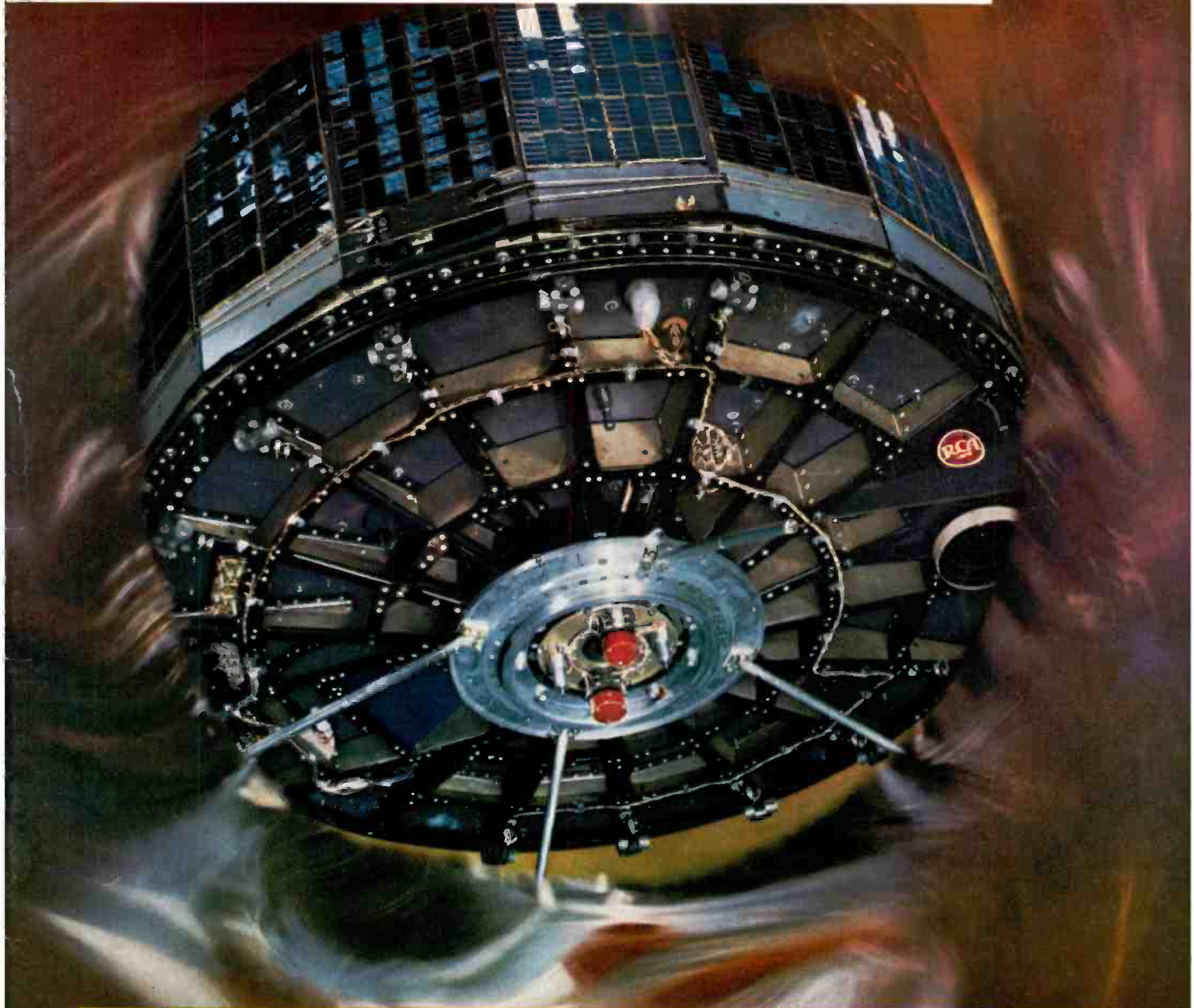
RCA

AUTUMN 1961

electronic age



ELECTRONICS IN SPACE BY JAMES E. WEBB, ADMINISTRATOR NASA

DAVID SARNOFF'S 55 PIONEERING YEARS

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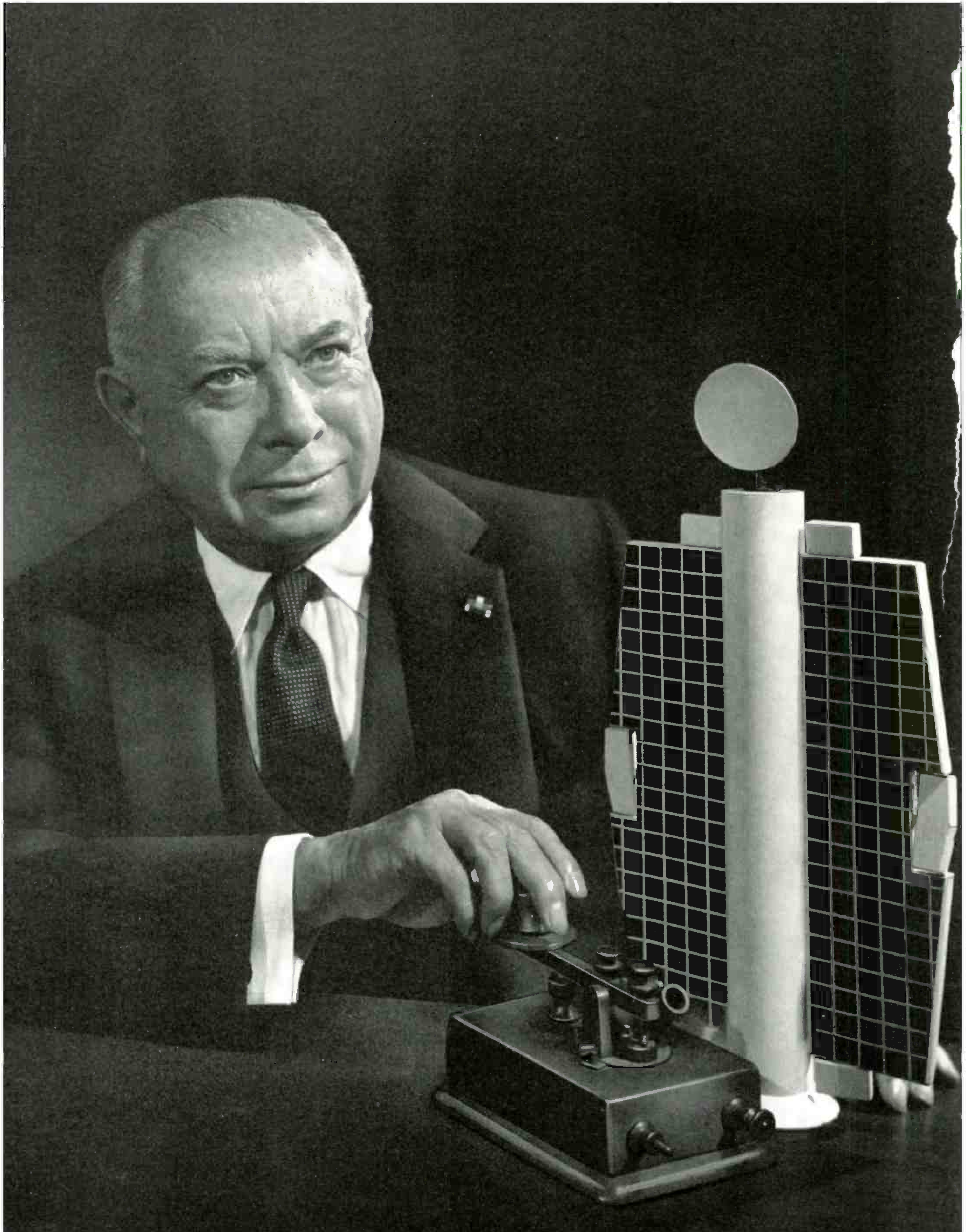

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RCA | electronic age

VOL. 20 / NO. 4 / AUTUMN 1961

COVER: *The RCA-built Tiros III weather satellite spotted hurricane Esther several days sooner than it would have been detected by conventional methods. The feat was hailed as a prime demonstration of the potential of meteorological satellites for revolutionizing weather forecasting. For the exciting story of "Electronics in Space," see article by NASA chief James E. Webb, page 11.*

In this issue . . .

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RCA Chairman David Sarnoff, who is celebrating his 55th Anniversary in communications and electronics, has contributed to progress from the era of the telegraph key to the space satellite.

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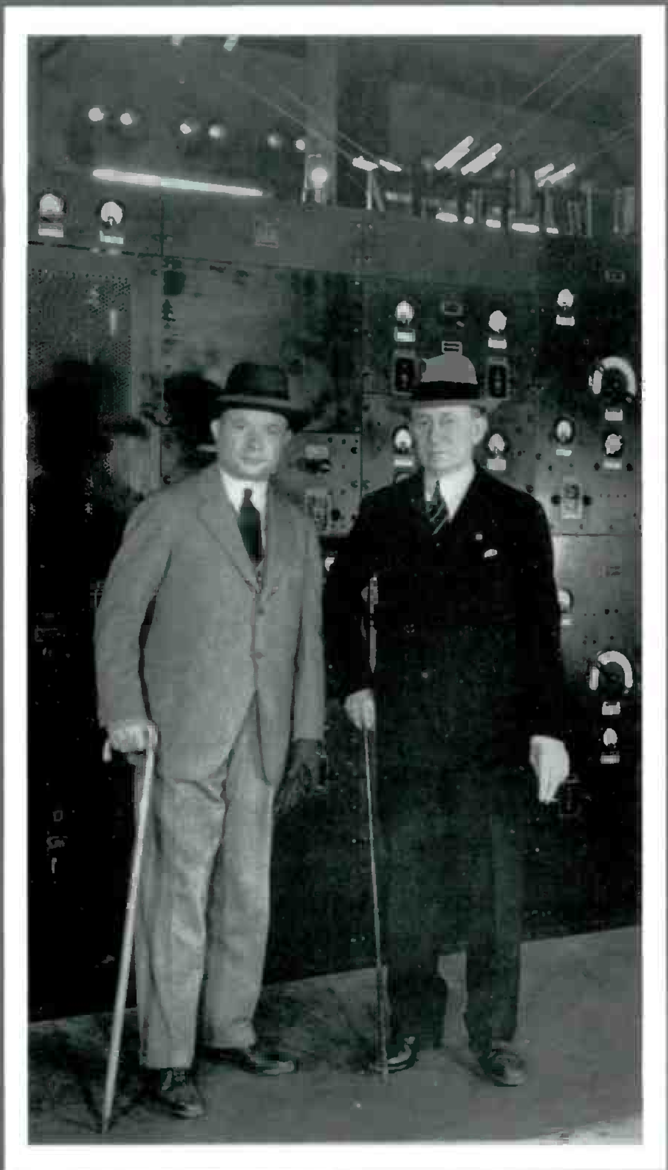
As a wireless operator for the Marconi Co.



With inventor Guglielmo Marconi in 1933.

FIFTY-FIVE

With Maestro Arturo Toscanini.

In uniform during World War II.

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DAVID SARNOFF'S CAREER HAS SPANNED
THE GROWTH OF ELECTRONIC COMMUNICATIONS
FROM TELEGRAPH KEY TO EARTH SATELLITE—
AND HIS OWN CONTRIBUTIONS TO THIS PROGRESS
HAVE BEEN BROAD IN SCOPE
AND ENDURING IN SIGNIFICANCE

Honored, with Mrs. Sarnoff, by France.

PIONEERING YEARS

FIFTY-FIVE YEARS AGO THIS FALL, David Sarnoff began a career that carried him from a $5.50-a-week messenger boy for the Marconi Wireless Telegraph Company of America to his present position as Chairman of the Board and chief executive officer of the world's largest all-electronics company, the Radio Corporation of America.

It has been a career studded with impressive "firsts." He first proposed radio as a home instrument for bringing entertainment, music and news into the living room in 1916; he arranged the first radio broadcast to a mass audience (Dempsey-Carpentier heavyweight championship fight in 1921); he established NBC as America's first broadcasting network in 1926; he made the first U.S. commercial telecast at the opening of the New York World's Fair in 1939; he pioneered in the production of the first commercial color television sets and programs in 1954; and he oversaw the development of the world's first weather satellite, Tiros in 1960.

Introducing television at 1939 New York World's Fair.

Today, Brig. General Sarnoff (he earned the title through wartime service with the U.S. Army

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Signal Corps) is intimately involved in another "first" — NASA's first active repeater communications satellite which the Radio Corporation of America is building for Project Relay. His far-ranging proposals on space communications have attracted world-wide attention. He has called for an all-out national effort to develop the first practical global satellite communications system as quickly as possible. He has urged that the United Nations be given programming access to the first satellite television channel, so that it might project to the world a live picture of crucial deliberations in the Security Council and General Assembly.

President of the Radio Corporation of America at 39, and Chairman of the Board since 1947, General Sarnoff has had the longest span of any chief executive officer among the nation's top twenty-five industrial corporations. Over the past three decades, he has directed RCA's growth from an entertainment-oriented company with 22,000 employees and sales of $137 million to a broadly-based enterprise with 88,000 employees and annual sales of $1.5 billion. Its twenty-eight manufacturing plants in the United States and fifteen plants abroad turn out products ranging from tiny ferrite cores for computers to huge radars for tracking missiles and satellites.

Asked recently what was his favorite segment of RCA's far-ranging business, the General replied: "The one that's in trouble. If things are going all right, they don't hear anything from me."

