cent of computer people are under 37 years old, with 40 per cent of them under 32 years old.

programming, instructors, consultants, and service workers. For example, employment in the production sector alone now accounts for 105,000 persons. In 1956, it was 65,000. Even during recession-ridden 1960, employment in this area rose 10 per cent.

"The computer field isn't for the man who wants to work on the same old thing over and over again," one administrator recently remarked. "The word 'static' isn't in our vocabulary. Each day we're faced with a new challenge. You can't amount to much unless in addition to knowledge and intelligence you've got the most important ingredient of all – imagination.

"A man working in computers may start out thorough understanding of the new developments in computer methodology and technology."

Flanking the programmer and methods analyst is the supervisor or manager of a computer installation, who is high man on the operations totem pole, and the operator, who is an integral part of the team.

The supervisor is usually a man who has gone through the rigors of being a programmer and methods analyst. He may be a supervisor of an installation in business, industry, or government. Or he may be at a computer center, which supplies services to small and medium-sized firms that do not have their own computer installations.

Computer manufacturers like RCA have taken the lead in setting up centers (far left) to train personnel for their own and

by working from detailed flow charts and writing machine-language instructions for computer processing. Soon, he may be required to develop a program for computer solution or processing. In addition to preparing detailed flow charts, he may write machine-language instructions, debug programs, and test results for corrections. Next, he may be given the opportunity to conceive, develop, and improve automatic programming routines such as assemblers, compilers, and so on for specialized utility programs for debugging and for operational aids that involve large, sophisticated, or complex computer routines. And finally, a limited number may have the chance to progress into positions where they formulate and plan, in broad conceptual terms, original programming applications for large computer systems by using advanced knowledge of scientific, mathematical, or economic disciplines. To do this, they've got to have a

The operator seated squarely in front of the computer strikes an array of keys that trigger the complex mechanism. He – and often she – may or may not be a college graduate and is usually, like others in the field, in his 20's or 30's.

To meet growing personnel requirements, computer manufacturers have taken the lead in establishing training centers to assist them in filling their own manpower needs as well as to assist computer users in training their personnel. The trainees may be recruited from among college graduates or persons in business, industry, or government working in related fields.

However, the basic objectives, regardless of where the trainees are recruited, are to teach them what the computer equipment can do and to expose them in a real-life situation to how these techniques work.

Illustrative of a highly efficient training program is the one conducted at Cherry Hill, New Jersey, by

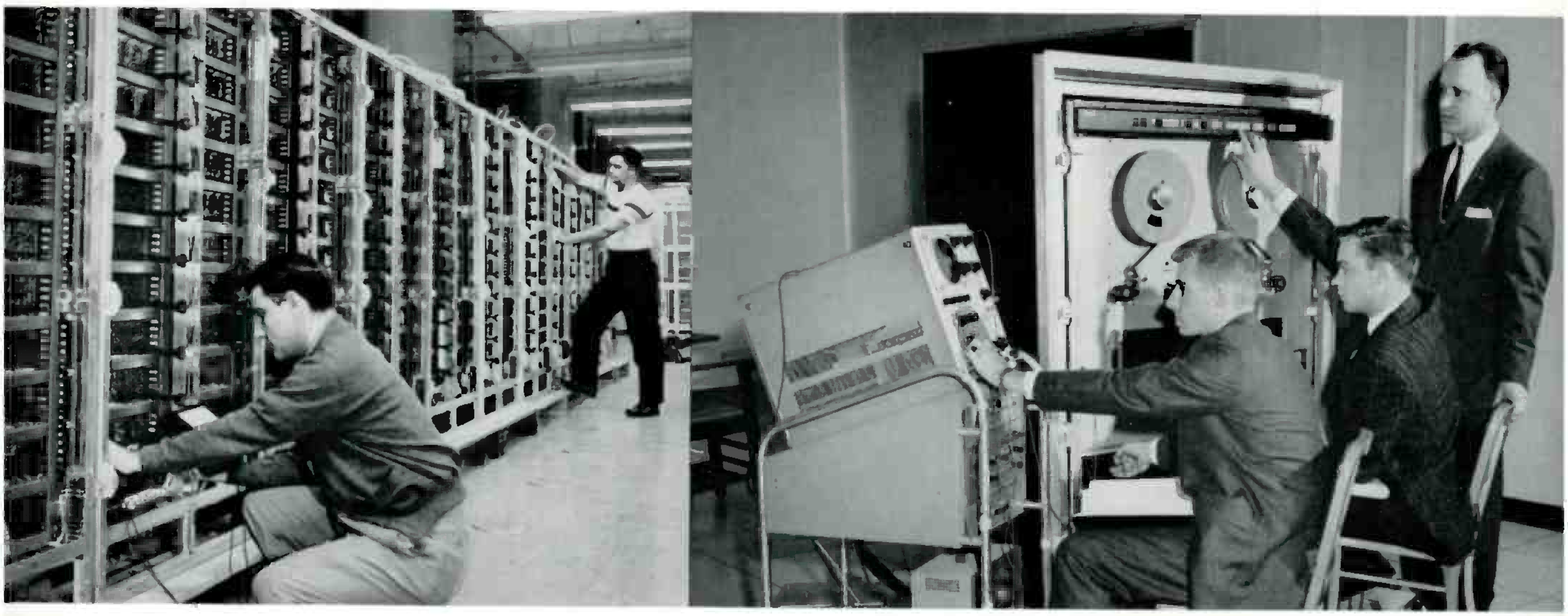
RCA, one of the country's leading manufacturers of computers, for sales representatives, programming and methods analysts, and product planning specialists.

College graduates with degrees in any of a large variety of disciplines are eligible. They are selected by means of tests and interviews that determine the candidates' general intelligence and imagination, as well as educational background. Experience to date has shown that educational background is not always the most decisive factor. One of the best trainees RCA has had majored in animal husbandry.

Training begins with an 11-week classroom work schedule that is both theoretical and practical.

"If he performs successfully in this capacity and shows interest and ability for sales, he then has the opportunity of becoming a salesman."

Other RCA-conducted training courses, specifically for persons interested in the programming field, were begun last December at RCA Institutes in New York. In addition to a 90-hour course for experienced computer programmers, a beginner's course is open to high school graduates who have had one year of business experience such as accounting, office administration, or bookkeeping; those who have completed a tabulating or data processing course at an approved school; or college graduates without previous experi-



their customers' organizations as (second from left to right) programmers, installation specialists and maintenance personnel.

"We try to get the trainee on machines as fast as possible," says D. H. Kunsman, Vice President and General Manager of RCA's Electronic Data Processing Division. "That's where the real test begins. It's a tough course, but the rate of attrition has been low. For example, in a class of 65 last year, only two students dropped out.

