

# ELECTRONIC AGE

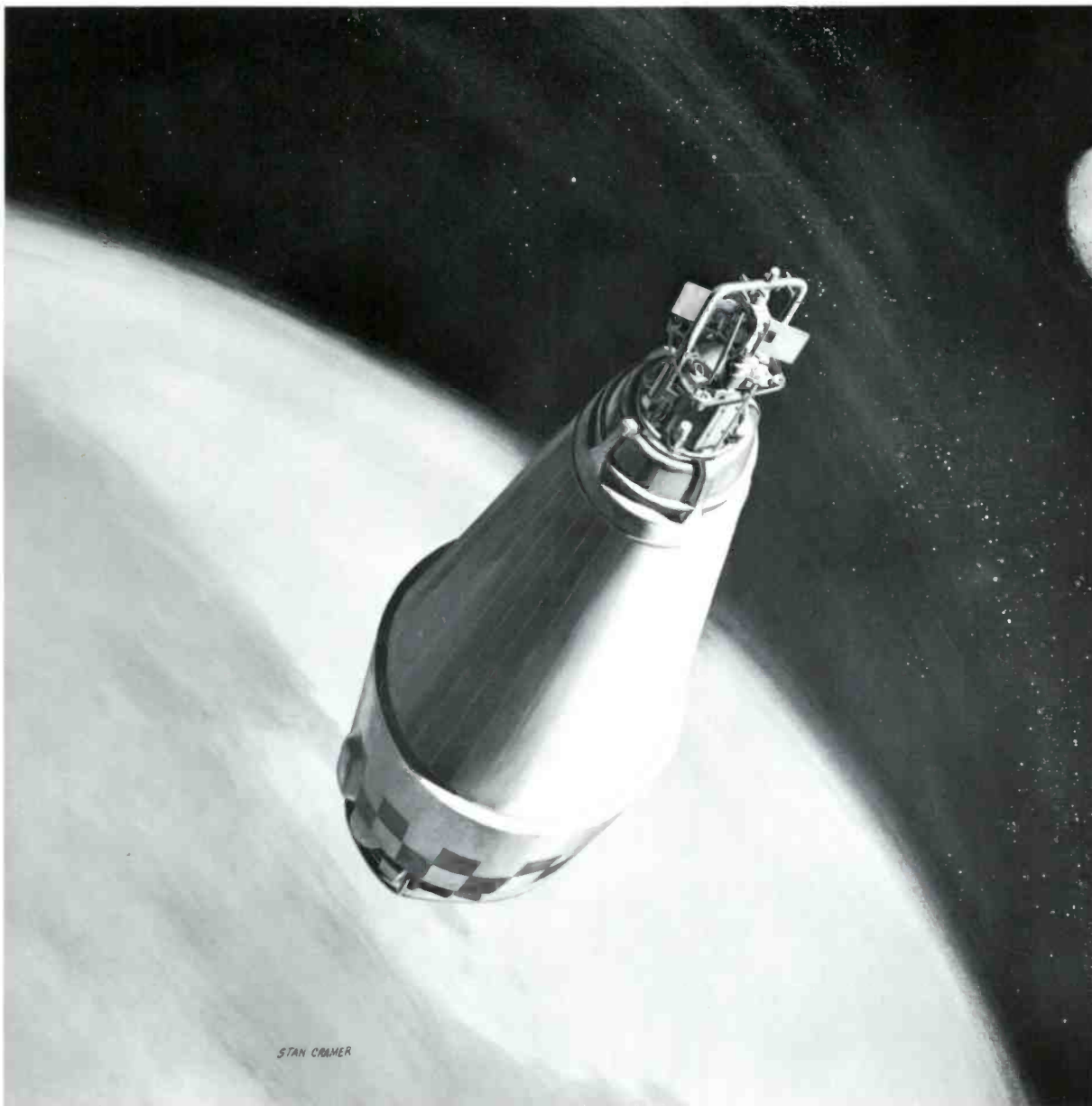
Spring 1965

SCIENTIFIC WORK

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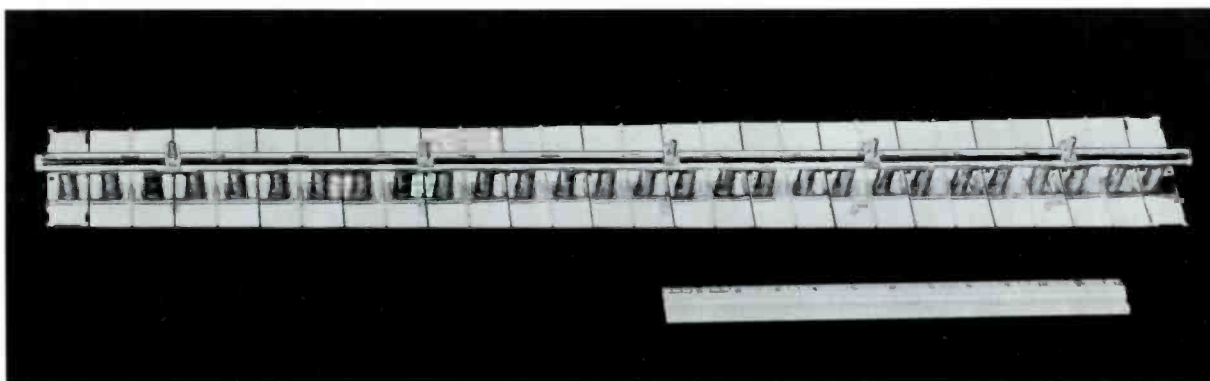
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STAN CRAMER

Artist's conception of the world's first orbiting nuclear reactor power plant. The Atomic Energy Commission's SNAP 10A (the acronym stands for Systems for Nuclear Auxiliary Power) spacecraft, launched from Vandenberg AFB, Calif., on April 3, 1965, carried the nuclear reactor into space. New silicon-germanium thermoelectric modules convert the heat from a nuclear reactor aboard the spacecraft directly into electricity. One hundred and twenty of the modules, developed by RCA Electronic Components and Devices for Atomics International, the prime contractor, were used to produce 600 watts of usable electric power. Below, one of the modules photographed alongside a 12-inch ruler.



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**ELECTRONIC AGE**



Cover: At the David Sarnoff Research Center, Princeton, N. J., an electron beam furnace erupts with a steady beam of 30,000-volt electrons so intense it will vaporize any known material in seconds. The importance of this furnace is that it delivers heat only at the focal point of its electron beam. An article on this furnace and other machines of science begins on page 6.

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Production of 25-inch rectangular color TV picture tubes at RCA plant in Lancaster, Pa.



Color television chassis on production line.

## THE COLOR TELEVISION EXPLOSION

by David Lachenbruch

Increases in color programming, lower prices for color sets, and advances in color TV cameras and receiving sets have combined to turn the color TV boom into an explosion.

Color television's sizzling boom has become an explosion.

Every day during the first three months of this year, Americans spent an average of \$3 million for color TV sets — some 5,500 families per day added the new dimension of color to their home entertainment. This is a rate of sales 80 per cent higher than that of last year's first quarter.

When the full year's results are tallied, color's daily retail sales rate in 1965 is expected to exceed 6,000 sets and approach \$4 million for each day of the year — Sundays and holidays included.

Color television, in fact, is closely retracing the phenomenal growth curve of black-and-white television in the early 1950s and has become the fastest-growing major new product in the world.