In overseeing RCA's world-wide operations from his office on the 53rd floor of Manhattan's RCA Building, General Sarnoff has a passion for efficient organization. "I don't want to do what someone else can do," he explains. He tries to concentrate exclusively on policy matters, and has delegated operating authority to RCA's President John L. Burns. The General never lets papers accumulate on his polished, leather-topped desk. When he finishes with one, he hands it to secretary Ella Helbig to dispatch to the appropriate executive with a penciled notation: "PSM" (for Please See Me) or "Pls Handle" or sometimes just a terse "Yes!" or "No!".

So extensive are the General's activities and so diverse his interests they defy a capsule summary. He has served as adviser to three Presidents. TIME Magazine has called him "one of the most imaginative strategists of the Cold War." Leaders in Government, industry and other fields consult him regularly to get his ideas on national policy. Twenty-one colleges have presented him with honorary degrees, and virtually every front-rank scientific, industrial and military group has paid official tribute to his accomplishments.

"About the only honor left for General Sarnoff," the noted clergyman, Dr. Ralph Sockman, observed recently, "is election to the Hall of Fame — and the only reason he hasn't achieved that is the stipulation that candidates must have been deceased for at least twenty-five years."

"DAVID IS LUCKY!"

Behind these honors is an up-from-the-bottom story as exciting as any in the annals of American business success. Sarnoff was born February 27, 1891, oldest of five children of a poor family in the tiny community of Uzlian, in Russia's province of Minsk. His mother used to describe her four sons in a way that has become a family classic. One of them she identified as the smartest, another as the kindest, a third as the handsomest. Then she would conclude the inventory by adding: "And David is lucky!"

"Frankly," says the General, "I have never underrated the element of luck in what passes for wordly success. I know it takes more than luck alone, but I do not hesitate to acknowledge that I have been lucky beyond my deserts. It was luck that my parents had the pioneering instinct and the good sense to bring me to this land of freedom and the opportunity that goes with freedom. It was luck that for me that opportunity materialized in an art and an industry even younger than myself. It was a lucky coincidence that I was born about the same time that the electron was discovered. And it was lucky that I hitched my wagon to the electron."

When young David arrived in America at the age of nine, he could not speak a word of English. His first school was the Educational Alliance on East Broadway where immigrants were taught the language (and where he is now an Honorary Trustee). After he had been at the school about a week, the teacher told him he was to recite at a school assembly. His one line was: "Cleanliness is next to Godliness."

When the time came for his recitation, his mind went blank. He stared out at his father and mother in the audience, but the words would not come. After a while, the teacher mercifully escorted him to his seat — but David never forgot this first humiliating experience as a public speaker. Determined to improve his technique, he joined a Debating Society and one year later was passionately arguing the question: "Resolved: That the Philippines be given their independence."

Today General Sarnoff ranks among the most widely sought-after speakers in the nation. Several hundred invitations pour into his office each year to address business conventions, scientific meetings, college convocations and other blue-ribbon affairs. Of these, he accepts fewer than a half dozen. But once he agrees to speak, he throws himself into the preparation of remarks with a zest that astonishes his associates. It

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is not unusual for a speech to go through a dozen drafts. The General likes to take it home and try it out on Mrs. Sarnoff to get some feel of audience reaction. Only when he is fully confident that a speech expresses his views precisely does he scrawl across the first page: "Stet" – printer's language for "Let it stand."

AN IMPORTANT DISCOVERY

As an office boy for the Marconi Company, Sarnoff made a discovery that was decisively to shape his life. He noted that the office men knew little about the technical side of the wireless business, and the technicians even less about the business side. He decided that the man who made himself equally at home in both departments would really go places.

Hearing that the Siasconset wireless station on lonely Nantucket Island was equipped with a first-rate technical library, he applied for a job there and got it. He studied books on electricity and wireless avidly, and two years later transferred to the Marconi Station at Sea Gate, Coney Island so he could enroll in night school. He took a special course in Electrical Engineering at the famed Pratt Institute in Brooklyn.

It was as a wireless operator atop the Wanamaker store in downtown Manhattan that Sarnoff first attracted world-wide attention. On April 14, 1912, he picked up a startling message that the Titanic had run into an iceberg and was sinking fast. For three days and nights Sarnoff remained glued to his earphones while a horrified country looked to him for news of the disaster. President William Howard Taft ordered all nearby stations off the air to reduce interference. Not until the rescue ship S.S. *Carpathia* had given him the names of the last survivors did the operator sleep.

General Sarnoff and Vice President Johnson (extreme right) with co-sponsors of Senate luncheon (left to right) Senators Aiken of Vermont, Magnuson of Washington, Javits of New York, Pastore of Rhode Island, and Keating of New York.

The absorbing drama of a young man in Manhattan as the sole contact with a catastrophe at sea made an indelible impact on the public mind. Radio was raised from a scientific curiosity to a necessity. Congress passed a law requiring every ship carrying more than fifty persons to install wireless and an emergency source of power for its operation. The Titanic sinking had thrust radio dramatically into the forefront of public consciousness – and with it the 21-year-old operator who for three days and nights reported the disaster.

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World War I gave further impetus to radio. At the suggestion of the U.S. Navy, the Radio Corporation of America was organized in 1919. It acquired the business and property of the American Marconi Company — and David Sarnoff.

BEGINNINGS OF RADIO BROADCASTING

One of Sarnoff's first moves was to sound out RCA's directors on his idea for a "radio music box" for the home. They were skeptical but finally agreed to risk $2,000 on the experiment. Sarnoff woke them up when he borrowed a Navy transmitter and helped give a blow-by-blow description of the Dempsey-Carpentier fight. Between 200,000 and 300,000 people heard the broadcast in theatres and lodge halls, ballrooms and barns, from Maine to Florida. They spread the news of the wonder so widely that the public clamored for sets. Some of Sarnoff's superiors of that day branded him a dreamer when he forecast "music box" sales of $75 million in the first three years. Actually sales from 1922 through 1924 ran to $83 million.

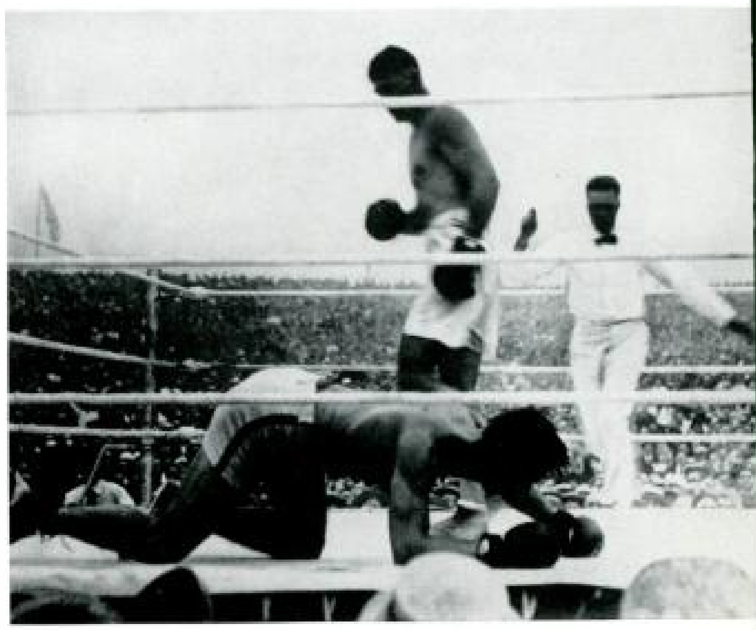
In 1926, Sarnoff organized the National Broadcasting Company "to provide the best programs available for broadcasting in the United States." To make sure he really got the "best," Sarnoff took a personal hand in shaping the programming. He arranged for Dr. Walter Damrosch to conduct the weekly "Music Appreciation Hour," which was widely received in schools throughout America. He put the Metropolitan Opera on the air from coast-to-coast. He hired the prestigeous President of Yale, Dr. James Rowland Angell, as NBC's educational counselor. His supreme coup was persuading Maestro Arturo Toscanini to return from Italy to the United States to conduct the NBC Orchestra — the first symphony orchestra created exclusively for broadcasting.

The Maestro's contract provided that if he did not like the orchestra, he could refuse to conduct. Mindful of Toscanini's fabled insistence on perfection, Sarnoff and his associates assembled the finest hundred-man musical aggregation they could muster. Everyone was a top-flight performer — everyone, that is, except the first clarinetist.

As Sarnoff and his aides walked up the gangplank to greet Toscanini, they debated whether they should confess their one weak spot. The debate was academic. The Maestro's first words were: "NBC Orchestra very good, first clarinetist not so good." He had been listening in Milan to the orchestra's preliminary concerts — by short wave. The Maestro immediately took the clarinetist in hand, and personally coached him into a first-class performer.

Sarnoff is credited with having contributed as importantly as any living individual to America's transformation from musical indifference to a nation where millions know and appreciate good music.

In his pioneering efforts, he never hesitated to spend money if he was confident that ultimately it would pay dividends. During the Depression of the 1930's, he resolutely refused to curtail spending for research



First mass broadcast: Dempsey-Carpentier fight in 1921.

activities. He fashioned a slogan and a weapon out of his belief that in troubled times, we need not only brave men but "brave dollars" as well.

He poured $50 million into the development of black-and-white television before realizing a nickel of profit. He invested almost three times that sum in bringing color television to full fruition. In both instances, he lived to see his judgment emphatically vindicated.

At the New York World's Fair on April 30, 1939, he launched television as a new service to the public with the words: "Now we add sight to sound. . . . Television is a creative force which we must learn to utilize for the benefit of all mankind." When the Television Broadcasters Association, in 1944, conferred upon him the title, "Father of American Television," it expressed the conviction that Sarnoff, more than any other individual, had nurtured TV through the dark years of immense outlays and no income.

The same determination characterized his fight for compatible color television. When the Federal Communications Commission in 1950 approved a rival colorcasting system, Sarnoff announced: "We have lost a battle but we'll win the war." And win it, he did. By working his scientists and engineers eighteen hours a day, seven days a week, he was able to stage a public

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demonstration of all-electronic compatible color by mid-1951. Many who observed the color contest at close range cite Sarnoff's stand as a matchless example of industrial idealism, a steadfast refusal to compromise on what he considered second-best at the consumer's expense.

Today, color is the most promising item in the entire television bag, and Sarnoff's soaring imagination is preoccupied with a new instrument he believes will bring on television's most decisive epoch – global satellite TV in full color.

"The future," he says, "has always interested me far more than the past." In recognition of his contributions to and support of research into the products of the future, the RCA Laboratories in Princeton, N. J. were officially designated in 1951 by the Board of Directors of RCA, as the "David Sarnoff Research Center." At the entrance is an imposing bronze plaque bearing this inscription:

"As a pioneer of wireless, he has contributed immeasurably to the development of radio, television and electronics as new services to the nation and to the American people.

"A creative crusader of progress endowed with a penetrating vision, David Sarnoff has continually led

First radio: Based on Sarnoff's "music box" concept.

the way across new frontiers in science, art and industry to make the universe vibrant with international communications.

"These laboratories, the RCA Victor plants, and RCA world-wide radio circuits and the NBC Radio-Television Networks, symbolize his faith in science, his constructive planning and enduring achievements.

"David Sarnoff's work, leadership and genius comprise radio's preeminent record of the past, television's brilliant performance of the present, and a rich legacy in communications for the future."

"WE'VE LEARNED TO LISTEN WITH MORE RESPECT"

First to hear about any new idea that emerges from the Sarnoff creative imagination is his Paris-born wife, Lizette, whom he married forty-four years ago.

"While we were engaged," she recalls, "he predicted to me that some day every family would have a little box in its home that would permit it to listen to Caruso, singing hundreds of miles away, and to baseball scores, news, lectures and so on. The radio, of course. My mother thought well of my fiance but told me she was concerned over his strange talk about voices coming through the air. It did not seem normal to her. Since then all of us have learned to listen to his predictions with more respect."

When the Sarnoffs return to their town house in Manhattan's East Seventies late in the evening from a dinner party, it is not unusual for the General to say, "Well, I guess I'll go upstairs to the office now and get some work done."

The "upstairs office" in his home is the General's favorite room. The walls bear inscribed portraits of Presidents Roosevelt, Truman and Eisenhower, a bronze plaque of Guglielmo Marconi, and a musical birthday tribute from Maestro Toscanini. The bookshelves are crammed with autographed first editions including Sir Winston Churchill's monumental series on the Second World War. There, too, are a few of the scores of citations, plaques, trophies, ribbons and medals he has been awarded ("the hardware you collect in the course of a lifetime," he explains).

The General is perhaps proudest of a series of World War II pictures showing his three sons, Robert, Edward and Thomas, in uniform, and his wife attired as a Red Cross Nurse's Aide. More recent albums trace the growth of the eight Sarnoff grandchildren from cradle to college.

Mrs. Sarnoff relates that as each of the grandchildren reaches the age of wonder, he invariably sidles up to her with the confidentially whispered question: "Tell me, what does grandpa *really* do?"

The question is natural enough. For in addition to his work in communications, Sarnoff has been actively involved in important Government and civic endeavors ever since 1929 when he served as Owen D. Young's assistant at the Paris conference on German reparations.

In an interview published in a national weekly, Mr. Young said of Sarnoff:

"He was our principal point of contact with the German delegation, and he did an extraordinary piece of work in negotiating for us with them.... One could easily see that each man in the group of American dele-

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gates and experts was effective and at one time did a job that saved that conference; each seemed to have a part in the crisis which prevented it from being wrecked, and that can be said of Sarnoff in particular, for there came a time when only one man could save the situation, and that arose toward the end with Sarnoff and the German delegation."