"After the 11-week training period is over, the trainee may be assigned to a control-point office. He is now a member of a team and may perform a variety of jobs connected with sales. Sometimes, at the control point, a man may be assigned to a customer location.

"During the next nine months, the trainee divides his time about half and half between pre- and post-sales situations. He might be called upon to program, to train others, to act as a captive consultant. At the end of one year, he is then eligible for assignment as an associate in methods programming.

ence either in business or in tabulating techniques.

From a long-range view, computers are still very much the miraculous prodigies they were a few years ago. In 1954, it was considered optimistic to predict that 50 companies would eventually use these electronic geniuses. Four years later, over 1,200 companies, government units, and the armed forces had installed more than 1,700 computers. Today, this number has doubled, with about half of them being used primarily for scientific work and the other half for business applications. Surveys indicate that the sales value of computers delivered will increase from an estimated $600 million in 1960 to $1.2 billion by 1965.

For the next decade or two, it is predicted that computers will continue to have the fastest growth potential of any industry in America. To the man in the field, this means he is getting in on the ground floor, and will grow as the industry grows. ■

Multi-million-dollar facilities like the one being built by RCA at Princeton enable scientists to simulate conditions that will be encountered beyond the earth's atmosphere.

INSIDE STORY OF OUTER SPACE

By KENYON KILBON

BEHIND THE SCENES of the Space Age lurks a new and off-beat version of the ancient paradox of extreme scarcity in the midst of surplus.

In the vastness of the universe the most plentiful commodity is space, starting a few score miles above our heads and stretching away in all directions through billions of light-years to infinity. Surrounded by this immensity, inquisitive man is yet compelled to expend thousands of man-hours and millions of dollars to obtain a reasonable facsimile of outer space in quantities of a few cubic yards for his use on earth.

The paradox is an inevitable result of our newfound ability to catapult machines into space before we have developed a reliable method for bringing them back for study or repair. Yet, because the construction and launching of satellites and space vehicles involves so much effort and expense, there must be some assurance in advance that they will function properly for a reasonable time in the harsh environment beyond the earth's atmosphere.

The answer today is to bring down within our reach some space in which spacecraft may be tested before they are launched. This is a task which, at first glance, resembles the legendary problem of Mahomet with the mountain. In this case, however, the mountain is moving. Bits of outer space are becoming available on earth through simulation of known space environmental conditions with the aid of increasingly elaborate and specialized equipment in laboratories across the land.

In tanks, chambers, and spheres of assorted sizes and uniform ingenuity, space engineers may now study the performance of their handiwork in reasonable approximations of the awesome vacuum, extremes of temperature, damaging radiation, and gravitational and magnetic forces that influence the strange devices which man is hurling outward from his small planet.

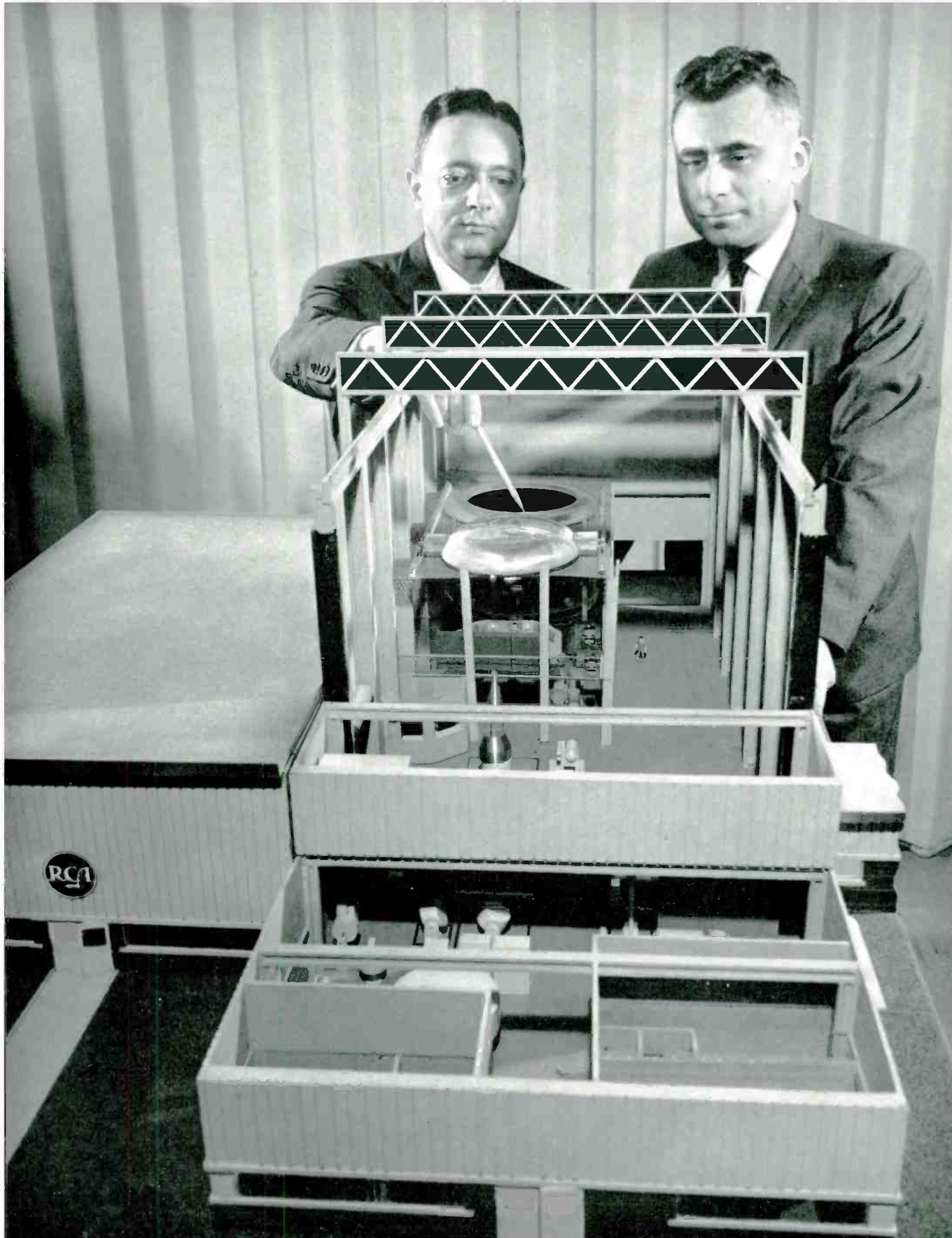
Through the first few years of the Space Age, such environmental testing has been performed with relatively small-scale and frequently improvised apparatus suited to the relatively small-scale objects that have been sent into space. Now, however, a more advanced era impends. In the planning and initial development stage are new satellites and space vehicles considerably larger and more complex than those of the recent past. Many will weigh a ton or more. Most will carry new and advanced equipment for specialized tasks: telescopes to study the heavens from beyond the earth's disturbing atmosphere; multiple television and electrostatic tape cameras to study the world's weather from vantage points in space; relay stations for global television and radio communications; scientific instruments to land on the moon and to scan the other planets at close range.