Although black-and-white television sets are continuing to sell at an all-time-high rate (in terms of units), color television's retail dollar volume this year — close to \$1.2 billion — should equal or exceed that of black-and-white.

By next year, color TV will be the consumer electronics industry's most important product in terms of factory dollar value.

So great is the surge in demand for color sets that the industry's production facilities are becoming strained to the limit. It is generally accepted that the output of color picture tubes threatens to be the limiting factor in color set sales this year — and even in the industry's normally slow first quarter, the tube plants are working day and night to meet the demand.

The dimensions of the explosion can best be understood by looking at recent color TV set sales estimates. From about 425,000 sets sold in 1962, the rate nearly doubled to approximately 750,000 in 1963. Again in 1964, color sales came close to redoubling, with nearly 1.4 million sets sold at the distributor-to-dealer level.

A recent survey of television set manufacturers and network broadcasters by *Television Digest*, the trade publication, yielded these median forecasts for future retail



Sets ready for shipment to RCA Victor distributors.



Color television sets on display in retail showroom.

color sales: This year, 2.1 million sets, increasing to 2.87 million in 1966 and 3.5 million in 1967. By 1970, the industry sees color sets selling at an annual rate of 5 million units. At the end of 1970, the survey indicates that 23.33 million color receivers will be in use, and color will have achieved 40 per cent saturation of the nation's television homes. The survey was completed before the extent of the first-quarter explosion became fully known, and since that time several television manufacturers have revised their 1965 predictions upward.

Nobody seems to know for sure why the boom became an explosion just when it did. It appears to be defying the seasonal laws that normally govern television sales. Set manufacturers enjoyed an exceptionally heavy fourth-quarter demand for color last year, then settled down for the normal first-quarter slowdown. But that slowdown did not come, and business continued at near-Christmas proportions. Some manufacturers attributed the unexpected first-quarter surge to the heavier schedule of color broadcasting, particularly in January. Others thought it was the result of the contagious effect of seeing Christmas-gift color sets in friends' homes. But as it continued without letup, most of the industry became convinced that the 1965 demand for color had just been greatly underestimated.