"We thought then," says Sarnoff, "that we had solved the pressing problems of that time. But we found out very soon thereafter that our plans and our hopes were all dashed to the ground by Adolf Hitler who repudiated the agreement that was signed in Paris."

During World War II, Sarnoff served as Communications Consultant on General Eisenhower's staff at SHAEF, both before and after the European invasion. Since the war, he has served on four special Presidential commissions dealing with National Defense.

When the Military Reserve program was faltering in the post-Korea ennui of 1956, President Eisenhower named Sarnoff Chairman of the National Security Training Commission to get the effort back on the track. With customary vigor, he staged an all-out promotion drive, embracing more than 6,000 radio and television programs and announcements (worth close to $2,000,000 in air time). He used stars like Dinah Shore, Perry Como, Garry Moore, Phil Silvers, Martha Raye and Ed Sullivan as "recruiting officers." Almost overnight the nation became Reserve-conscious. Enlistments shot up. The Defense Department pronounced the program a huge success. And Sarnoff, with characteristic regard for Government economy, turned back to Congress $12,000 of the $50,000 it had appropriated for the Commission's work.

A Memorandum he submitted to President Eisenhower in the White House in April, 1955, urging a bold new "Program for a Political Offensive Against World Communism," has become one of the most widely reprinted documents of the Cold War period. It has been designated as required reading in numerous college courses as well as in military officer training programs. In the Memorandum, he called for an unequivocal decision "to win the Cold War as the surest way to prevent a Hot War," and he outlined specific steps to achieve that objective.

This theme has predominated in Sarnoff speeches and articles over the past six years. It was elaborated on just recently in LIFE's series on The National Purpose and evoked an enthusiastic response from many leaders of the Free World. General Sarnoff's Cold War statements have appeared frequently in the Congressional Record. Few private citizens have been quoted more extensively on the floor of the United States Senate and House of Representatives.

TRIBUTE FROM SENATORS

In an unusual demonstration of admiration and friendship, members of the Senate recently invited General Sarnoff to a luncheon on Capitol Hill. "Several Senators present said they could not recall an occasion on which so many legislators had come together to honor a private citizen," reported The New York Times. Altogether, thirty-two Senators and Vice President Lyn-

DAVID SARNOFF'S FOUR

At a Senate luncheon in his honor August 30, General Sarnoff spoke of four journeys which, he said, "symbolize the spirit, the meaning, the purpose and the opportunities of America." He described them in this way:

My first trip was made in 1900 when I left with my mother and two brothers the country of my birth, Russia. I was then nine years old and the oldest of the children. We sailed across the Atlantic Ocean in a small and slow ship. We traveled in the steerage and it took us more than a month to arrive in the United States — the wonderful new land of opportunity. When I arrived in New York, I was unable to speak or understand a word of English. I was in a new world, in a new society, a new people. However, it didn't take me very long to reap all the advantages of America's fine and free public school system — nor did anybody interfere with me when I worked as a newsboy before and after school hours, in order to help support myself and my family.

That was trip number one in my memory.

Trip number two came only nine years later. As a boy of eighteen, I sailed on the Steamship New York of the American Line, from New York to Southampton, England. This time I traveled as the Marconi Wireless Operator on the ship. I was the only operator aboard, for it wasn't until the Titanic disaster in 1912 that a law was passed by the Congress requiring each passenger ship to carry a complement of wireless operators who could serve around the clock. So there I was, nine years after arriving in this country, serving as the Marconi Wireless Operator on a first-class passenger liner, with a first-class cabin all to myself, with a uniform and gold braid, classified as a ship's officer, messing with the Captain and the other officers, and entertaining and being entertained by the first-class passengers.

That was another trip for my memory.

My third trip, twenty years later, in 1929, was on the Steamship Aquitania. I left New York for Paris as an Assistant to Mr. Owen D. Young, who was Chairman of the United States Reparations Commission. In addition to Mr. Young, I accompanied Mr. J. P. Morgan, Mr. Thomas Lamont and Mr. Nelson Perkins, all members of the Commission. Our mission was to reach final agreement with the Germans on the debts and other problems left by World War I, and to replace what was then the Dawes Plan with what later became the Young Plan. In the company of these financial and industrial giants, and working as Mr. Young's Assistant, I was selected to negotiate on behalf of our Allies with Dr. Hjalmar Schacht, who represented the

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Color television: A scene from "Sing Along With Mitch."

don B. Johnson turned out. As a memento of the occasion, they presented the General with a handsome illuminated scroll, signed by each of them and bearing the citation: "Fifty-Fifth Anniversary Testimonial to David Sarnoff in Commemoration of His Dedicated Service and Outstanding Contributions to the Advancement of Communications and Electronics in the United States of America."

SENATOR KEATING'S STATEMENT

When called upon to speak, General Sarnoff told the Senators:

"I am not sure that any man deserves so great an honor as you are bestowing on me. But I do want to express to you how deeply moved and profoundly grateful I am for the friendship you have shown me, for this handsome tribute and this wonderful reception."

Later, on the Senate floor, several members delivered glowing encomiums to General Sarnoff. Senator Kenneth B. Keating of New York summed up the sentiments of his colleagues – and Sarnoff's own pioneering career – this way:

"I know that I speak for thousands of Americans – and thousands more the world over who have benefited from his extraordinary scientific achievements – when I express the hope that General Sarnoff may continue for many years to give leadership to the communications industry of which he is so great a part, and to the land of his adoption which he has served with distinction in war and in peace." ■

MEMORABLE JOURNEYS

Germans. I carried on these negotiations with Dr. Schacht for some six weeks. Of course, we thought then we had solved the pressing problems of that time but we found out very soon thereafter that our plans and our hopes were all dashed to the ground by Adolf Hitler who repudiated the agreement that was signed in Paris.

However, the impressive and human part of that trip to me was not only the companionship of these important men, who were much older and wiser than I, but the fact that I was a member of that group, and that we were met at Cherbourg by high officials of the French Government. This time, no passport problems, no baggage problems, no customs problems. Our reception was conducted with the pomp and protocol that the French are so expert in providing. We were taken from a special tender to a private train supplied by the French Government which whisked us to Paris and the comforts of the Ritz Hotel.

I shall never forget the moment, during this third trip, when I stood on the deck of that tender, reflecting upon this novel experience. The picture that flashed through my mind then was my first crossing of the Atlantic in the steerage. I thought of the contrast between the two trips and the fact that this could happen only in America. For it is as true today as it was then, that no other country in the world provides such vast opportunities to develop and to express whatever talents an individual may possess. On that occasion, I remember saying to myself, "God bless America." Surely, I am no exception for there are many, many others in the United States who have also developed, advanced and prospered. I have tried to convey this message to the rising generation of Americans and to point out to them that in my view there are more opportunities in our country today than there were when I arrived in New York, in 1900.

Now I come to my fourth trip, and that has occurred only today. From New York, I have come to the Capitol of this Nation to be received and honored by the distinguished Members of the United States Senate – the greatest deliberative body in the world. I am not sure that any man deserves so great an honor as you are bestowing upon me, but I do want to express to you, Mr. Chairman, and to your distinguished colleagues, how deeply moved and profoundly grateful I am for the friendship you have shown me, for this handsome tribute and this wonderful reception.

I will not presume further upon your time, because I know that you must respond to the Senate Roll Call. So I simply say, with all my heart, Thank You and God Bless You. ■

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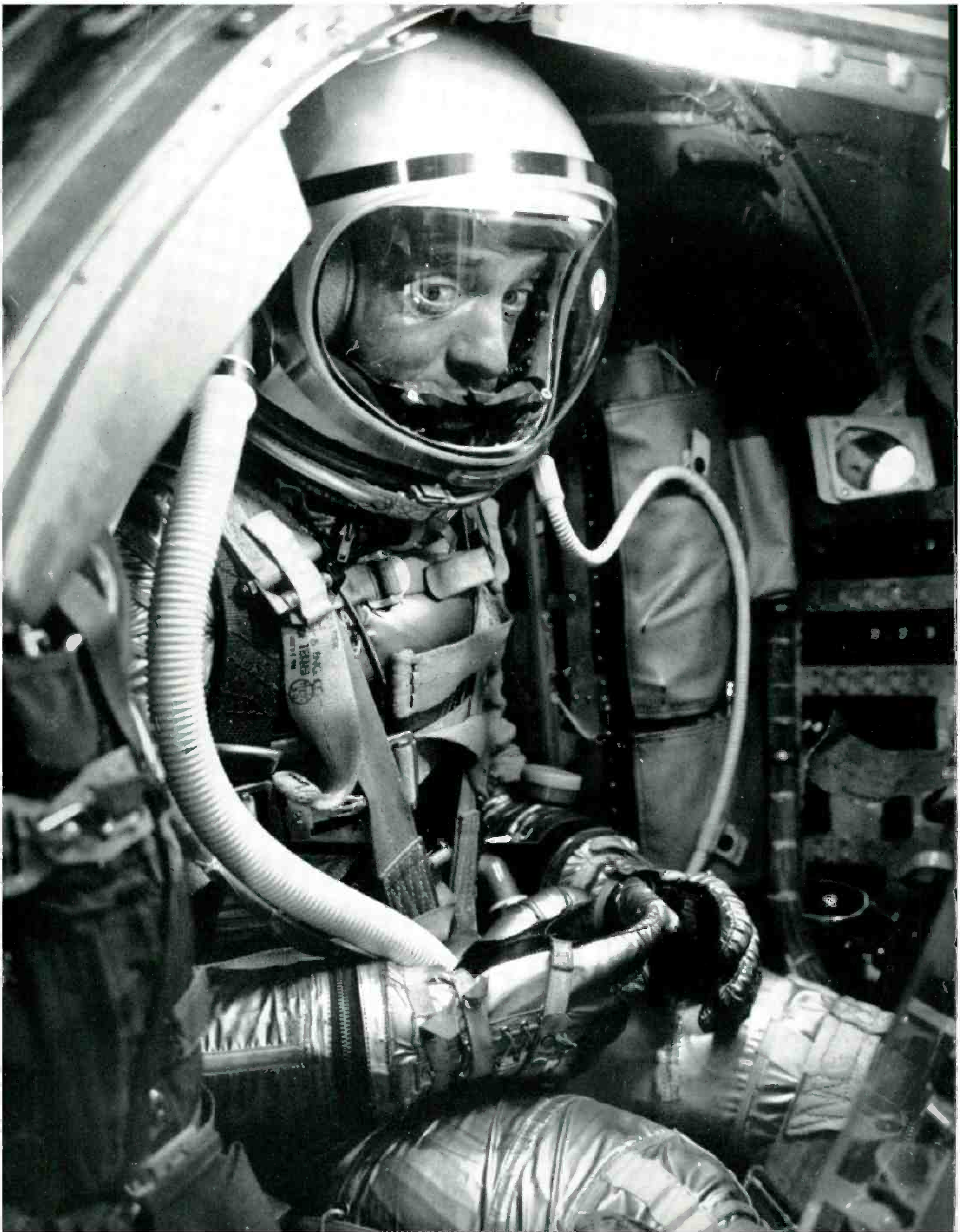

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by **JAMES E. WEBB**
Administrator,
National Aeronautics and Space Administration

ELECTRONICS IN SPACE

ITS ROLE IS BECOMING INCREASINGLY VITAL TO THE SUCCESS OF OUR NATIONAL SPACE PROGRAM, ACCORDING TO NASA'S CHIEF

SPACE EXPLORATION IS PRESENTING the technology of electronics with some of its greatest and most urgent challenges. Piloted as well as unmanned space missions are vitally dependent on electronics. Manned spacecraft must be equipped not only with highly reliable electronic systems for communications, navigation, and control, but also with devices upon which human survival in space depends.

Today, approximately fifty cents of every dollar spent for space systems goes into electronics. This ratio will certainly not decrease as the accelerated national space program advances toward one of the major goals for which President Kennedy has called — sending a three-man team of U. S. astronauts to the moon before 1970. Chances are that an even larger proportion of space funds will go into development of advanced electronics for Apollo, the manned lunar spacecraft, and for various unmanned vehicles that will be used to explore the moon's surface and investigate the nearer planets.

The longest strides in space electronics to date have been made in the fields of reliability, miniaturization, and reduction in power requirements. Even after man achieves the ability to overcome the universal force of gravity more efficiently than he can now, these three factors will continue to occupy a major part of the time and attention of space scientists and technicians.

At NASA's Goddard Space Flight Center, on the outskirts of Washington, D.C., where many of our scientific satellites are created and assembled, more than half the time spent in satellite construction is devoted to reliability testing — testing the components, the subsystems, and the overall systems.

Miniaturization has, of course, become an electronics commonplace in the United States through that ubiquitous device of the mid-Twentieth Century — the transistor radio. To the radio owner, this miniaturization is a convenience. In the U.S. space program, miniaturization is a major requirement.

The on-board telemetry systems of early U.S. space probes — Aerobees and Vikings, for example — weighed about 30 pounds and could operate on some fifteen channels, with battery-furnished power limited to a few minutes. One of our present telemetry systems, with battery power capable of four weeks continuous operation over forty-eight channels, weighs six and one-half ounces. And a joint U.S.-British ionospheric study satel-

Astronaut Alan Shepard, in his space capsule, is surrounded by electronic devices.