Greater size and complexity entail in each case a more substantial investment of time, ingenuity, and money, so that an even greater premium is placed upon reliable operation of the new vehicles in space. Hence, with the new generation of spacecraft is coming a new generation of large specialized environmental test centers to prove the systems before they soar irretrievably into the heavens.

Already, these new centers are taking shape in key locations across the country; the sites so far include California, Pennsylvania, Tennessee and New Jersey. More will follow within the decade, backing up a swiftly expanding space program with a substantial new technology aimed at simulating space conditions before the eyes of engineers on the ground.

These environmental laboratories will have certain impressive features in common – king-size vacuum chambers, large temperature-humidity rooms, and ponderous vibration machines. One of the pioneering examples, typical of the breed in its general features,

Barton Kreuzer (left) and Sidney Sternberg of RCA's Astro-Electronics Division examine a scale model of the Space Environment Center now under construction near Princeton, N.J.



is the multi-million-dollar Advanced Space Environment Center now under construction at RCA's Astro-Electronics Division, Princeton, New Jersey, under the direction of the Major Defense Systems group of RCA Defense Electronic Products. Upon its completion late this year, the new RCA center will be the largest such facility in the electronics industry, and the second largest anywhere in the nation.

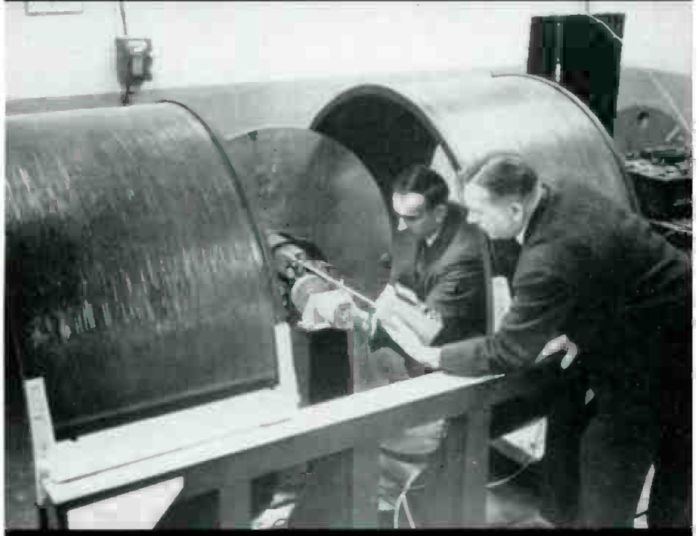
Construction of the RCA center began in an appropriately Space-Age fashion on March 23 with a small ground-breaking charge triggered by a signal from the Tiros II weather satellite, which was designed and built for the National Aeronautics and Space Administration at the adjoining facilities of the RCA Astro-Electronics Division. The signal was received through the division's tracking antenna as the satellite passed within range on its 1,763rd orbital trip around the world. The day also marked the completion by Tiros II of four months of successful operation in space – a full month beyond its anticipated operating life.

Built into the structure rising on the site of the novel ground-breaking are some of the most advanced concepts of environmental testing for space. The most conspicuous feature, housed in a vast room equivalent in height to an eight-story building, is a large vacuum-thermal chamber designed to accommodate completely assembled satellites and space vehicles now in the planning stage, and to subject them therein to a cruel range of environmental conditions through days or weeks of operation.

Developed by RCA Electron Tube Division engineers at Lancaster, Pennsylvania, the system outwardly resembles a gargantuan pressure-cooker – but one which functions in reverse. Looming 32 feet above floor level, with a diameter of 29 feet, the chamber receives and disgorges the space payloads through a top opening provided with a removable lid. The operation of the chamber is fully automatic, controlled from a central console in accordance with a pre-programmed sequence of test conditions.

When the vehicle is lowered into the chamber by an overhead crane, the lid seals automatically into place and powerful pumps lower the pressure within the chamber to the equivalent of the vacuum existing several hundred miles out in space – about one thousand-millionth of the normal atmospheric pressure at the earth's surface.

While the spacecraft experiences the vacuum, thermal systems within the chamber may alternately freeze and bake it by exposure to temperatures ranging from 100° F below zero to 250° F above. Throughout the process, instruments outside the chamber record the performance of the devices and sub-systems that comprise the satellite or space vehicle.



At the completion of its ordeal in the chamber, the payload is retrieved through the top opening and lowered to the high-bay area adjacent to the vacuum tank. Here it is inspected – or resuscitated, if necessary – and readied either for shipment to the launching site or for any further tests that may be required.

The trial by vacuum is the most spectacular phase of pre-flight testing, but it is only part of the story. Before any space payload breaks free from the earth's atmosphere, it runs a strenuous course strewn with numerous hazards that can cause failure in almost any part of the system. It is exposed to dampness during a wait of days or even weeks at a seacoast launching site in Florida or California before it soars aloft on its mission. Propelled upward in the nose of a rocket, it takes heavy punishment from acceleration and shaking before it is finally separated from the launching vehicle in the relative calm of space. The new generation of environmental test centers are being elaborately equipped to determine the effect of these hazards upon the more complex and larger space vehicles now on the way.

At the new RCA installation, for example, the need is being met by a large thermal-humidity chamber and an extensive vibration system, both designed to handle entire vehicles as well as their individual components and sub-systems. In the thermal-humidity chamber, test operations can be run in any type of environment from Arctic temperatures and desert dryness to a steamy 95 per cent humidity and extreme 250°F heat. The vibration system, resembling an outsize kettle drum, supports the vehicle on its flat upper surface for vibration with a 14-ton peak force at frequencies ranging from 5 to 2,000 cycles per second.

Into the new RCA center also will be moved an array of environmental test equipment already employed by engineers of the Astro-Electronics Division in the Tiros I and Tiros II programs as well as other space projects. Among these are a smaller vacuum chamber, shock and vibration machines of assorted sizes, and magnetic field simulators to determine the effect on space systems of the magnetic fields surrounding the earth and other bodies in space.

Upon its completion this year, the new center at Princeton will be the focal point of an environmental testing program which extends to other parts of RCA's Defense Electronic Products division and includes further existing test facilities that will aid in the space program. Installed at engineering centers in Camden and Moorestown, New Jersey, these comprise large stratospheric chambers, extensive vibration systems, and shock and impact devices designed primarily to prove the ruggedness of missile and airborne systems operating at or near the boundaries of outer space.