The color explosion is being manifested on the broadcasting front, too. Rooted in the folklore of color's 11-year history is the legendary "vicious circle" — not enough sets means not enough programming, not enough programming means not enough set sales. The circle was broken forever early this year, partly as the result of a rather astonishing survey.

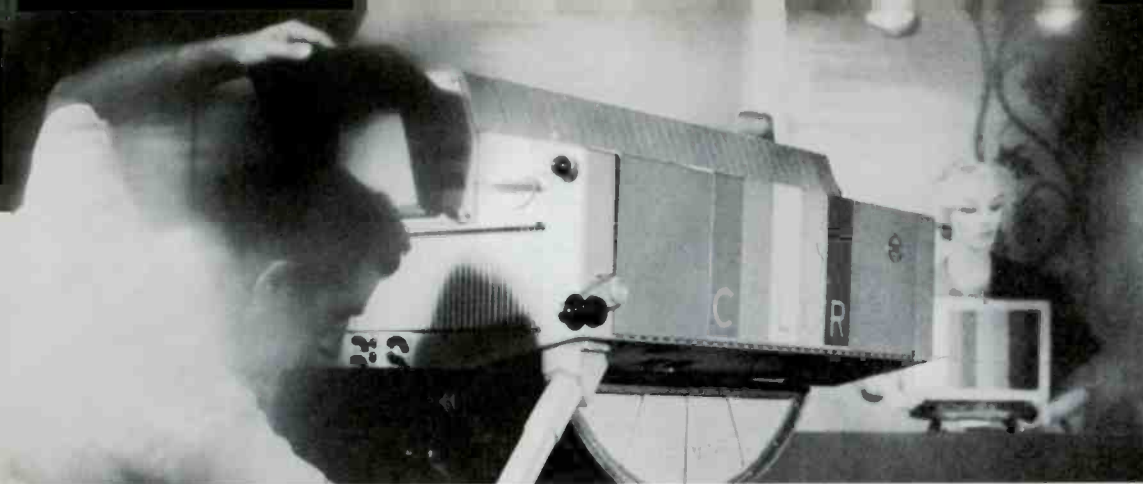
In an attempt to evaluate the true effect of color programming on audiences, all three national networks joined late last year in underwriting a definitive color study

by the American Research Bureau, a major audience-measurement organization. This study compared the viewing habits in 4,600 color-set homes and 4,600 black-and-white homes on a nationwide basis.

The results, tabulated in February, indicated that the average color program earned an 80 per cent higher rating in color-set homes than in black-and-white homes. This meant that during the survey period — November, 1964 — the average color program had a built-in advantage of almost one full rating point in all American television homes. On the basis of an anticipated 5 million color sets in use by the end of this year, the results were projected to show that color will increase the average show's rating by about one and one-half percentage points by next Christmas.

The 1964-65 television season has been the most competitive in history among the three networks. Rarely have their total nighttime ratings been separated by more than one rating point. The ARB survey indicated that color is virtually the decisive factor in determining program choice in color-set homes. As a result of the steady increase in color sales, color homes now are assuming an important — even decisive — role in program ratings. All other things being equal, the survey showed, color can now give a network, or an advertiser, a noticeable edge in circulation. Despite its extra costs, color is becoming a better buy than black-and-white programming in terms of the advertiser's all-important measurement of "cost per thousand viewers."

Shortly after the survey results were tabulated, the NBC Television Network announced it would become the first "full color network" when the new season programming begins next September. All of its regular nighttime programs, with the exception of two shows weekly, will be in color. This means that 96 per cent of the network's evening schedule will be in color, compared with 70 per



New RCA four-channel color camera.



RCA color caravan in Moscow.



Trevor Howard and Pamela Franklin in TV drama "Eagle in a Cage."

cent this season. NBC also increased its daytime colorcasting schedule to 30 hours a week, bringing its color programming to a 3,000-hour-a-year rate.

It was clearly time for the Columbia Broadcasting System to move. That network had repeatedly stated that it would go all-out for color broadcasting as soon as color viewing became a "significant factor." In mid-March, it announced that it would resume regular color programming next season for the first time since 1957-58. The American Broadcasting Company also plans an increase in color programming next season. In network television, the color race is on. Color's competitive pull, and the growing influence of a quickly mounting audience, will dictate expansion toward all-color programming on three networks as soon as practicable.