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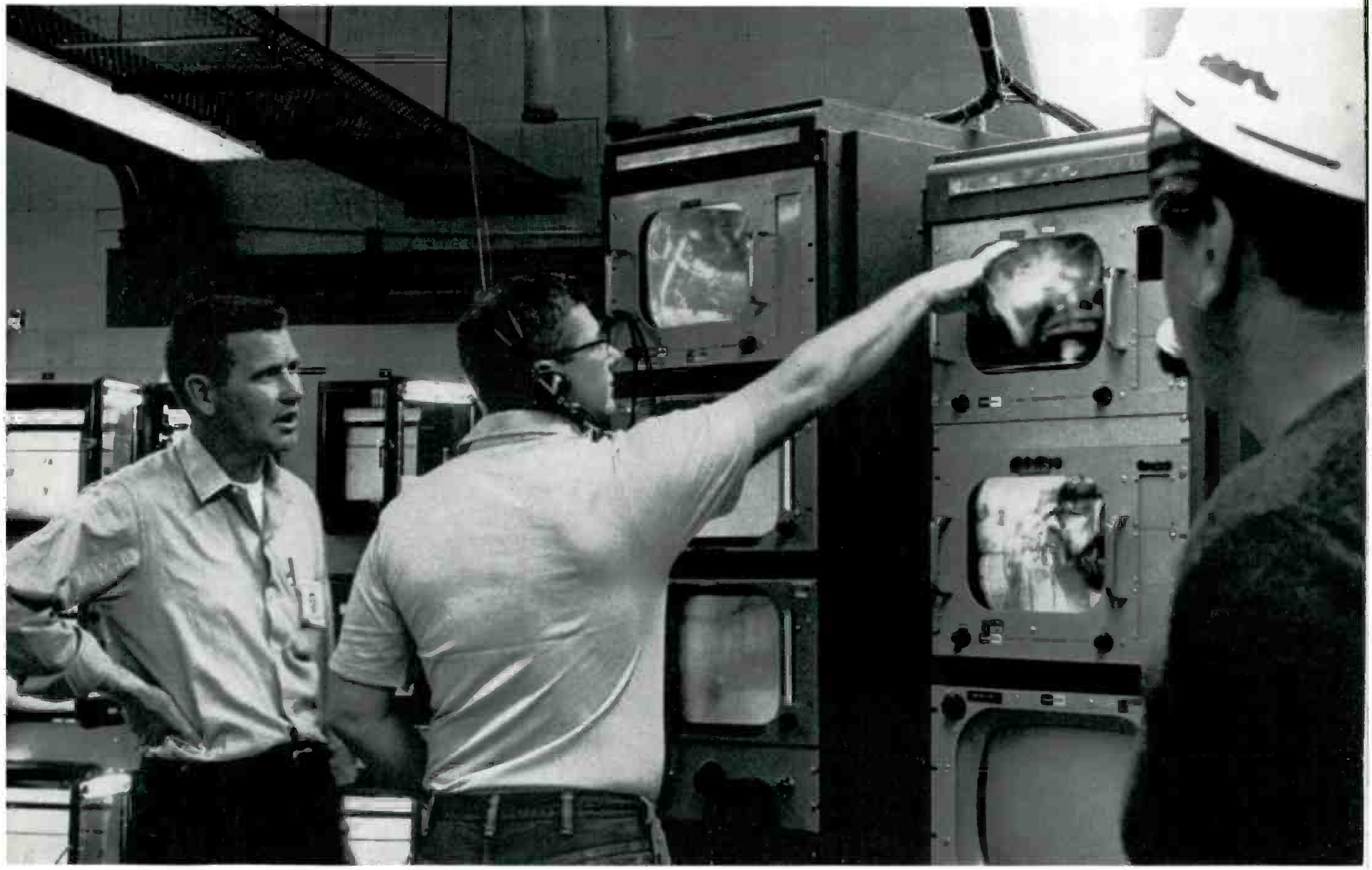
lite, to be launched in 1962, will send back information on 256 channels. More channels, of course, permit more experiments per satellite.

One electronic device used to switch currents in modern satellite telemetry is as complicated as four table-model radios. The device occupies about one-half cubic inch of space. In general, displacement of most electronic devices used in space exploration has been reduced from cubic feet to cubic inches in more than direct ratio.

The reduction of power requirements is, of course, a direct dividend of miniaturization. The decreased demand for power from smaller devices is translated into decreased weight of batteries and other power sources. New techniques, such as substitution of welding for soldering of connections has brought not only improved reliability but more efficient stacking of power packages and smaller space requirements.

The use of nickel-cadmium in chemical batteries and employment of solar cells to collect power from the sun mark two of the greatest improvements in power sources, both in efficiency and weight reduction.

Most missions in space require relatively long operating times, with no opportunity for maintenance. Reliability contributes to miniaturization by reducing the need for redundancy – either for parallel operation if the equipment should be considered marginal, or sequential if there is fear that no single unit can perform successfully during the entire mission.



Closed-circuit TV plays important role in monitoring rocket engine tests at the Edwards Rocket Site in California.

Among the more critical needs for reliability, miniaturization, and low operating power in manned spaceflight are the requirements for the instrumentation of the astronaut himself. In Project Mercury flights, this instrumentation not only provides a constant check of the astronaut while in space but records and preserves an enormous amount of physiological data for use in plan-

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ning the much longer Project Apollo space missions that will follow Mercury.

Continuous monitoring of physiological data during flight is a relatively recent concept. When Project Mercury was started three years ago, there were neither techniques nor instruments available for recording such measurements on board the spacecraft and simultaneously transmitting them by telemetry channels to ground monitoring stations.

In the flights of Astronauts Alan Shepard and Virgil Grissom, more than 100 miles above the earth, three physical measurements were made continuously—those of body temperature, respiration and heart action. The bioinstrumentation techniques had to be compatible with the electrical system in the Mercury capsule. They had to be reliable. The instruments had to be small enough not to interfere with the work the astronaut performed. They had to be comfortable for the duration of the mission.

For constant monitoring of body temperatures a new, miniaturized thermistor-tipped device was improvised for sternal application. Like other biomedical devices, it was connected electrically with both the onboard recorder and a ground telemetry system, and produced very good data without undue intrusion upon the astronaut's awareness.

MEASURING RESPIRATORY ACTIVITY

Several approaches to the problem of measuring respiratory activity were tested. A direct method was finally selected. In this technique, a thermistor is electrically heated to 200 degrees F. and attached by a special fitting to the astronaut's microphone. On the thermistor is a funnel which takes in air exhaled from the nostrils, while air from the mouth passes directly across the instrument.

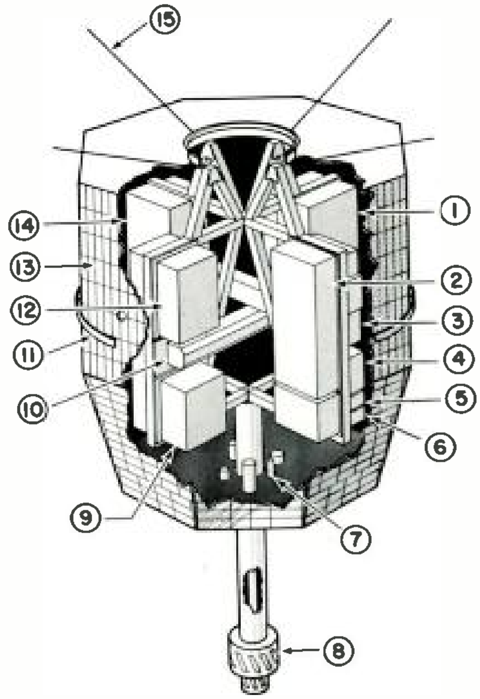
Electrocardiograms have been in use for half a century. Notwithstanding, for Project Mercury a greatly modified electrocardiogram had to be devised that would record accurately despite the astronaut's body movements and function effectively throughout the mission.

Among other things, this involved gluing firmly to the skin a non-conducting cup containing a non-irritating electrode paste which served as a connecting lead-off. Pulse rate and other heart information were picked up through the paste by a shielded wire attached to a stainless steel mesh. Buried in the paste, the mesh did not touch the skin. To reduce interference and muscle noise, the electrodes were placed on the trunk instead of on the limbs.

Pulse rates of the astronauts were plotted approximately at five-minute intervals during the early part of the countdown. As lift-off approached, these rates were counted for 10 seconds at 15-second intervals. This procedure continued during flight. Respiration rates were charted during both countdown and flight.

The pulse rate for Astronaut Shepard, incidentally, was a fairly constant 80 beats per minute during countdown, rose to 108 prior to liftoff, was about 126 at liftoff, and climbed to a peak of about 138 when the Mercury capsule separated from the Redstone booster. During weightlessness, the rate dropped to a low of 108 and reached 132 just after peak entry acceleration. This corresponded well with rates recorded for the astronauts during simulated flights in a centrifuge device.

A fourth, and extremely important, electronics check on the astronaut is provided by the communications system through which he is almost constantly in touch with one or more of the Mercury ground stations. It is difficult to overestimate the value of being able to



PROJECT RELAY

Major components of NASA's Project Relay active communications satellite, being developed at the RCA Space Center, are: (1) Travelling Wave Tube Power Supply, (2) Radiation Effects Experiment, (3) Receiver Exciter, (4) Encoder, (5) Decoder, (6) Receiver and Subcarrier Demodulator, (7) Radiation Sensors, (8) Wide-band Antenna, (9) Receiver and Travelling Wave Tube Exciter, (10) Travelling Wave Tube, (11) Altitude Control Coil, (12) Travelling Wave Tube Power Supply, (13) Solar Cells, (14) Batteries, (15) Telemetry Antenna

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inquire from earth, "How are you, Al?" and have a recognizable voice come back from space, "I'm A-okay."

The complex instrumentation requirements for small, lightweight satellites have inspired many of the new Space Age electronic devices used in both manned and unmanned space vehicles. For example, extensive use is being made of solid-state devices such as transistors, diodes, photodiodes, silicon solar cells, and so forth. Ideally suited to space use, these devices make possible rugged, compact, lightweight systems with high degrees of reliability and low operating requirements. Many of these systems have survived exhaustive ground tests under conditions that simulated shock, velocity vibration, and the general environment of spaceflight. They have gone on to prove their worth during actual space missions.

In nineteen satellites recently built at Goddard Space Flight Center, many thousands of transistors were used, but only six vacuum tubes, all told. This is not to underrate the vacuum tube but simply to point out the dependence space exploration is placing on solid-state devices.

Components used in space systems include radio transmitters and receivers, telemetry encoders, data storage and memory systems, and a variety of general and special purpose amplifiers and converters in a wide range of voltage and power ratings.

Many specialized components have been custom designed and built for specific missions — components such as optical and magnetic aspect indicators, event counters, pulse-height analyzers, and memory devices. Techniques that have gone into the design and building of specific items for specific missions provide an excellent foundation for progressively more advanced spacecraft electronic designs. Construction methods have included printed circuits and the point-to-point mounting of individual components on insulating and metal bases.

In many instances, groups of functional modules are assembled into the electronic system with foam-in-place plastics employed to protect the components and to provide solid form to the modules. These, in turn, are stacked and fastened into rigid assemblies with the interconnecting wiring added to form the final electronic system.

Searching for better utilization of area and weight in coming generations of spacecraft, NASA is developing a new concept of standardization. Heretofore, U.S. satellites have, in effect, been "custom-designed," including supporting power supplies, telemetry, hardware, and basic structures for each particular mission and scientific payload. For early and comparatively light and simple payloads, this procedure was dictated by the variety of launching vehicles employed and by the embryonic state of space science and technology. During the next few years, however, use of more powerful launching vehicles will make far larger satellites possible. To custom-design the heavy and complex scientific satellites that these launch vehicles will make possible would be prohibitive both in expense and in lead times. Moreover, to take full advantage of rapid advances in the space sciences, there is urgent need to reduce lead time for incorporating improved and new instruments into payload structures.

MODULAR DESIGN

The new standardized satellites will be constructed with modular compartments capable of carrying as many as fifty different experiments on a single mission. Each module or compartment in the satellite will be a simple, plugged-in electronic building block, devised so that various scientific experiments can be built independently and remotely, if desired, to fit one or more modules.

The standardized spacecraft will be used initially as the scientific payload of the first Orbiting Geophysical Laboratory (OGO). Weighing about 1,000 pounds, OGO will be placed in a highly eccentric orbit with a perigee of about 175 miles and a 10,000-mile apogee. The satellite will measure energetic particles and other geophysical phenomena. Later versions of OGO will take measurements of magnetic fields, atmospheric structure, the ionosphere, cosmic dust, and planetary data, and will make studies of solar physics, astronomy, meteorology, and biology.

The standardized approach has promise for other satellite applications. On a "space available" basis NASA will be able to provide room in some of its satellites for experiments designed by other Government agencies, other nations, commercial firms, universities, and private research institutions.

While many advantages can be foreseen in the standardized satellite, such as lowered cost, diversified utilization, and common power supply, perhaps the major gain it offers to space technology will be the added reliability which comes from the repeated and selective utilization of systems, sub-systems, and components.

Reliability is a factor whose value cannot be overstressed. Consider, as one last example, that asking one telemetry encoder in a satellite to function perfectly for a year is the equivalent of asking one hundred household radios all to operate flawlessly and without interruption for the same length of time. That is the degree of reliability we are seeking in order to bring standardized satellites for scientific and commercial use into operational reality. ■

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OPERA

Who would dream of going to the supermarket to purchase a ticket to the Met? In effect, thousands are doing it all across the country

OPERA IN THE UNITED STATES may never seriously challenge baseball as the national pastime, but few would have thought fifty years ago that its popularity would achieve the proportions it enjoys today.