The importance of such facilities as these in the advancing space program is emphasized by their multiplication across the country under both governmental and private industry sponsorship. Ranking high in the government program, for example, is the Mark I Aerospace Environmental Chamber being erected with RCA help at the Arnold Engineering and Development Center of the U.S. Air Force at Tullahoma, Tennessee, to accommodate large spacecraft planned for future Air Force programs. Management of the design criteria and the system design of the Mark I is being exercised by Government Services, RCA Service Company, under a contract with the Air Research and Development Command.

When completed, the Mark I's chamber will accept a satellite up to 65 feet high and will simulate outer space conditions up to 300 miles. Other RCA divisions actively participating in the Mark I project are the Electron Tube Division, with its wealth of experience in designing the C-Stellarator Vacuum System; and the Astro-Electronics Division, with its success as prime contractor for Tiros I and II.

Together, the novel test centers, public and private are about to lay the foundation for new and spectacular advances in our burgeoning space technology. In themselves, they represent a unique and ingenious answer to a major technological problem: proving the worth of our most complex machines before we send them beyond recovery into an environment totally alien to human experience. ■

This special unit checks the Tiros satellite's solar cells.

Among the assortment of odd and specially-designed equipment necessary in the testing of spacecraft and satellites are (top to bottom) vibration units, magnetic drag test equipment, and vacuum systems.

Industry enters period of rapid expansion as common carriers, governments and business put the versatile electronic signals to work

THE BOOM IN MICROWAVE

By EDWARD J. DUDLEY

HIGH ABOVE Philadelphia's City Hall, the man with the power drill bent to his work. If it was a hole in the head they wanted he was equal to the task. The bit whirred, and in seconds it had burrowed neatly into the head of William Penn's statue.

The workman paused a moment to share with "Billy" Penn the panorama below, the sweep of the city that had replaced the sylvan scene of Penn's day. Then, before climbing down from his 600-foot perch, he tooled six more holes in Billy's hat.

The "hatpins" that the Father of Pennsylvania wore a few days later were UHF radio antennas. Instead of just standing there, as he has for generations, Billy was doing something. For the statue had become a vital link in the city police department's new and extensive communications complex.

Relying heavily on microwave relay, the RCA-built system is regarded as a model of municipal communications. Police officials from across the nation have visited its elaborate dispatch center to watch the fast and efficient handling of messages.

Mounted below the City Hall statue, microwave dishes beam signals to transmitters at the headquarters of four regional two-way radio networks, assuring strong coverage over the entire city. Duplex radio equipment in police cars permits uninterrupted two-way conversation, in the manner of telephone calls.

The effect is that of a spiderweb of communications over the whole of Philadelphia.

Philadelphia's choice of microwave for more effective and reliable communications is one that is being duplicated increasingly all over the nation, and in dozens of foreign countries, as the "pole lines in the sky" enter a period of rapid expansion.

Currently, industry bookings (exclusive of telephone company manufacturing facilities) for commer-

The New Jersey Turnpike's microwave system, originally installed by RCA, is being expanded to increase facilities for

cial microwave systems in the United States are running at an annual rate of approximately $50 million and are expected to surpass $70 million by 1965.

Sparking this accelerated domestic growth is the large-scale adoption of microwave by the common carriers. Prospects in the foreign market, where microwave is providing some emerging nations with their first communications of any kind, are equally bright.

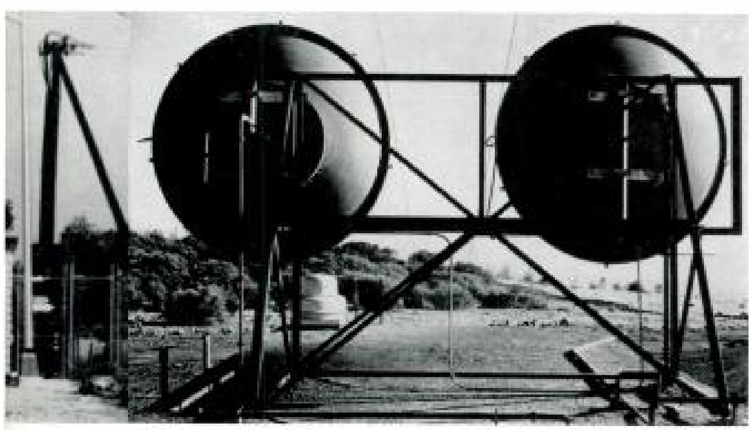
RCA has played a major role in the microwave industry's growth and development — as evidenced by the more than 1,000,000 channel miles of RCA systems now in operation — and has expanded its engineering and production facilities to meet the requirements of new and anticipated business.

A potential new market for microwave was opened last September when the Federal Communications Commission made frequencies available for the first time to virtually any type of business or industry.

This growth prospect was added to the existing FCC-licensed market made up of common carriers; government agencies, including the armed forces, public safety and highway departments; the television industry; and utilities, railroads, pipelines and similar right-of-way businesses.

A recent report of the Association of American Railroads illustrates how the microwave boom is taking hold in that basic industry. This year, says the report, U.S. Railroads will add more than 6,000 route miles of microwave systems to the 2,100 miles in use now.

communications and to permit remote control of warning signs.



Microwave works on the railroad as a communications jack-of-all-trades. It's a weather-proof, streamlined means of transmitting signals that control switches, activate signals, govern electric power flow and perform such other chores as speeding waybills between terminals by means of facsimile reproduction.

Among common carriers, Western Union is leading the microwave surge with the current construction of a 3,700-mile transcontinental network. It will use RCA's new MM-600 equipment, providing 600 channels to carry message traffic coast-to-coast at the enormous rate of up to 2,400,000 words per minute.

Microwave comes by its huge capacity through multiplexing, a method of multiple modulation by which many signals are transmitted simultaneously by a common means. The microwave channel is subdivided into comparatively narrow bands of frequencies. Thus many types of information can be sent simultaneously over the same radio circuit without interfering with each other.

Microwave was first made to hop the English Channel in 1931, but its commercial possibilities became apparent later during engineering studies of higher frequency waves for radar and television transmission. In these frequencies (1,000 megacycles and above), radio waves take on optical qualities, making it possible to focus them into narrow, powerful beams in a line-of-sight over long distances. A high-directional antenna focuses the waves into a concentrated beam to a fixed repeater station, located an average of 25 miles away, which relays it to the next station.

Because microwave combines huge capacity with freedom from the physical limitations of poles and wires, initial investment and maintenance costs generally are lower than for wire lines of comparable facilities. It has established a record of dependable communications even under the most severe weather conditions. In fact, air turbulence actually improves microwave performance.

Using microwave, any function that can be converted to an electrical impulse — such as pressure, temperature and engine speed, among others — can be transmitted to a central location and recorded. Mechanical equipment at unattended stations can be started, stopped and regulated by means of impulses sent by microwave.

Thus it is possible to install microwave equipment on oil well platforms, twenty to thirty miles offshore in the Gulf of Mexico, to meter oil flow from far below the surface and instantly report the data back to the mainland headquarters.