The same week that CBS took its color plunge, it also announced that it would equip its five owned-and-operated TV stations as soon as possible for the broadcast of locally originated film and live color. (NBC's five owned stations are already equipped for local live and film color telecasting, while ABC's five outlets all can originate color film.)

On the local station front, the color activity has become almost frantic. According to latest estimates, some 150 of the 670 television stations on the air are equipped to originate color film and slides, while about 501 have live color origination facilities. More than 90 per cent of the total are capable of transmitting network-originated color programs.

The number of color-equipped stations is increasing almost daily, and a new generation of broadcast equipment is resulting in better color pictures.

RCA recently introduced two new color cameras — one for live telecasting, the other for the broadcast of color film. Both of them use four "pickup" tubes, as contrasted

with one tube for black-and-white cameras and three for earlier color cameras. In the new cameras, three of the tubes pick up the primary colors (which in television are red, green, and blue) and the fourth picks up the "luminance," or black-and-white, signal. This system is designed to produce better color registration and clearer, sharper black-and-white pictures. A new ultrasensitive color pickup tube developed by RCA — the "Selenicon" — will be used in the live cameras beginning early next year.

As of mid-March, RCA reported a record backlog of more than 150 orders, totaling about \$10 million, for its new live and film cameras. Other broadcast equipment manufacturers, some of whom have also recently introduced new color equipment, also report heavy demand.

Although most of the rest of the world is on the sidelines, the color fever is not confined to the United States. At the present time, only the U.S. and Japan have regular color broadcasting, both using the NTSC (for National Television System Committee) system pioneered by RCA. Although Canada has no color broadcasting, color sets are manufactured there, and the color audience is sizable in border areas where U.S. broadcasts can be received.

Several European countries — particularly Britain, Germany, and the Netherlands — are eager to begin color telecasting, following the success of color in the United States. A political alliance between France and the Soviet Union endorsing the French SECAM system now appears to have weakened the prospects for a single color system for all of Europe. However, at a meeting in Vienna in early April, the nations representing the largest portion of the European television industry endorsed the approach represented either by the NTSC system or a West German variation known as PAL.

Britain has announced it will start color broadcasting



NBC televises World Series in color.



Scene from forthcoming NBC-TV color special "Michelangelo."

as soon as possible, using NTSC standards. NTSC and PAL are variants of the same basic system and use basically the same color receiver and the same studio equipment, while the French-type SECAM color employs the same color tubes and much of the same station apparatus as NTSC. For several months before the Vienna meeting, RCA conducted demonstrations throughout Europe from a complete color TV station mounted in a van, showing the performance of the American color system to engineers, broadcasters, and government officials across the continent from London to Moscow.

In the United States, for the first time, prospective color-set buyers are faced with a variety of screen sizes. In addition to the standard 21-inch round tube, shorter rectangular tubes are now available in 23-inch and 25-inch sizes, along with a few Japanese-made sets with 16-inch rectangular picture tubes. Late this year, a new 19-inch size will probably be available but in very limited quantities.

The vast majority of color tubes now being produced are in the standard 21-inch size, and it is estimated that this type will account for at least 75 per cent of all production in 1965. RCA is currently producing both 21-inch and 25-inch types, and has sent receiver manufacturers samples of the 19-inch rectangular tube.

While new sizes and shapes are being developed, engineers have been continuing the process of increasing the brightness of the color picture. The light emission of color tubes is now being improved through the use of a rare-earth element in a new red phosphor, which also provides a richer, "redder" red. RCA's new series of Hi-Lite color tubes uses this phosphor.

Despite the continued expansion in color tube manufacturing facilities by RCA and all other color tube producers, demand seems certain to outstrip supply this year,

and perhaps again in 1966. According to one industry estimate, about 2.25 million color tubes will be produced this year, of which 1.5 million will be built by RCA. In response to high demand, however, it is possible that this number will be exceeded by putting the utmost strain on current facilities and speeding up expansion projects originally scheduled for further in the future.

Contributing importantly to the rapid growth of color has been the steady decline in receiver prices. The lowest-priced RCA 21-inch color set in 1955 carried a suggested retail tag of \$895. The regular 1965 RCA line now begins with a table model with an optional list price of \$399.95. A special model produced for the recent "Bargain Bonanza" promotion had a suggested list price of \$379.95.

But consumers have not confined their purchases to the so-called "low-end" models. Consoles have been far more popular than table models, and the average color-set purchase is said to be in the neighborhood of \$525.