Last January the debut of a young American soprano, Leontyne Price, at the Metropolitan Opera House in New York, made the front pages of newspapers throughout the country. This year's new seasons in Dallas, Chicago, and San Francisco are international music events rivaling those of legendary opera houses of La Scala, Vienna and Covent Garden. When the 1961-1962 Metropolitan Opera season looked as if it might be canceled because of labor problems, President Kennedy himself directed Secre-

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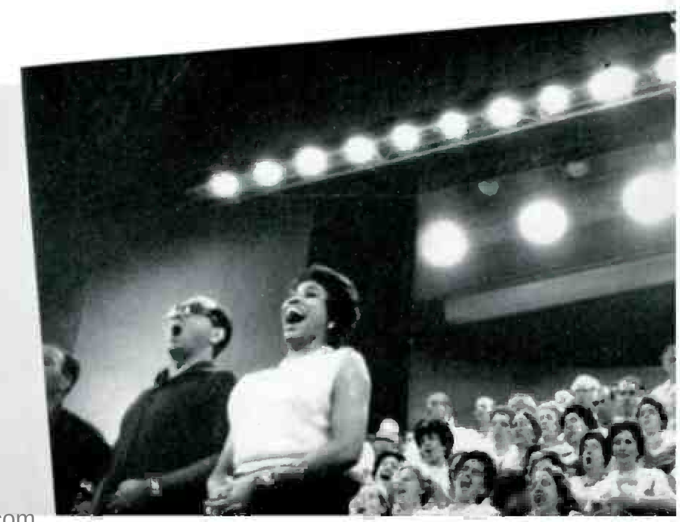
tary of Labor Arthur J. Goldberg to help work out a solution. Opera, obviously, is no longer the special domain of the fortunate few.

There are several reasons for the growth of opera's popularity. Radio and television have brought serious music into the country's most remote townships with programs such as NBC-TV's Opera Workshop, creating important early showcases for such stars as Leontyne Price and Giorgio Tozzi. Motion pictures have played an important part. And educators, with an ever-increasing emphasis on the value of music appreciation, have done much to help create new audiences.

However, the most important single factor may well be the development of the recording industry during the past half-century and its effect on the musical taste of the nation.

Enrico Caruso — the first, and to this day the most successful opera recording star — set the industry squarely on its feet and forecast the dynamic potential of opera in America. Through the years, such great singers as John McCormack, Amelita Galli-Curci, Lily Pons, Rise Stevens, Ezio Pinza and Jussi Bjoerling, among many others, have continued in the Caruso tradition — each adding a permanent mark of superb artistry, available wherever records are sold (and in 1961, opera records are being sold in drug stores, supermarkets, department stores and many other places in addition to the neighborhood record dealers.)

Millions of opera fans who may have never seen an actual opera are able to enjoy immortal performances starring the world's greatest artists in their own home. "Records," as Rudolf Bing, the Met's General Manager, has said, "have the advantage of being at the music-lover's beck and call, like a great novel or



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poem, at all times." Recording an opera becomes more than just another performance. As the world's great artists gather — in an empty opera house — the atmosphere is gay, almost festive. The stars look forward to the occasion, knowing that they will be spared the tension of a usual performance by the miracle of recording on tape which permits retakes and editing. Two new operas, recorded last summer in the Rome Opera House, have created much excitement.

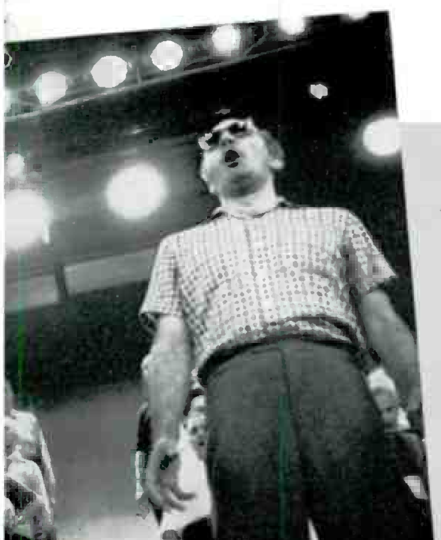
Featured in the recording of "Aida" are Leontyne Price (below), who was accorded the honor of opening the Met this season, Jon Vickers, Robert Merrill, and Giorgio Tozzi. The second new recording made in Rome — "La Boheme" — presents Anna Moffo (far right), the young American soprano from Philadelphia who was given the lead the second night of the Met season, Mary Costa, Richard Tucker, Merrill and Tozzi.

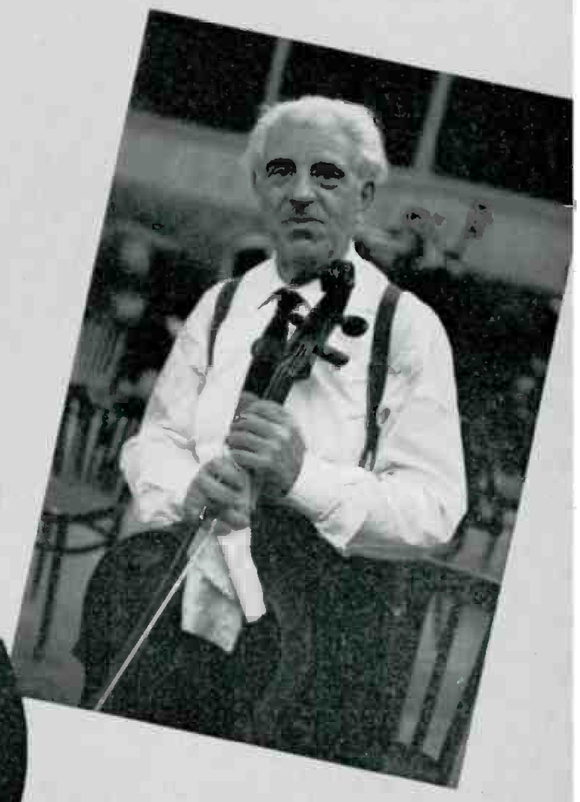
OPERA IN STEREO

These two operas also benefited from the use of stereophonic sound.

A stereo session requires many extra rehearsals and recording tools to achieve the effect of an actual performance. The seats in the opera house are removed to make room for the orchestra and the recording engineers on the orchestra floor. On the stage, a chessboard pattern of forty large, numbered squares is used to direct the singers' movements. A stage manager with thorough knowledge of the action of the opera physically moves the artists *while* they sing.

Standards of perfection such as these give fresh clarity and depth to recorded music, and the consensus is that records will continue to attract new audiences for opera. ■





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ELECTRONICS' NEW SEMESTER

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by **EDWARD J. DUDLEY**

For decades, the earphone headset has been a badge of communications. In the crystal set's heyday, it brought us Amos 'n' Andy. A generation later it rode aloft with the squashed-hat pilot of World War II. In a multi-lingual United Nations and a space-probing capsule, it is clamped over the heads of today's history-makers.

This fall, in thousands of schools and colleges across the nation, the ubiquitous headpiece has a new symbolism: learning through electronics. For in just two areas – language laboratories (the headset's new frontier) and television – educational electronics' growth and scope has been truly phenomenal.

During the language laboratory's introductory 1948-58 period, when it endured the "gadget" label of its detractors, there were some 250 installations, mostly in colleges. In 1959, another 450 labs were added, and last year 1,500 more. The U.S. Office of Education expects this year's installations to reach 3,000, which would bring the total number in use to well over 5,000.

Educational television came into existence in 1953, when the University of Houston's KUHT became the nation's first ETV station. Since then, another 56 stations have gone on the air. ETV stations can now reach a total of 70 million people. One hundred and fifty closed-circuit systems operate in schools and colleges; 7,500 schools use television for regular instruction; 250 colleges and universities give academic credit for televised courses. Altogether, more than 4 million students receive part of their instruction by TV.

All this adds up to the impression that an earlier student generation, whose learning aids were confined largely to dog-eared world maps of the roller-shade variety, would marvel at the classroom changes that electronics has wrought. For the electronics kit has many teaching tools besides open and closed-circuit television and language labs: motion picture and slide projectors, records and record players, tape and tape recorders, and a host of other audio-visual aids.

Among them, the language laboratory is definitely a growth item and prime example of how electronic equipment is being welcomed as a working partner in America's classrooms.

LANGUAGE LABS ON THE RISE

An acknowledged expert in the field, Professor Elton Hocking, head of Purdue University's department of modern languages, says that "in the last few years, enrollments in foreign languages have been increasing more rapidly than the school population, and language laboratories have been multiplying more rapidly than enrollment."

As an item of original equipment for new high school buildings, the lab is making an even more impressive showing. *School Management* magazine, in a recent survey, reports that 27 per cent of the new high schools being planned or under construction are installing language laboratories.

AID TO LANGUAGE TEACHING

Why this rush to join the "headset set?" A basic reason is the lab's proven capacity to enhance language teaching. Professor Hocking says the lab's advent "reinforces the modern concept of language teaching in the primary sense of speaking and understanding." Another reason is the constant improvement and simplification of equipment. A school marm no longer recoils in fear at a confusing array of buttons, dials and switches. Further impetus has come from the National Defense Education Act of 1958, which makes matching Federal funds available to school districts purchasing laboratories and other audio-visual devices.

Nobody suggests that the language laboratory will replace the teacher, whom one school official has described as "probably the most versatile audio-visual 'device' ever invented." But the lab can and does supplement the teacher's efforts, bringing a new and exciting dimension to foreign language instruction.

From RCA's standpoint, as a major supplier of language laboratories and other educational tools, the lab exemplifies electronics' broadening role in the urgent national effort to upgrade education. And it is part of the reason why RCA has become the nation's largest single source of electronic teaching devices.

LOW-COST MOBILE LAB

New equipment is constantly being introduced. For example, RCA's "Preceptor" language laboratory was joined last summer by a low-cost (under $1,000) mobile laboratory that can be moved from classroom to classroom and can be used to instruct up to ten students at time. A. J. Platt, Marketing Manager for RCA Audio Visual Products, expects the compact mobile unit to stimulate greater interest among elementary and junior high school administrators in laboratory teaching. It also will enable other schools to test the

THOUSANDS OF STUDENTS RETURNED TO CLASSROOMS NEWLY EQUIPPED WITH TELEVISION, LANGUAGE LABS AND OTHER ELECTRONIC DEVICES

Above left, Chicago pupils follow language lesson on tape; below, classroom in Hagerstown, Md., nation's largest closed-circuit educational TV installation.

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laboratory method at modest cost, without the $7,000 to $10,000 investment required for a fixed installation of twenty or thirty booths.

One of the mobile lab's unusual features is a newly-designed headset that combines the two earphones, a tiny transistorized amplifier, and a boom microphone all in a single unit. Because of the low level of sound required, the "tea cart" lab can be pushed into a classroom corner and put to use without disturbing other pupils working at their desks.

A visit to a typical fixed language laboratory can be an illuminating experience, particularly to an old grad whose French recitations were the despair of another generation of teachers. The student sits in an individual booth, equipped with a microphone and a headset connected to the teacher's control panel. As the lesson begins, he hears foreign words and phrases from a tape recording played into the system from the teacher's control console. When the voice on the tape pauses, the student repeats into the microphone what he has heard, and his own words are also reproduced in the earphones. The same equipment can be used by the teacher to give a "live" lesson.

SIMULTANEOUS RECITATIONS

This "listen-respond" technique allows the student instantly to compare his pronunciation and inflection with that of the instructor, a comparison made more meaningful by the common source and frequency level of the two sounds. This is essentially a form of learning by rote, but with a rather obvious difference. In the old one-at-a-time classroom recitation, the student stands conspicuously among his peers, prepared to amaze, amuse or bore, depending upon his facility with the language. The laboratory makes this kind of time-wasting togetherness a thing of the past. Since each student works alone, virtually without distraction, an entire class can "recite" simultaneously.

The student has his "own" instructor, plus the classroom teacher who can monitor or record his progress at any time by flipping a switch. An intercom system enables her to speak to the students individually or, by using an "all call" switch, as a group. And if a student is embarrassed by his lack of proficiency, it remains a private-wire secret that only the teacher shares.

STUDENTS LESS SELF-CONSCIOUS

Mrs. Marian Noll, foreign language teacher at Downingtown (Pa.) High School, where an RCA laboratory recently was installed, lists this as one of the lab's major advantages. "Teen-age youngsters feel less self-conscious about making these new sounds in the privacy of a booth than they did about reciting in front of their often unsympathetic classmates," she says.

What about learning rate differences among individual students? Mrs. Noll solves this problem by preparing taped lessons of varying degrees of difficulty. Thus, the slow student stays with the basic exercise until he masters it, while the advanced student can plow new ground.

At LaSalle Academy in Providence, Rhode Island, a large RCA laboratory is in use six periods a day, five days a week, and provides simultaneous instruction in French, Spanish and Italian. As many as five classes may attend the laboratory during a single period. The LaSalle lab has 150 student booths, arranged in clusters of six, and four teaching posts. Despite its size, LaSalle's "listen-respond" system permits a high degree of individual instruction.

Besides foreign tongues, the language laboratory brings other sounds to student ears. At Calvin College in Grand Rapids, Michigan, for example, an RCA laboratory is used for classes in music theory where the student listens to and records chord progressions and other sounds. The college has more uses in mind: for speech classes, and for recording and reviewing the sermons of student ministers. This suggests a whole new area of usefulness for the lab, well beyond its original purpose. Some schools now use it for remedial reading, for stenographic practice, and for geometry and other rote-learning courses.

Printed texts, photographs and other visual aids are being used in language laboratories with increasing frequency. And progress has been made toward a full-scale "listen-view-respond-record" system that would incorporate film slides, motion pictures or television for viewing on individual or classroom screens.

This could mean that U.S. schools and colleges are moving toward a future in which language labs, television and other audio-visual devices will be integrated into an "electronic learning center" that would encompass a large part of the curriculum.