Men of the microwave fraternity who blaze communication trails in the sky to such remote locations often find that getting there is half the problem.

Over-water travel to the man-made islands is customarily by work boat or seaplane, anchored in choppy seas for the difficult transfer of men and equipment.

On land, work crews traverse a topographical melange and endure extremes of heat and cold. Often they may be found crouched in snowcats against the bitter wind, or gliding on skis over deep snow. At times they have to do battle with natural marauders.

During tests of a new station in California's San Bernardino mountains, engineers found that their equipment was emitting an abnormally weak signal. Upon checking the wave guide, a cylindrical component, they uncovered a squirrel's cache of acorns which had been absorbing some of the station's power.

In the Cheyenne Mountains, the optimum location for another station proved to be an outcropping of sheer rock. A 218-step staircase was built up its face and the cement, cinder blocks and other material for a 10-by-12-foot building, plus the electronic gear, was laboriously hand carried to the summit.

Less spectacular but increasingly important is the microwave installers' job of adding new links to systems paralleling the nation's superhighways.

Of the more than 900 miles of RCA microwave systems along highways in four states, the Illinois Turnpike network perhaps best illustrates microwave's versatility. In addition to its normal communications job, the system is used in the daily accounting of motorists' tolls. Payments are recorded on punched paper tape at each booth and the information is transmitted at intervals over microwave to a central computer.

Recently begun is the second addition to the New Jersey Turnpike's microwave system, originally ininstalled by RCA in 1952. Besides providing expanded facilities for police, administrative and maintenance communications, the new equipment will permit remote control of turnpike warning signs, now individually controlled by manual switches.

Guardian and expediter of the highway traveler, microwave also has proven to be a boon to the television viewer, particularly one who lives beyond the range of a TV broadcasting station. His picture signal is beamed by microwave to a community antenna where it is distributed by cable to subscribers.

Network television programs cross the nation and are sent to individual stations along the way via microwave. Live program pickups from remote points frequently are beamed back to the home studio by mobile microwave units.

More broadcasters are turning to microwave to link a downtown studio with an outlying transmitter station, an instance in which microwave avoids the difficulty of obtaining a pole line or cable right-of-way through built-up areas, and the expense of installation.

Such installations are not without their problems, however. Recently an educational TV station in New Orleans discovered that a proposed microwave path from its studio to the transmitter four miles away would be intersected by a new Mississippi River bridge. Upon study, RCA engineers determined that a line-of-sight beam could be aimed under the bridge at a point just high enough to clear the superstructures of passing ships.

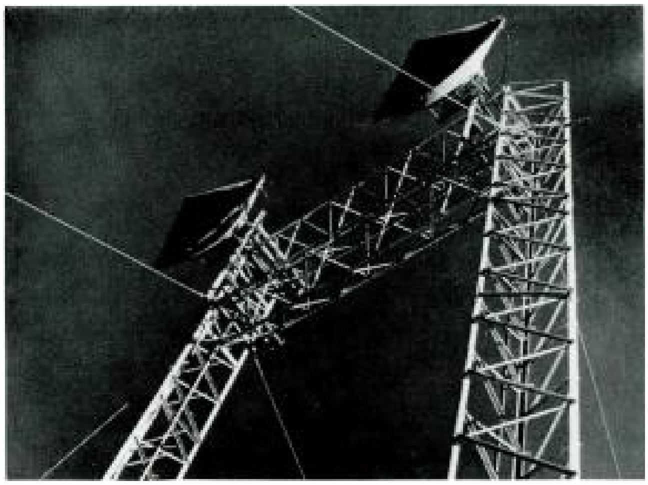
Overseas, where microwave has made impressive progress and is reckoned as a $100 million annual business, RCA has installed major systems in more than a dozen countries.

When disastrous floods struck the Netherlands, severing land lines, RCA mobile microwave equipment built for NATO rolled to strategic points to fill the communications breach.

A similar experience was reported by RCA engineers returned from Pakistan where a microwave system provided the only communications link between Dacca in the interior and the seaport city of Chittagong during last year's damaging hurricanes.

Until the RCA system was completed, the wide rivers, heavy monsoons and frequent floods had made unsuccessful any form of land line communications. The Pakistan network now provides for the first time nationwide voice and telegraph communications to 43

Microwave links Brazil's new capital with the outside world.



Western Union is installing a cross-country microwave system.

million people living in East Pakistan, on the Delta of the Ganges and Brahmaputra Rivers.

In Colombia, a five-hop, 200-mile link recently was added to an existing microwave system that now totals 111,000 channel miles. Some of the system's relay stations were built on mountain peaks 12,000 feet above sea level where work crews were isolated for weeks at a time by heavy snows.

To the south, where RCA earned Brazilian accolades for completing a cross-country system in record time for the dedication of the new inland capital city of Brazilia, microwave signals hop over thick jungle and rugged mountains to connect the city with major communications centers.

What happened in Brazil is about to happen much further north where, along the Alaska Highway, a 1,200-mile microwave system is being built through rugged territory from southwestern Alberta to the Yukon-Alaska border. Due for completion this July, it will provide greatly improved telephone facilities for Western Canada and for the new State of Alaska and will forge a new communications link in the U.S.-Canada defense system.

And so the world-wide web of microwave grows, sending threads into outer space as the forerunners of a global satellite communications system of tomorrow.