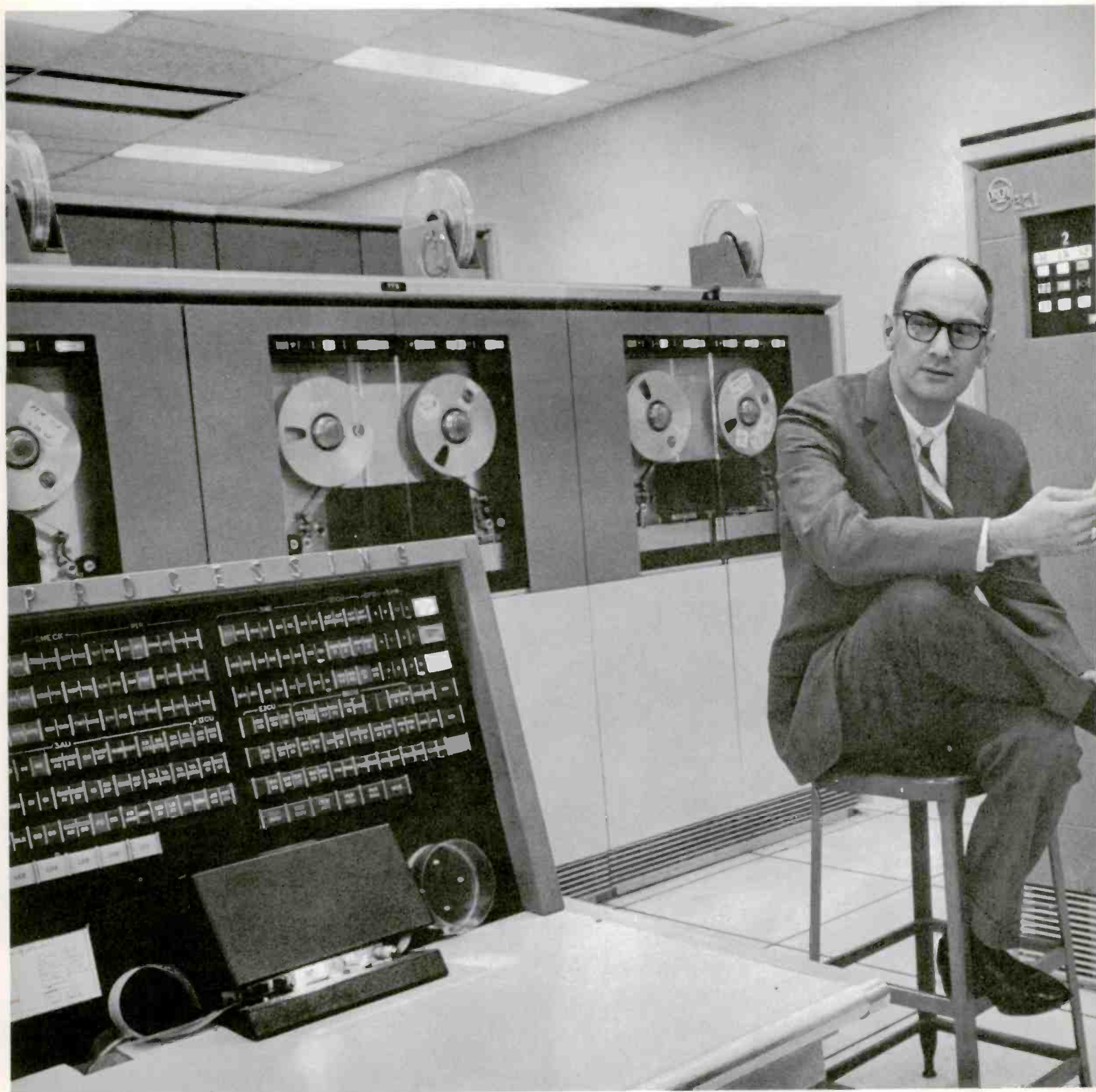
American television is now well embarked upon the color era. From this point on, television is a high-fidelity, full-color medium.

The nation's continuing economic prosperity has contributed to the growth of color. And now the color explosion bids to make a major contribution to the American economy. The sales of color receivers, station equipment, antennas and installation, the added revenues from color broadcasting, the increased sales of products and services resulting from the greater impact of color commercials will add up to an infusion of new billions of dollars into the economy. The explosive growth of black-and-white television after World War II is recognized as having contributed significantly to America's growing prosperity. Television's second explosion — in living color — will help assure a continuing expansion. ■

# MACHINES OF SCIENCE

by Bruce Shore

STRANGE AND FORMIDABLE MACHINES ARE HELPING SCIENTISTS TO ATTAIN A MORE COMPLETE UNDERSTANDING OF MATTER IN ALL ITS FORMS.



Of all the wondrous machines of science, the electronic computer is certainly the most versatile. Nathan Gordon (above) is in charge of computer operations at RCA Laboratories, Princeton, N.J.