GROWTH OF EDUCATIONAL TV

Educational television's rapid growth gives substance to this prospect. For instance, Florida, which leads all states in educational television, has five stations in operation and is planning to add fourteen more. An estimated 300,000 Florida students now get some part of their education via television. Neighboring Alabama has three ETV stations, and four more are planned. Georgia has two, and has plans for three more.

In New England, plans are afoot for a regional network of three ETV stations, tying together via microwave links WBGH-TV, Boston; WENH-TV, Durham, New Hampshire; and a new Maine station being built jointly by Bates, Colby and Bowdoin Col-

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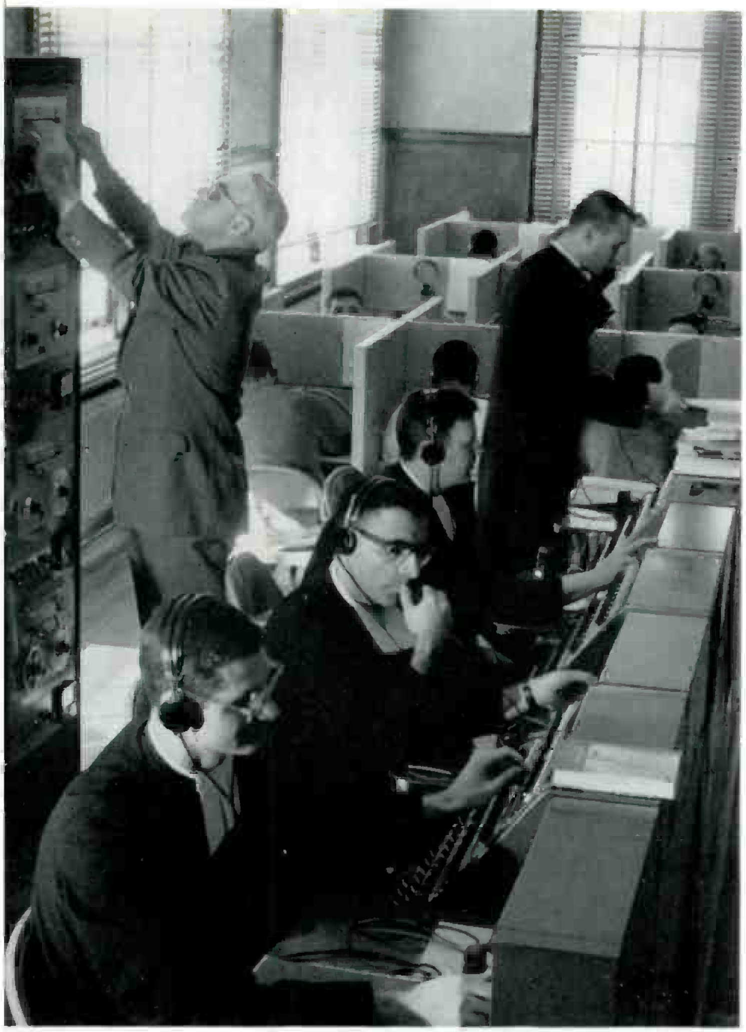

Language lab at LaSalle Academy, Providence, R.I., affords greater opportunities for student improvement.

leges. Six Midwestern states are planning an even larger network by 1963.

Closed-circuit television also is on the move. Here again a Southern state, South Carolina, has taken the lead with a statewide system that eventually will reach nearly all of its schools. With two educational broadcasting stations tied in, the system will bring instruction by the most talented teachers to pupils in city and rural schools alike.

Another prime example of closed-circuit TV's effectiveness is at Wayne State University in Detroit, where some 2,800 students receive instruction in eight different courses entirely by television. The University's two RCA television tape recorders are in operation more than 50 hours weekly, taping new subject matter and playing back taped lessons into the system.

OUTLOOK FOR THE FUTURE

With the value of learning through electronics amply demonstrated by the language laboratory, television and the myriad other teaching aids, many observers believe the next great surge will come from the "teaching machine," or as some prefer to call it, "auto-instructional methods" or "programmed learning."

Teaching machines now available are relatively simple mechanical or electro-mechanical devices. In a typical machine, the lesson appears in a viewing window as a series of frames or short steps, and the student responds by writing his answer or by pushing a button.

Work under way in this field indicates that more sophisticated machines, embodying the latest electronic techniques for both audio and visual presentation, are coming soon. The next step may be the "electronic school," an over-all approach to the use of electronic equipment and one of the areas RCA is exploring. This could evolve as an entire system in which a computer would control teaching machines and perform such chores as grading examinations, keeping a complete updated record of each student's progress and handling paperwork of several schools.

WHAT ABOUT TEACHER'S PET?

Electronics' full potential as a force for better education has barely been tapped. But the shape of tomorrow begins to appear in the vivid new sights and sounds entering more and more of today's classrooms through the magic of electronics. Against this bright vista of educational electronics, one well might ask what becomes of the teacher's pet, the rosy-cheeked lad who claps the dust from the blackboard erasers. Chances are he'll still be around, staying after school to study a wiring diagram. ■

Students at Camp Hill, Pa., High School talk privately with teacher through microphones.

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REVEILLE FOR COMPUTERS

Combat Operations Center at the headquarters of the North American Air Defense Command, Colorado Springs.

OUT OF THE NORTHERN NIGHT, electron beams trace a ghostly image over the polar horizon. Instantly, powerful radars seize the image in its spaceward flight. In seconds, the object – what it is, how great its speed, its course and probable impact area – becomes the intimate knowledge of the electronic computer. Moments later, this information is racing to North American Air Defense Command (NORAD) headquarters in the American Rockies. The nation stands alerted – if ever it need be – to a missile assault.

From polar wastes to tropic waters, from command centers to combat posts and storage depots, the computer is fast becoming the focus of the nation's military intelligence and deterrent strength. Its ability to gather, evaluate and release vast quantities of information for immediate action has made it, in effect, the electronic "brain" of the Armed Services. As one high-ranking Air Force officer put it: "Without computers and high-speed data handling we might as well cut out of the pattern and wave the white flag." The computer's importance to military and quasi-military applications is readily apparent in the sharp rise of defense expenditures for electronic data processing equipment – from less than $200 million in 1955 to over $800 million in 1960.

The Ballistic Missile Early Warning System

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ARMY, NAVY AND AIR FORCE ARE RELYING MORE AND MORE ON ELECTRONIC DATA PROCESSING TO KEEP PACE WITH THE SWIFTLY CHANGING PATTERNS OF MODERN DEFENSE

RCA's DATS system checks out aircraft fire-control.

(BMEWS), for which the Radio Corporation of America is prime systems contractor to the Air Force, graphically illustrates the critical role computers play in national defense. From three widely separated areas – mid-Alaska, western Greenland, and the Yorkshire moors of England – the electronic fingers of super-power radars fan out in vast, overlapping arcs to cover the northern approaches to the North American continent. Seconds after a missile or other space object blasts from its pad somewhere within the Eurasian heartland, the probings of the giant radars will have trapped its image in their sweep. Instantly, a "data take-off" computer-type device linked to the radar translates the visual image into digital form – calculating distance, range, angle of flight, speed and direction.

Data from all three BMEWS sites immediately are fed to an RCA-designed computer at NORAD headquarters – the Data Information Processor – which quickly evaluates the nature and scope of the information. Automatically, the computer flashes its findings on a graphic display. If the evaluation shows the threat to be real, alerts instantly speed to the nation's defense outposts. Time elapsed since the spotting of the first blip – eight to ten seconds.

Less than fifteen minutes from the northernmost BMEWS outpost, in Thule, Greenland, as the missile flies, lies the scrub-covered sand spit of Cape Canaveral, Florida. Here, where America's own missiles and space vehicles are tested and flown, the computer is monarch of a far-flung electronics empire extending 5,000 miles across the Caribbean and deep into the South Atlantic.

The computers' functions at Cape Canaveral are fourfold: to provide an instant-by-instant report on a missile's complete flight course; to assure the safety of areas over which the "bird" will fly; to predict the point of missile impact; to sort, compile and evaluate the billions of bits of information on each missile test.

Responsibility for these vital control and data gathering operations rests with the RCA Service Company as subcontractor to Pan-American World Airways, Inc., the prime contractor for the Air Force in operating the Missile Test Center.

The moment a missile blazes from its launching pad, a high-speed computer becomes a key instrument at Cape Canaveral. Ten times a second, as the missile makes its powered flight, the computer reports its precise location, the course it is following, and where it will impact should it veer dangerously off course.

The Range Control Officer, watching the swift developments on a display board, can decide instantly – if he must – whether to push the button that will terminate the flight.

Once the rockets cease firing, the missile is in free flight, in a predictable trajectory. Reports from key tracking instruments on down-range stations continue to pour into the computer, pinpointing the missile's position, its probable course and the point of impact, if it is destined to return to earth. It is here that the computer performs another vital function. Without its ability to calculate and predict the missile's precise place and moment of impact, the ultimate knowledge of a missile's accuracy against targets thousands of miles distant would suffer gravely. The importance of the computer becomes even more understandable if the object is a Mercury capsule, carrying one of America's astronauts.

In the event that a missile must be fired for combat purposes, the most critical element, of course, is time. When the Atlas intercontinental ballistic missile was first introduced into the U. S. defense arsenal, it required swarms of technicians ten to fifteen hours to prepare it for flight. Today, this 190-ton, ten-story giant is able to blast off within minutes after an alert. The reason behind the dramatic time shrinkage is RCA's Automatic Program and Checkout Equipment, developed from computer research.

From the Atlas' flank, electrical lines snake deep into its vital organs. On the surface of the missile, the lines connect with heavy cables leading to computer-type consoles in the Atlas Launch Control Room. Periodically, the intricate workings of the missile are given a remote checkout to make certain they are in perfect condition. The checkout equipment signals an order through the lines to trigger a reaction inside the missile. A sensing device linked to the part under test instantly flashes a response. In seconds, the device checks the reactions against the expected results. If they tally, the checkout equipment quickly moves to the next group of components. If the response indicates

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something is wrong, technicians know immediately where to look for the trouble.

When the checkout is completed, the Atlas is ready for the launch phase. At this point, the automatic remote launch control system takes over. Red lights flashing to green indicate all is well. At T minus 10 seconds, the final sequence of the missile launch operation begins. The launch control operator pushes a series of buttons — and, with a deafening roar, the missile arches into the sky.

In the event of bomber attack, computer-type equipment also holds the key to instant combat readiness — in this case by the nation's fighter aircraft. Today's supersonic, high-altitude, all-weather fighter-interceptors demand an incredible degree of sophistication in fire-control, navigation and communications.

Portable computer for military field operations.

The pilot must rely decisively upon electronics to find the target, aim the aircraft, fire the missiles, and return to base.

From RCA's computer research has come the Dynamic Accuracy Test Set (DATS) for checking the fire-control system of the F-102 Delta Dagger interceptor. This mobile equipment, rolled up to a plane on the flight line, gives the fire-control system a series of target tests, swiftly checking its total performance. Within minutes the system is clocked out and the fighter is ready for action. "If we had to rely on manual checkout," said one veteran fighter pilot, "we'd still be sitting like lame ducks after the enemy had blasted everything in sight."

Similarly, the nation's ground forces must be maintained in constant readiness, especially such highly electronized systems as missiles and communications. To assure their prompt serviceability, RCA has developed its Digital Evaluation Equipment, a rapid automatic computer-type checkout device. This equipment will test, in minutes, an entire field system — the missile as well as its associated radar — or a complete communications operation.

MOBILE COMPUTER

The development of nuclear warfare has changed forever many of the techniques of defense — battle plans, troop and weapons deployment, logistics, information-gathering for command decision. The amazing diversification of material, the increased tempo and the need for quick response have produced increasing consideration of the computer for tactical combat conditions. Already developed for such purposes is a mobile computer to support the tactical striking forces of the modern army. Its use is for combat computations in such functions as military intelligence, up-to-the-minute logistics data, correlation of combat reports. By far, its greatest benefit is to free staff officers from the time-consuming chore of assembling and extracting vital information necessary to the combat commander in making his decisions.

For military land operations, in the near future, it is possible to anticipate a tactical computer of less than two cubic feet in size, capable of translating a complex series of variables into meaningful information to guide missile firings and other operations.

The communications needs of the Air Force require equipment of ultra-high speed and enormous capacity. RCA is providing the electronic switching equipment for COMLOGNET, the world's largest and most sophisticated message communications system, now being established for the Air Force by Western Union. Approximately 100 million words a day, more than double the 24-volume Encyclopedia Britannica, will cascade through this network, relaying logistics information vital to the combat readiness of the Air Force. Each message will carry a "header," noting its priority, destination and length.

If the message has top priority, the computer will interrupt all other communications. It will store less important messages for transmission when the network is clear. The COMLOGNET computers also will translate different codes into a single "language" for processing and transmission. As the message is delivered, it is automatically retranslated into the code used by the equipment at the receiving end.

Such is the increasingly vital role of the computer in modern defense. The experts' consensus is that the day is not far off when there will be no major military system that does not have a computer at its heart. ■

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The story behind Professor Ludwig von Drake, star of "Walt Disney's Wonderful World of Color"

WHAT A CHARACTER!

IN ONE CORNER OF THE ROOM, two men are blowing bubbles and watching them drift lazily away. In another corner, a group is entranced by a burning log. Elsewhere some artists are watching a fellow on a ladder dropping leaves, one by one, and near them, a man is dropping pebbles into a bucket of water. This is not a haven for eccentrics — it is the Animated Effects Department at the Walt Disney studio.