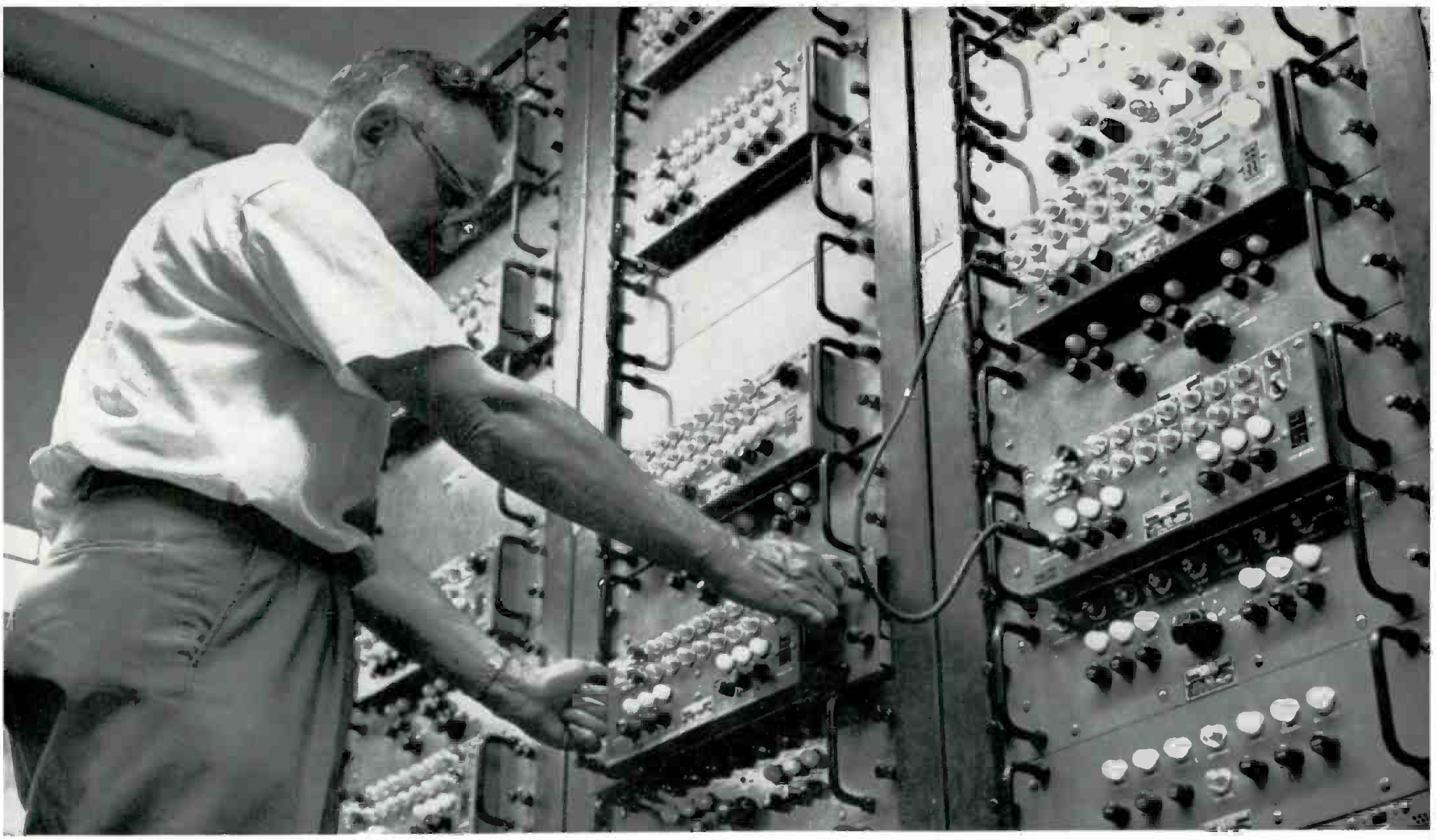
One of its immediate prospects for growth lies in the need for economical, high-capacity means of transmitting business data from scattered locations to a central computing headquarters.

Elsewhere, new uses are being found for microwave, and systems operators who have sampled its benefits are adding more links to their facilities.

Tomorrow "pole lines in the sky" may stretch beyond the atmosphere but, until that day arrives, they will continue their earth-bound job as a communications workhorse, a job that daily grows bigger. ■

Railroads will add 6,000 route-miles of microwave in 1961.

Microwave is used extensively in the nation's petroleum industry to control processes remotely.



FROM WIRELESS TO SATELLITES

SANTA MARIA INCIDENT POINTS UP THE ROLE OF RCA COMMUNICATIONS IN PRESENT GLOBAL MESSAGE-HANDLING AND ITS EXCITING PLANS FOR THE FUTURE

THE "GRAVEYARD" SHIFT at RCA's Chatham marine station on Cape Cod had barely settled down to its accustomed routine when the midnight quiet was broken by the staccato chirpings of a radio message:

"To The New York Times and all the newspapers of the world . . . Everything normal on board. We will inform the world in due time (what) we will do."

To a waiting world grown accustomed to space probes, ICBM's and satellites, it was like a throw-back to a bygone era. The message was the first word received from the Portuguese luxury liner S.S. Santa Maria since its capture more than twenty-four hours earlier by a band of armed political rebels – and it had arrived by "wireless" – the oldest form of electronics.

The RCA Chatham marine station, one of the most powerful in the world, continued to be the principal contact between the Santa Maria and an anxious outside world for a week while the crisis resolved itself.

The incident served to focus national attention once more on the role of international communications in today's world and on the revolutionary changes occurring in communications at an accelerating rate. As a leader in global communications with more than 400 cable and radio channels providing telegraph, telex, leased channel and radiophoto service to 96 nations, RCA Communications, Inc., was the center of much of this interest.

A look at the industry reveals that while, as in the case of the "Santa Maria" incident, manually-operated "wireless" still performs an important function in international communications, electronic data processing systems soon will be handling the mounting volume

A technician checks the transistorized automatic error detecting equipment at RCA Communications' Central Radio Office in New York.

of messages. And plans have been proposed to launch an all-purpose satellite communications system which would be open to all nations.

Emergencies such as the "Santa Maria" are not new to RCA Communications. In fact, the company boasts a long tradition of service under such circumstances.

The tradition began with the formation of the Radio Corporation of America in 1919 at the request of the United States Government to give this country pre-eminence in international communications. RCA absorbed the facilities of the old Marconi Wireless Telegraph Company of America, and by the end of 1920 had established message circuits to England, France, Norway, Hawaii, Japan and Germany.

Early headlines included the revolutionary transmission of radiophotos from New York to London and back again on December 1, 1924, and the receipt of the first wireless message from the North Pole – broadcast by the dirigible "Norge" in May, 1926. RCA operators kept the world in touch with the Byrd expeditions to the South Pole, the 'round-the-world flights of Anne and Charles Lindbergh in 1932, and Howard Hughes in 1938. And ironically, the same operator – Francis Doanne – who first contacted the Santa Maria was also the last to contact the German dirigible "Hindenburg" before it exploded on landing at Lakehurst, N. J.

During World War II, RCA operated a network of communications stations set up in the wake of the advancing Allied Armies to handle press dispatches and personal messages for the G.I.'s and thus relieved the pressure of traffic on the Army's command network. In the closing days of World War II, it was RCA Communications' operator John Schaub who sent the radiogram which outlined the Allies' terms for the unconditional surrender of Japan.

When the Korean conflict erupted in 1950, RCA again sent men and equipment to the scene to handle press dispatches and personal messages for the troops.

The biggest news story of the post-war era – man's first step into space – also involved the company when, on October 4, 1957, its receiving station at Riverhead, L.I., picked up signals from Sputnik I.

Last September, the end of an old era and the dawn of a new one was signaled when a carefully-placed demolition charge caused a slight tremor throughout RCA Communications' 70-year-old headquarters building in lower Manhattan.

A modern 39-story glass and steel skyscraper is being constructed around the present brownstone without interfering with the company's 24-hour-a-day operations. When completed, it will house the most modern international communications system center in the world!