As practiced today, electronics science is the meteorology of matter. Air currents, inversion layers, electric storms, tornadoes, thunder, heat, humidity, drought, smog — all have their counterparts in the various atomic atmospheres we call substances. In fact, the 104 natural and man-made elements which scientists have now identified and stuffed into the pigeonholes of the periodic table are really dense clouds of atoms in bulk form. They grow, thin, condense, and evaporate in response to the ebb and flow of lambent energy in the same way that cumulus, cirrus, and other natural cloud formations materialize and dissipate in the sky above us.

It is for this reason that matter — especially solid matter — has always been so difficult to explore. Materials scientists — like meteorologists — have had to be content with observations and remote measurements from the ground, so to speak. In 7,000 years of recorded history, the best these allowed us to do was to saw wood, chip stone, bake clay, pour glass, and smelt iron. Not until the last century did anyone suspect the electronic nature of matter, and not until this century have we been able to do anything about it.

How we have since capitalized on that monumental perception to create machines that do everything from brushing our teeth to lobbing us into outer space is already well celebrated. Less recognized, perhaps, is how it has also led us to the creation of strange and formidable machines that may yet carry us to a complete understanding of matter in all its forms.

Though they are legion in number and groan under such fearsome titles as electron microscope, Van de Graaff accelerator, X-ray diffractometer, emission spectrograph — they are a tame bestiary of high-voltage, high-vacuum, high-priced monsters whose care and feeding constitute a good part of what goes on in a modern research laboratory. They are neither so frightening nor so enigmatic as their names might imply.

For the most part, there are four species of such laboratory leviathan classed according to whether they produce electron beams, photon (light) beams, ion beams, or neutron beams. An exception is the computer.

The purpose of those that “finger” matter with high-speed beams of electrons is to study the physical structure — the architecture — of solids. Thus, the *electron microscope* produces a beam of 100,000-volt electrons that are focused by magnetic “lenses” into an electronic needle with which to probe, in vacuum, the surface and atomic underpinnings of various materials. This beam can reveal details down to two atomic spacings, in some cases, and can magnify a specimen up to 250,000 times. When such a beam passes through a material, it is captured on photographic film where a picture of what it has “seen” is instantly fixed for study. By this means, scientists are able to examine the size, shape, and distribution of particles in the sample, to elucidate its surface structure, and to detect hidden flaws.

A variation on the electron microscope is the *electron beam scanner* whose focus is deliberately kept to only about 2,000 atomic diameters — about one-hundredth the width of a human hair. In one version of this machine, the beam penetrates its target to a depth of about a half-thousandth

of an inch, whereupon it is absorbed. Electrons in the target material itself, however, disturbed by the passage of the beam, rebound from the sample and are detected by a scintillation counter (a crystal that emits tiny flashes of light wherever electrons strike it). The face of the counter, in turn, is watched by a photomultiplier, which converts the flashes to a continuous electrical current that varies as a function of their brightness. This current is then fed to a TV kinescope on which an actual picture of the sample sub-surface is made to appear. Since the active parts of most transistors and integrated circuits go no deeper than a half-thousandth of an inch, the electron beam scanner makes it possible to study their structural features in all three dimensions.

The *Van de Graaff accelerator*, on the other hand, develops a 1-million-volt beam of electrons so powerful that, when it bursts into a material, structural damage results. Such a device is currently teaching scientists how electrons in the Van Allen Belts girding the earth slowly rob solar cells of their ability to generate electric power for space satellites.

Equally intriguing in the category of electron beam machines is the *electron beam furnace*. Built like a diving helmet with one huge, Cyclopean eye that stares out from the top of two spindly legs, this brachycephalic basilisk wears in its headdress an electron gun that plunges down into a cavity behind its eyelike faceplate. When a vacuum pump exhausts this cavity of air, the electron gun erupts with a steady beam of 30,000-volt electrons so intense it will vaporize any known material in seconds.

What is novel about this furnace is that it delivers heat only at the focal point of its electron beam. For this reason, it can be used to create new compounds and new alloys by vaporizing high-temperature materials and allowing them to condense jointly on a cool surface somewhere else in the furnace. Rhenium-tantalum alloys and malleable sheets of molybdenum have been produced this way for the first time.

In the class of scientific machines that do their work with beams of photons — light, X-rays, gamma rays — the *metallograph* deserves mention. It is the last word in classical microscopy, having an ability, in white light, to magnify a specimen up to 1,600 times for direct viewing by the naked eye. For photographic film, it can nearly double this magnification to 3,000 times. It is still the best instrument for direct optical study of the surface structure of materials.