The effects experts are simply searching for realism in preparing backgrounds for a Disney cartoon. Their problems are but a few of the many involved in such a production.

Recently, Walt Disney contracted with the National Broadcasting Company for a new television series "Walt Disney's Wonderful World of Color" to be sponsored by RCA and the Eastman Kodak Company. The weekly series would require all of Disney's techniques, talents and experience gathered throughout the years. It was to be designed specifically for color viewing. It was to have a variety format. And it had to appeal to a wide audience as wholesome family entertainment.

A most important requirement was a new star to appear in the first show of the new series,

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A story conference at the Disney studios.

Disney checks background possibilities.

Ward Kimball gets in the mood to animate.

preferably a cartoon character bearing the unmistakable Disney trademark. None of the characters in Disney's stable of talent seemed to fill the bill. Mickey Mouse, patriarch of Disney Productions would have been the logical choice, but his do-good personality and his perennial Boy Scout approach ruled him out for this role. Donald Duck? With his diction and temper he could hardly serve as a spokesman for color television.

Walt Disney has an advantage over other major producers in the entertainment business — with the stroke of a pen he can create a star to fit a role. This is what he has done for the "Wonderful World of Color" series but the long weeks of preparation for the new character's debut on September 24, were staggering.

The production problems involved were enormous. For example, it takes 16 frames or separate drawings to make up a foot of film — and film is shown at 90 feet a minute. A program the length of the new show requires nearly 5,000 feet of film — about 80,000 frames, each a separate drawing.

How does Disney do it? For one thing, he doesn't do it alone. This superb showman has gathered together unlimited creative talent, and each has a specific job function that is closely integrated with the total Disney operation.

Step by step, this is the typical procedure followed at the studio when a new character is created or a new production is started:

First, the story department comes up with a basic idea, a story line and suggestions for the animated character of the story. In this case Donald Duck's Uncle Scrooge was close to the character needed. Why not discover another of Donald's uncles? Why not a highly educated personality from the European branch of Donald's family?

And so Professor Ludwig von Drake was born. He is the first new and continuing Disney character in nearly thirty years.

At this point, Disney artists step into the picture and produce a series of rough sketches to illustrate the story, much as a comic strip might be presented in rough form. This constitutes a "storyboard," which is submitted for story approval. Each of the boards consists of about 60 rough drawings.

The shape of Ludwig's head was the subject of conversation, conjecture — and change. As originally conceived by veteran story man and artist Joe Rinaldi, Ludwig was a big-domed, high-brow intellectual type. As Rinaldi recalls it, "Our original Ludwig looked too much like an egghead and not enough like a near relative of Donald Duck. I guess you'd say we shaved off some of the intellectualism — but even so, he emerges as a mighty smart cookie."

Dialogue recording follows story approval. The storyboards are turned over to a director who plans out the timing of action, music, sound effects and dialogue.

The problem of giving the new character a voice was solved by a skilled actor named Paul Frees. In the Frees repertoire was a fast-talking, low-comedy Viennese dialect. When recorded and played at a slightly faster than normal speed, the middle European dialect proved ideal for the new creation who could discourse intelligibly on all manner of subjects and unlike his nephew Donald, could be clearly understood.

NEXT: THE ANIMATOR

Once beyond this stage, the work then goes to an animator. After the pencilled animation is keyed to sound, it progresses to a test camera; the test film produced is studied by the director and the animator. Once they have been okayed, individual sections of the overall project are ready for finished drawings, an electrostatic copying process that eliminates the need for inking, layout and background (the Disney equivalent of "sets"), then color, and finally, shooting by special cameras. Once the film has been shot and synchronized to its sound track, it is subject to what many consider Disney's most delicate operation — editing and "cutting" to eliminate unnecessary portions.

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A studio paint laboratory.


Painter adds a final touch to a character.


Photographing an animated cartoon scene.

Ludwig von Drake received the full Disney treatment. With his speech determined, it remained for the Disney writers to define his character. They gave him an education second to none, with degrees from Oxford, Cambridge, Heidelberg, Harvard and other leading universities of the world. They made him slightly nearsighted, a little forgetful and an expert on almost everything—especially color television. The Disney writers even made him sing — with the help of Buddy Baker, one of the studio's composers, and Richard M. and Robert B. Sherman, lyricists.

MURDER ON CELLULOID

With his character so well defined, the stage was set for story lines. These came easily according to the Disney writers, because Ludwig is a character of extremes. "One of the reasons he is so funny is that he murders the king's English," says one of the writers who helps Ludwig with his mispronunciations. "Actually, his mistakes in speech tend to endear him to an audience and lend a warmth of character that would be missing if the good professor happened to be perfect, which he isn't."

All the dialogue for Disney's animated cartoons is recorded before the characters are drawn, of course. This enables the artists to draw facial expressions to match the dialogue—to synchronize sound with lip movement. It's a good thing that the drawings follow the dialogue, because Paul Frees often gets carried away with the character of Ludwig von Drake and doesn't limit himself to what the writers have put down on paper. His ad libs are so good that many are found in finished recordings.

For animators, there is no substitute for a good mirror. They still do their dialogue by gazing into a mirror and mouthing the sounds as they draw. With this kind of a script, they have at least one thing working in their favor: it isn't a Donald Duck script. They're working with words—and lots of them.

The animators receive recordings of the speech of the cartoon characters, exposure sheets which tell the length of scenes, the musical tempo, the dialogue continuity and the feeling that is sought for the scene. Then their work begins.

The creation of an entirely new character is a laborious task. The key animators sketch out what they think the actions and feelings of the scenes should be. They make the "extreme" drawings. For example, when an animator attempts to portray the figure of a running man he must visualize at least two "extreme" poses, one of the foot as it leaves the ground, the other of the foot touching soil again.

The "breakdown" animators receive the sketches next. They execute additional lines, reducing the number of actions between the extreme drawings to a point where the animation job can be completed.

Animators really prefer closed-mouth consonants such as M, P and B because these offer contrast to the rest of normal speech. They find the letter F difficult to work with because there is the possibility that a scene showing a character's top teeth over the lip may turn out to be humorous when it isn't meant to be.

THE EYES HAVE IT

Disney maintains that an audience watches a character's eyes in a closeup rather than the mouth. This means that Disney animators focus a great deal of attention on the eyes as well as the lip movements. Despite the importance of other action in a given scene, it is of little value unless sound and lip movement coincide.

The synchronization of sound with picture film is the work of the cutting department, which has become more and more important, as the art of synchronization has advanced. Sound effects men make one track for dialogue and another for music. Not until the picture is completed are the two tracks combined and recorded on the final composite reel. To make matters more complex, the same dialogue scene frequently is recorded four or five times, which means the cutters must select

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Checking a test scene of animation.

Assembling the footage.

Synchronizing music and pictures.

the best portions of each recording and combine them into one final track.

Besides creating coherency out of an array of film, the cutter must read sound film carefully and record what he finds. If, for example, the animator is to make Professor von Drake's mouth move precisely for the pronunciation of a particular word, he must know how many frames of film he can use in forming the action. The cutter provides him with this information and together they make the animation fit the sound.

One of the simplest problems a Disney cutter might encounter, for example, would be an expression such as "What is this?" At the normal rate of dialogue speed, the consonantal "wh" and "th" sounds occupy a single frame or one exposure on the film. The longer "a" and "i" vowel sounds, however, occupy from four to six frames. Although the entire phrase would take up only a second on the screen, the cutter knows he must deal with 24 delicate frames, any one of which could cause a noticeable jump in the sound if deleted in the wrong place.

Once a production has taken form on a rough negative film and is approved by Walt Disney, it goes quickly into the final phases of production. These phases include the painstaking efforts of dozens of women who apply predetermined colors to the characters. Actually, the inking and painting department goes to work as soon as colors for characters are suggested — early in the storyboard stage.

CHOICE OF COLORS

"Walt Disney's Wonderful World of Color" series presented the studio artists with a special problem. As one explains it, "Because the series is being broadcast in color, we have had to take special care in the choice of color shades so that the viewers watching on black and white television sets will not find color values blending into gray shades of the same value."

Walt Disney has established an enviable reputation as an innovator in the entertainment industry — not only for the variety of his productions but for the techniques that have made them possible. Perhaps the most outstanding technical advancement at the Disney studios is the development of special cameras and camera techniques. With modern camera mobility, it is now possible for Disney animation cameras to "truck" or move in various directions. Among other advantages this allows the camera to go from a long shot to a closer shot, making use of the same drawing in each case. The drawing remains stationary on a horizontal plane while the camera, directly overhead, is lowered and the drawing is shot in as many different exposures as necessary to guarantee smooth action.

INSIDE DONALD

The new series will comprise film from the Disney library never shown before on television. The "Inside Donald Duck" episode to be broadcast on November 5 alone will have 1,025 feet of new animation. The December 10 production of "Kids Is Kids" required 905 feet of new film. This is the equivalent of almost two movie short subjects for each of the shows — or around 15,000 new drawings for each of but two of the animated features to be shown on "Walt Disney's Wonderful World of Color."

One thing is certain about the new Disney series. While the animated films are going to feature a talking duck — even two verbose ducks in most instances — they will never include a gabby giraffe. This has been a certainty ever since the film "Lady and the Tramp." During a story conference devoted to talk of a zoo sequence for that film, someone suggested that a lion could be used in the dialogue. Another Disneyite suggested an elephant or bears or monkeys. Finally, someone spoke up and said a giraffe could be used.

Walt Disney looked questioningly at the last speaker and said calmly, "Don't be silly. Everyone knows giraffes can't talk." ■

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WORLD OF THE 'WHITE EYE'

Daylight sometimes lasts 'round the clock and temperatures drop to 40 below at Thule, Greenland, where a group of men maintain a lonely Arctic defense outpost

FAR TO THE NORTH, suspended from the ceiling of the world is an island of surprising beauties and awesome wonders. It is Greenland, a country three times the size of Alaska, our largest state. It has been quarantined from the world by Denmark since before the American Revolution but now, caught by the accident of geography and tensions of our times, it is emerging from its long seclusion.

Far up Greenland's fog-bound and storm-torn Northwest coast, at the top of Baffin Bay, is Thule (pronounced "TOOL-ee"). There, where for nine months the only road in or out is the sky, more than 1,000 RCA employees live and work. Most of them are personnel of the RCA Service Company, which operates the Ballistic Missile Early Warning System (BMEWS) base at Thule. Others are employees of RCA's Major Defense Systems Division, which managed the construction of the base, as well as the No. 2 site at Clear, Alaska — both now in fully automatic operation — and is building still a third site in northern England to provide a full warning network as a major deterrent to missile attack.

Today the Eskimos, long-time residents of the valley in which Thule lies, have abandoned their ancient village and moved 80 miles northward to New Thule or Kanak, as they prefer to call it. Now where once the lonely hunter crawled across the ice of North Star Bay to lie in patient wait beside the breathing holes of seals, men go about their daily routines at one of the world's most modern bases. Living is comfortable, though the elements are raw and unpredictable.

In all, BMEWS personnel occupy eight dormitory buildings at Thule. Most of the quarters are double-occupancy, though there are some singles and, rarely, three to a room. These living quarters and the main

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mess hall which seats 400 diners at a time and serves 70,000 meals a month, are on the Air Base itself. At the BMEWS site, atop a sharply rising hill eight miles away, there is another mess hall, seating 96, serving 20,000 meals a month

There too is a dormitory, for use when weather prevents the shuttle buses from operating between base and site. This ride takes an average of 30 to 35 minutes at best, and the road, despite constant grading, is so rough that it regularly shakes the radiators out of the buses.

TRAVEL BY COVERED VANS

About half of the RCA people at Thule are engaged in actual operation and maintenance of the BMEWS site and equipment, so each of three shifts, employing approximately 160 men, have to be transported twice daily between living area and site. At the site motor tugs pulling covered vans – known as "Thule Trolleys" – carry the men to their various assignments through covered passageways which link all buildings together.

The normal work week of 63 hours is now being reduced to 59 hours. Greenland contracts are for 18 months, and most of the men fulfill them.

"Initially," says Charles LoBue, the RCA personnel manager, "we expected about 6 per cent to 'pull the pin,' that is, ask to go home before the end of their contract. Actually, the rate is only 1.5 per cent."

This is in the face of many drawbacks to Arctic life. During the summer months there are long periods of 24-hour daylight, as bright outside at 4 a.m. as at 4 p.m. Before they become accustomed to this phenomenon, some men have trouble sleeping – an affliction known locally as "having the white eye."

"THULE-ITIS"

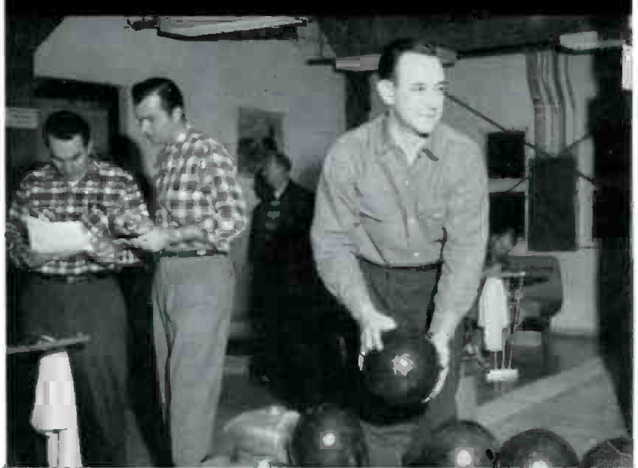
It's lonesome too. There's often a chilling of the spirit which comes from brooding over the fact that thousands of miles of ice and snow lie between Thule and family and wife or sweetheart. This is known to the men as "Thule-itis" and to the Danes as "that gray gloom which besets the mind."