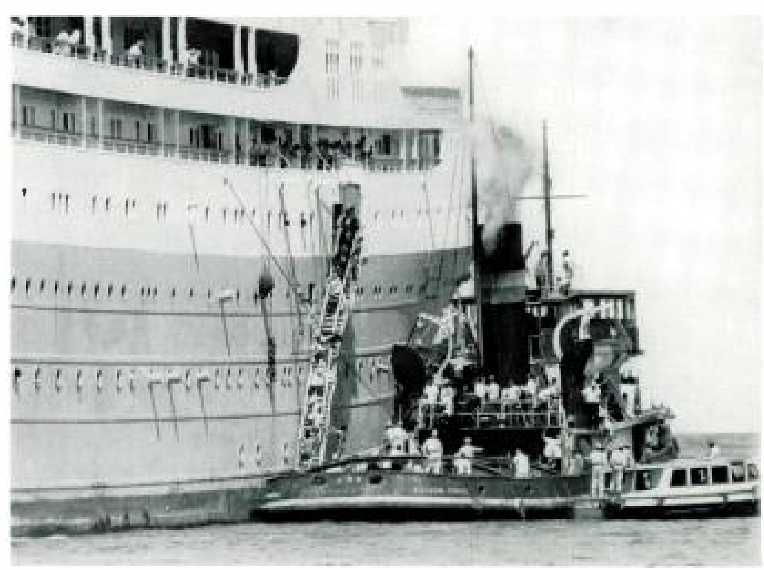
The center will contain an automatic telex exchange which in its ultimate form will permit direct dialing between teleprinter subscribers in the United States and the more than 50,000 telex subscribers in 61 other nations. The center also will include a completely new automatic switching system to control the flow of telegram traffic. At the heart of the system will be an array of electronic data processing equipment adapted from the RCA 601, the largest in RCA's family of computers. The equipment will automatically guide telegrams through the New York Central Telegraph Office to their destinations, while providing a permanent record of the messages sent and preparing bills for customers.

RCA Communications engineers also are perfecting plans which will lead to advances in the field of custom-engineered communications services, including the transmission and reception of computer-produced data over long distances.

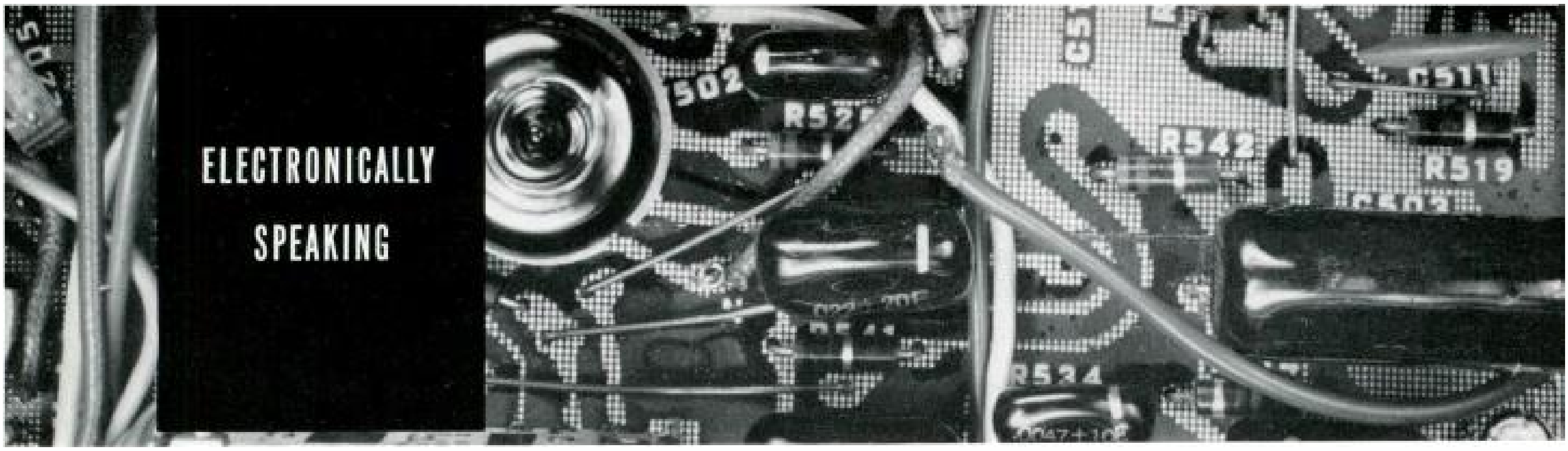
In the area of space communications, RCA Communications will provide the National Aeronautics and Space Administration with a number of international teleprinter and voice channels for administrative and command purposes preceding the launching and during the orbiting of the first U.S. astronaut.

The company also is studying the use of satellites as a means of newer and better methods of communications. As a result of these studies, RCA, together with RCA Communications, recently proposed to the Federal Communications Commission a new concept in global communications – a single, all-purpose satellite system that would be available to all nations for worldwide telephone, radio, television, telegraph and data services through two or three relay stations "fixed" in space high above the equator.

With such revolutionary advances in the offing, along with the prospect of continued global unrest, the international communications industry appears headed for a long stay in the world spotlight. ■



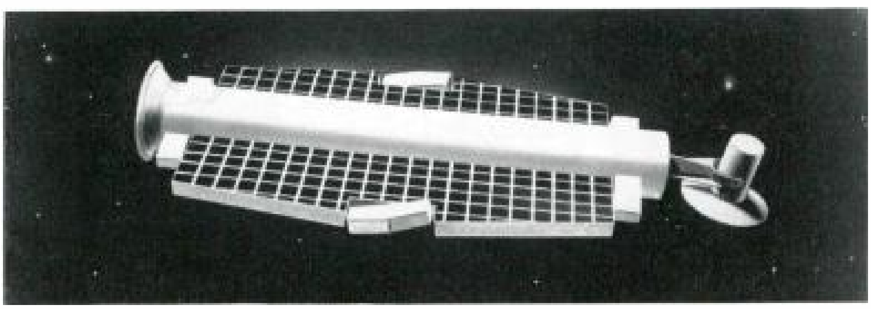
Principal contact with the "Santa Maria" was "via RCA."



ELECTRONICALLY SPEAKING

ALL-PURPOSE SATELLITE

A communications satellite of a design proposed by RCA to the Federal Communications Commission orbits above the earth in the artist's conception pictured below. It would play a key role as relay station in a single, all-purpose satellite system that would be available to all nations for world-wide telephone, radio, television, telegraph, and data services, through two or three such space relays.



The system was proposed as a service that could be achieved during the 1960's in a form that would provide communications channels for all nations through their own ground stations.

As described to the FCC, the system would employ synchronous satellite repeaters — space-borne relay stations orbiting 22,300 miles above the equator, where their speed would match the speed of the earth's rotation to keep each satellite effectively "fixed" above one point on the earth's surface.

"A system of this type employing only two satellites could link the major international communications areas of both hemispheres," said the statement. "With three satellites, it would cover every inhabited part of the world, with substantial overlaps."