The work horse of this genre of machines, however, is the *X-ray diffractometer*. Soft X-rays (as opposed to the hard ones used in medicine and industry) are generated in a cylindrical housing at the hub of a circular platform and released through four portholes to fall on targets set at various angles and distances in front of them. Depending on their strength, these X-rays penetrate their targets to varying degrees and are then reflected onto photographic plates. If the target material is polycrystalline — as are most natural substances — a pattern of rings like growth rings in the trunk of a tree is registered on the plates. By the brightness of these rings and the spacings between them, scientists can determine precisely what the target material is and whether more than one element is present. In fact, such diffraction rings are the fingerprints of matter.

Man and the Machines of Science at RCA Laboratories...



H. H. Whitaker and the emission spectrograph.



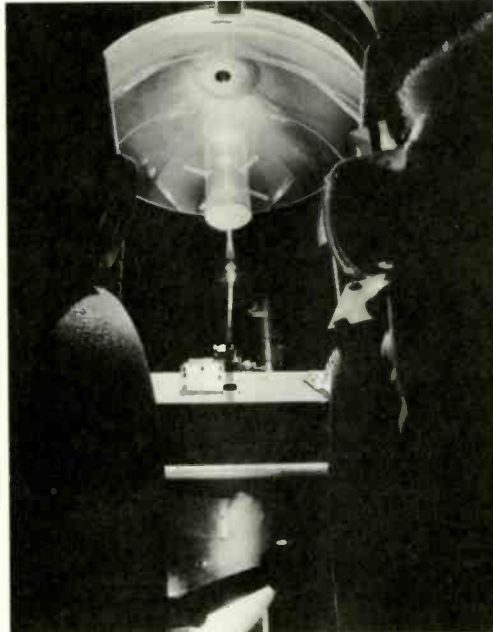
R. C. Hand and the Van de Graaff accelerator.



J. R. Woolston and the mass spectrograph.



H. S. Berman and the electron beam furnace.



M. M. Hopkins and the arc-image furnace.



Dr. M. Coutts and the electron microscope.

On the other hand, if, instead of rings, there is a geometric pattern of white dots on the plate — such as appears in photographs of the constellations — then the material is a single crystal such as diamond or quartz. Such patterns are also distinctive for each element and, accordingly, can be used to discern and identify each. Thus, X-ray diffractometry provides a reliable means for determining the composition as well as the structure of a material.

A very different machine that derives its utility from the use of photon beams is the *emission spectrograph* — a 16-foot-long chamber in which light from an incandescent specimen ricochets off a series of precisely aligned mirrors to a diffraction grating scored with incredibly fine lines — 15,000 to the inch. These lines break up the light into its various wavelengths and reflect them onto photographic film where they are recorded as a strip of bright vertical lines separated by dark spaces. Since each element emits a combination of wavelengths peculiar to itself alone, it is possible with emission spectroscopy to ascertain the composition of any material to a high degree of accuracy. In fact, one foreign atom among a million others can be seen and identified this way.

The subtlest of the photon-beam machines — dependent on a technique known only since 1947 — is probably the *electron spin resonance* instrument. Here is a device that reaches into metals and many organic compounds to assay if they contain “free” electrons — those not involved in holding the material together. Such materials make good masers for detecting and amplifying weak radio signals coming in from space probes millions of miles away.

In the electron spin resonance machine, a material for study is placed in a microwave cavity and subjected to a magnetic field. Free electrons in the sample are captured by the field and compelled to orbit around its lines of force. A microwave signal at right angles to the field is then transmitted to the cavity and through the sample. Now, the magnetic field is deliberately varied in strength until any “free” electrons in the sample are made not only to rotate around its lines of force but to do so at the same frequency as that of the microwave signal. When this state is reached, such electrons absorb energy from the microwaves and tip over in their orbits, causing a loss of power to occur in the microwave signal that is easily detected by a microwave receiver. Data so obtained provide a wealth of information on the nuclear spin of atoms in the material, the bonding strength between them, the force and direction of electric fields that may exist inside, and the behavior of excited electrons in such an environment.

Easily the most awesome — from the point of view of size and noise — of this family of electronic griffins is the *arc-image furnace*. A carbon arc of blinding intensity is generated and focused through a chain of concave mirrors to a needle point in a vertical shaft down which falls a steady snow of crystalline powder. As this powder reaches the focal point of the mirrors, it is melted instantly and solidifies into a molten mass that grows in size as the powder continues to fall. Strange and beautiful single crystals of materials with very high melting points — zirconium and hafnium oxides, for example — are produced in such a machine for potential use in lasers and other exotic devices.