"Actually though," reports Dr. Richard W. Jarecki, an RCA physician recently assigned to BMEWS, "emotional disturbances are less common than in a comparable group of 1,000 men in the United States.

"At Thule, there is a close and simplified life – nonetheless a full and actively stimulating one. A man's work is 'cut out' for him. Everyone has a certain job to do. He's relieved of all decisions of where to sleep, what to eat, where to go. Thus, tensions are lessened when compared to living in the United States."

Despite the "closed circuit" aspect of Thule living, and the relative sameness of the milieu, RCA doctors

Top, construction worker surveys BMEWS site at Thule; second photo, workers dine in style; third photo, insulated pipes carry water, steam and electricity; below, men relax at day's end.



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report that there is a relative absence of hostility among the men. Fights are rare.

What isn't rare though, is a healthy appetite. Food consumption is enormous and weight gains of twenty or thirty pounds a year are not unusual at the Thule base.

Danger, hardships and the direct effects of cold (40-degree-below temperatures are common at Thule) do not represent important stresses to the men, according to Dr. Jarecki's observations. Indeed, their absence and the relative luxury of the living conditions are often sources of considerable disappointment and disillusionment for many of the young and more venturesome individuals.

"Perhaps this is the reason why so many of our people are motivated to grow beards while at Thule," Dr. Jarecki comments with a wry smile. "It's an attempt to regain a primitive atmosphere."

There's nothing primitive about the entertainment and recreational advantages at Thule. The Air Force runs 'round-the-clock radio and TV programs, the base movie theaters offer films before they're shown in major U.S. cities, and the library is one of the most complete anywhere overseas. So is the base gymnasium which includes a steam-room. There are three clubs and entertainers are flown up on a regular schedule from New York. Each of the RCA residence halls has its own recreation room and TV and reading-room lounge.

FAVORITE SPORT: HIKING

"Most of the men, sooner or later, get wanderlust here," reports Forrest Paradise, Site I Manager. They want to hike. We encourage it actually. It gets them away, out of the dorms and recreation rooms where they see the same faces day after day."

Because of the storms that can blow up in a few minutes, however, those going walking have to take a walkie-talkie radio along with them, wear special arctic survival clothing and go with a buddy. No one is ever allowed to travel off-base alone.

During the summer months, regular excursions are run on Thule tugs up the fjord to the face of a scenic glacier.

"It's a wonderful trip, a thrilling experience," says Paradise. "So deep is the stillness as you go up the fjord that even the throb of the launch's motor seems to fade away. You feel alone as never before."

TAPES FROM HOME

The Thule-based RCA men also go in heavily for hobbies such as tape recorders, photography and hi-fi. Andy Eliopoulos, a staff engineer bought two tape recorders and sent one back home to his wife in Akron, Ohio.

"Now we exchange tapes weekly," Andy says. "I can talk for a half hour or so. My four boys can talk to me, too. It's lots better than letters."

Letters at Thule are important, though. Mail, along with long-distance telephone calls, rates high in all morale polls. In reverse, letters and phone calls can be a problem. The wrong word, in a letter or talk, and a trivial episode is exaggerated.

One wonders about the reasons for taking the Thule assignment. They are as complex as human behavior itself. Studies show that many of the men are saving their money to go on to college. Others are collecting a nest-egg to buy a house, or saving cash to get married. Among the older men, one big goal is the accumulation of tuition money for their children's college education. For some it's the advanced technical knowledge they can gain on the job. Freedom from state-side income tax is another big incentive.

"HE'S TOO HAPPY!"

"Most men here feel that they have gained something in the experience such as more self-discipline, greater adaptability and better understanding of their fellow man," Dr. Jarecki reports.

"In fact," says Site Manager Paradise, "one of our engineers kept writing home to New Jersey, telling his wife how good things were in Thule. This went on for almost a year. Then one day *I* got a letter from his wife. 'Send my husband home at once,' she demanded. 'He's too happy there.'" ■

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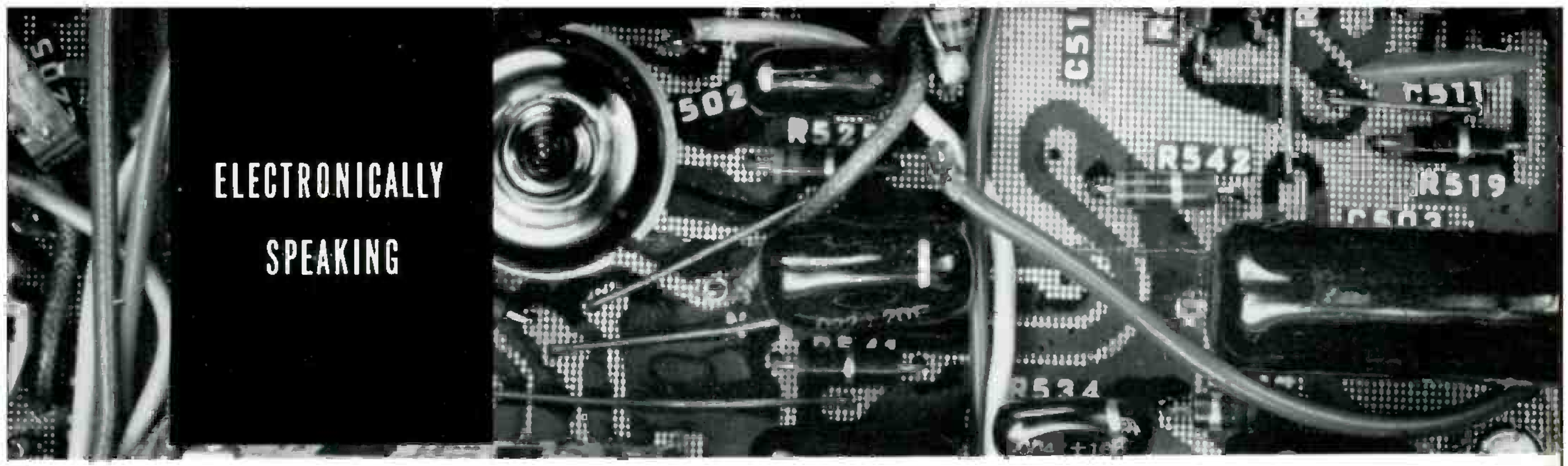


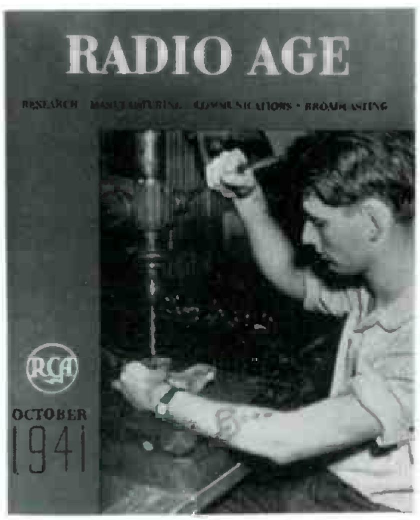
ELECTRONICALLY SPEAKING

TWENTY YEARS OF 'AGE'

In October, 1941, as RCA and the nation geared for defense production, the first issue of this magazine was published under the name of *Radio Age* "to catch and reflect the fascination found in the field of radio science, art and industry." With this issue, *Age* marks twenty years of chronicling developments in the world's fastest-growing industry—a period which has spanned several stages of progress.

DEFENSE ELECTRONICS

The war years found radio pre-empted largely for the compelling needs of national defense. The cover picture of *Age's* first issue (below), showing an intent defense



worker set the tone for the magazine during the early Forties.

No area dramatized electronics' defense contributions more effectively than radar, sometimes called "the wartime miracle of radio." RCA had been experimenting with radar since 1932, and was ready when the big production push came.

Many of electronics' wartime achievements were kept secret during the crucial years of conflict. Workers at RCA's Bloomington, Indiana, plant concentrated on a project known as "Madame X." Only later did they learn that they had produced more than half of the 10,0000,000 proximity fuses which had played such a vital role in the closing years of the war.

TELEVISION

With the end of the war, RCA resumed its work on black-and-white television which it had introduced as a new service to the public at the New York World's Fair in 1939. The debut of RCA Victor TV receivers in the fall of 1946 signaled the start of a new era in home entertainment. Rooftops sprouted with antennas. The press recognized TV's matchless ability to enthrall — with cartoons like the one of the teen-ager sitting on his suitcase before the television screen while his mother explained: "He's running away from home — just as soon as this program is over."

Even as black-and-white television vaulted into a position among America's top ten industries (in one-third the time it took the auto industry) RCA was working on a remarkable new development — television in full color. In the hectic experimental days, color technicians tried frantically to cope with stars who turned purple under the hot lights; they painted dresses grey when they were found to be too bright for the color cameras; they even used shoe polish on trombones to cut down the glare.

Eventually, color TV began to capture the viewers' fancy, and programming expanded prodigiously. From a scant 68 hours in 1954, the network tint schedule grew to more than 1600 hours in 1961.

SPACE ERA

While color television was advancing with significant strides in the consumer area, electronics was also finding dramatic application in another sector. At Cape Canaveral, RCA scientists and engineers tracked the first American space ventures. At Princeton, they developed one of the most sophisticated of all space vehicles — the Tiros weather satellite.

Tiros and other satellites embrace the full range of electronics' "Three C's" of Computers, Controls and Communications which symbolize the pervasive impact electronics has had on our lives in just two decades.

On the basis of work being done in the laboratories today, it seems reasonable to predict that the next two decades will bring even more far-reaching advances. And the editors of *Electronic Age* look forward to the opportunity "to catch and reflect the fascination" of an increasingly fascinating science, art and industry. ■

In mass production is an RCA silicon transistor that can perform the job of up to 40 per cent of the 2,000 current transistor types.

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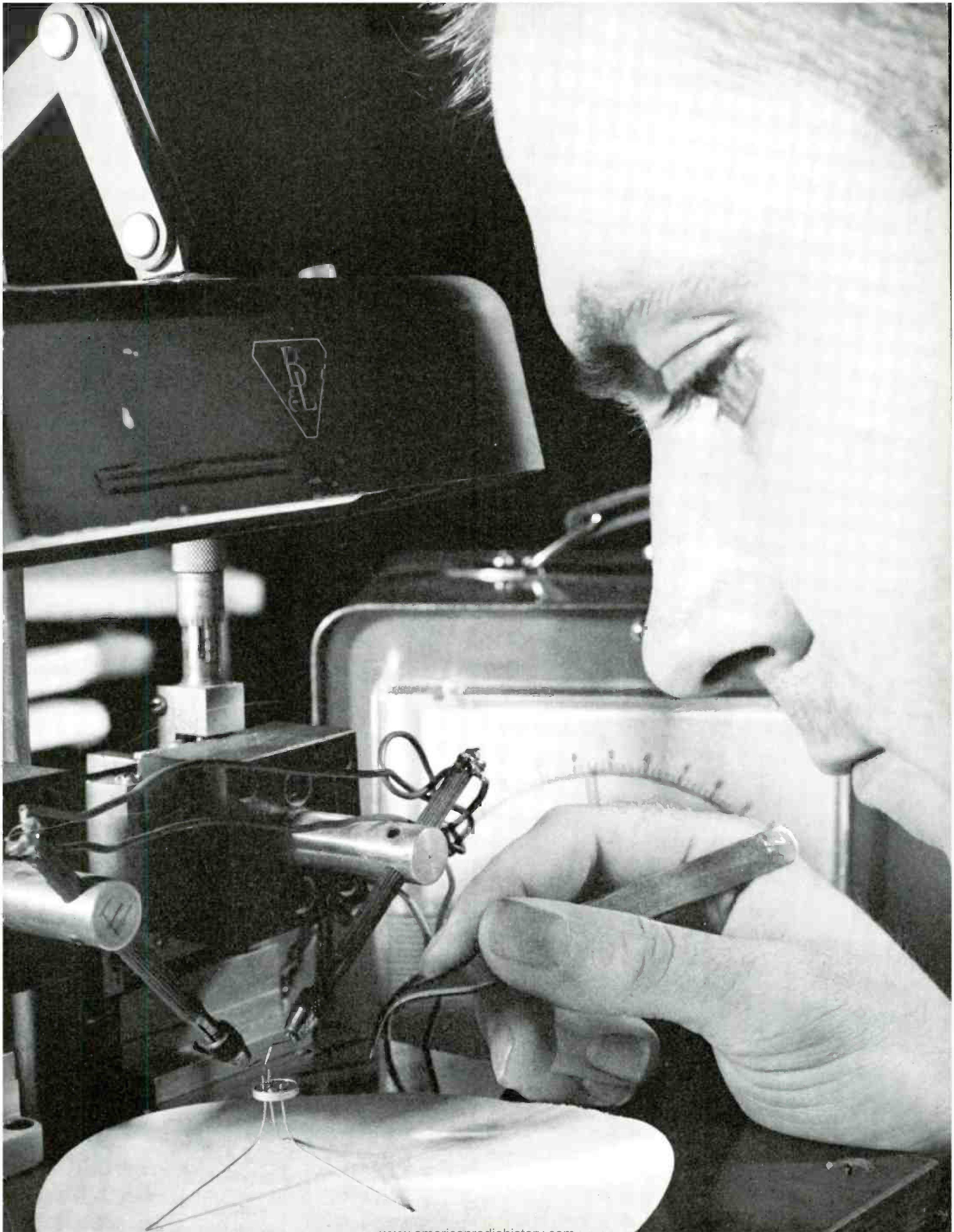

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