RCA engineers pictured the satellites themselves as relatively small units, each consisting of a slender cylindrical body 13 feet long, with wide fins bearing solar cells to generate power from sunlight, and a dish-shaped antenna at one end, directed constantly toward the center of the earth.

THE COMFORTS OF HOME

The 3,500 officers and men of the U.S. Navy's aircraft carrier Franklin D. Roosevelt aren't without some of the comforts of home on journeys far from port.

Installed and operating aboard the big carrier is one of the most extensive closed-circuit television systems ever installed on a Naval vessel. Designed by RCA and purchased by the ship's crew from funds accumulated in its Recreation and Welfare Fund, the system comprises such professional equipment as portable TV cameras, motion picture and slide projectors and a control center console capable of feeding programs to 25 television receivers placed selectively on the 974-foot carrier as well as to TV sets on nearby ships.

SMOOTH AS SILK

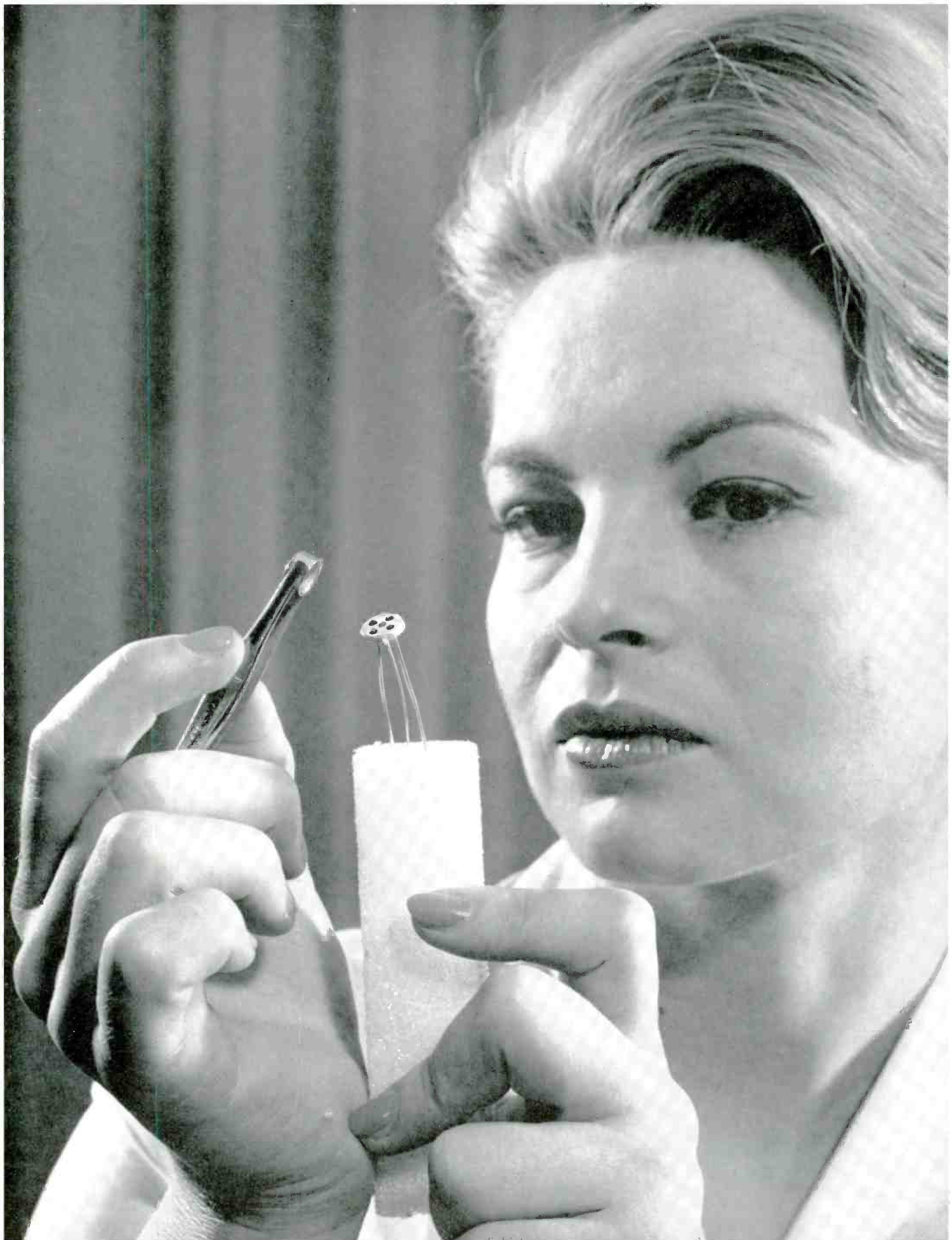
How smooth is a normal airplane landing compared with a ride on city streets? Four times as smooth, if a taped record made by RCA engineers is any criterion.

The engineers attached a tape recorder to the console of an RCA 501 computer that was shipped recently from Camden, N.J., to a bank in Stockholm, Sweden. A stylus inside the instrument recorded all the "ups and downs" — and horizontal motions as well — that the equipment experienced from start to finish.

The translated data showed that the equipment traveling by van over city streets was subjected at intervals to a jostle in excess of two "g's". A "g" is roughly the pressure of an object's own weight upon itself. The tape showed only one-half "g" on landings at airports in Iceland and Sweden.

SIAMESE TWIN

Nanita Greene (right) inspects the cap and internal structure of a valuable addition to RCA's family of transistors. Dubbed the "Siamese-Twin," it incorporates revolutionary design and construction principles in which it combines two identical transistors capable of boosting ten-fold the voltage of a standard car battery. Two transistors formerly were required to achieve the same performance. ■



RCA designs and builds the TV cameras and other TV studio equipment that record the action and sound . . .

RCA designs and builds the equipment that transmits the TV signals.

And RCA designs and builds the TV sets, color and black-and-white, that bring the picture and sound into your home. There is an RCA Victor model for every taste and pocketbook.

RCA takes the picture...sends the picture...and receives the picture!

No wonder RCA is the most trusted name in television

When you buy an RCA Victor television set, you can rest assured that you're getting the very finest your money can buy.

For RCA has an unequalled background of experience in every phase of the television industry. In fact, the very same RCA electronic skills, research, and facilities that build everything from studio cameras . . . to transmitters . . . to the tube you see the picture on . . . combine to bring you the sharpest, clearest television pictures you've ever seen.

From the very beginning of the industry—first in black and white, then in Color TV—RCA has been recognized as the most trusted name in television. Today, more RCA Victor sets are in use than any other make. Yet important as television is to RCA, it is but one of many fields of electronics in which the Radio Corporation of America is active as a pioneer and leader.

TMK(s)®

RCA

The Most Trusted Name in Television

RADIO CORPORATION OF AMERICA