Turning to machines that use beams of ions — atoms with a positive charge caused by the loss of one or more electrons — undoubtedly the most impressive is the *mass spectrograph*. Here is a power-packed machine that blasts atoms from a solid sample with a 50,000-volt electric spark, ionizes them, and sends them packing down an S-shaped path across an intense magnetic field that segregates them, according to weight, to crash like spent bullets into a photographic plate. The vertical line patterns thus created in the photographic emulsion are a clew to the composition of the sample. So sensitive is this technique that one foreign atom among a billion others is easily descried. Such small impurity concentrations are often the ruin of transistors until they are detected and rooted out.

With the attainment of controlled atomic fission during World War II, a wholly new breed of electronic machines for research grew up based upon the particles and electromagnetic energies emanating from the hot interiors of nuclear reactors. At the Industrial Reactor Laboratories in Plainsboro, N.J., RCA is one of 10 owners sharing in the use of a 5-million-watt swimming pool reactor from which scientists daily siphon beams of slow neutrons and penetrating gamma rays to study the magnetic structure of atomic matter, to induce crystal damage, and to catalyze unusual chemical reactions. Using this latter technique, RCA succeeded in building the first laser capable of being activated solely by energy from the sun.

The *pièce de résistance* of electronic machinery for research, however, is the computer — a machine, at last, that analyzes, correlates, and, in some cases, interprets automatically the rising torrent of complex data spilling from other machines in an ever-widening flood.

Already, the recently completed RCA 601-301 computer combination installed at RCA Laboratories in Princeton, N.J., is being used to analyze and print out results obtained with the mass spectrograph and X-ray diffractometers. Now, work that used to take four to six hours of laborious human analysis is being done by machine in 15 minutes with more efficiency and greater economy.

If this were all, it would be enough. However, the real promise of the computer in research lies in its extraordinary capacity for mime — its ability to simulate real events and atomic architecture mathematically. The postulation of mathematical models that attempt to describe or explain what has occurred in an experiment has always been one of the most powerful techniques of the scientific method. Proof or disproof of such models, however, often requires years during which there is great uncertainty and delay. With computers, it is expected these delays will be drastically reduced, if not eliminated. Also, the models they produce should be more nearly accurate since computers can digest far more data, far more quickly.

Such are the wondrous machines of science with which the materials meteorologists of today are charting the electron clouds and photon showers, the magnetic winds and molecular pressure fronts that shape the turbulent atmospheres of the solid state.

Manned by crews of dedicated crystallographers, microscopists, spectroscopists, and mathematicians, these machines are powering us through the surface barriers of atomic matter and on to the conquest of inner space. ■

# Electronic Music

by William Bender

Electronic techniques add new and different dimensions to the art of musical composition.

In 18th-century Europe, the tools a court composer needed were relatively simple: quill, paper, harpsichord, and a knowledge of harmony and counterpoint. Now, two centuries later, life has become more complicated for the creative musician, especially the composer of electronic music. The tools of his trade are amplifiers, tape recorders, electrostatic loudspeakers, oscillators, filters, sine-wave and square-wave generators, toggle switches, and an engineer's know-how.

As the last third of the 20th century gets under way, the electronic composer (this term will be used repeatedly, despite the fact that blood — not alternating current — courses through the composer's veins) has virtually unlimited horizons of sound to explore. Like Relay and moon-probes, electronic music belongs to the here and now.

Electronic music may be defined as music composed on magnetic tape for performance through loudspeakers, either in the concert hall or at home. This new art form makes it possible for a music lover to go to a concert and see nothing but the rest of the audience, the ushers, and two lonely loudspeakers on a stage that on another night might accommodate from one to 100 performers. Some composers try to overcome this dehumanizing effect by combining tape music with live performance.

The first thing that must be made clear about electronic music is that it is not an isolated or singular attitude or style of music intended for special uses, places, or audiences. It is, rather, a revolution of immense portent that is concerned with the fundamentals of music itself — pitch, tone, rhythm, timbre. It is a new medium that is available to any composer. Another thing that must be made clear about electronic music is that it is not designed to reproduce or imitate the past. Electronic music speaks out in its own way and with new materials and structures.

As composer Milton Babbitt, of Princeton University, puts it, electronic music makes it possible for the composer to begin at the very beginning and to control every aspect of the creative process from original concept to the final shaping of the musical work of art. To the electronic composer, the predetermined sounds of the conventional orchestra — strings, brass, woodwinds, percussion — are limiting and frustrating. He uses them, of course, but he is also able

to escape their confines when he wishes, just as Alexander Calder, the father of the mobile, was able to free himself from the limitations of immobile sculpture. The electronic composer must virtually compose each individual sound.

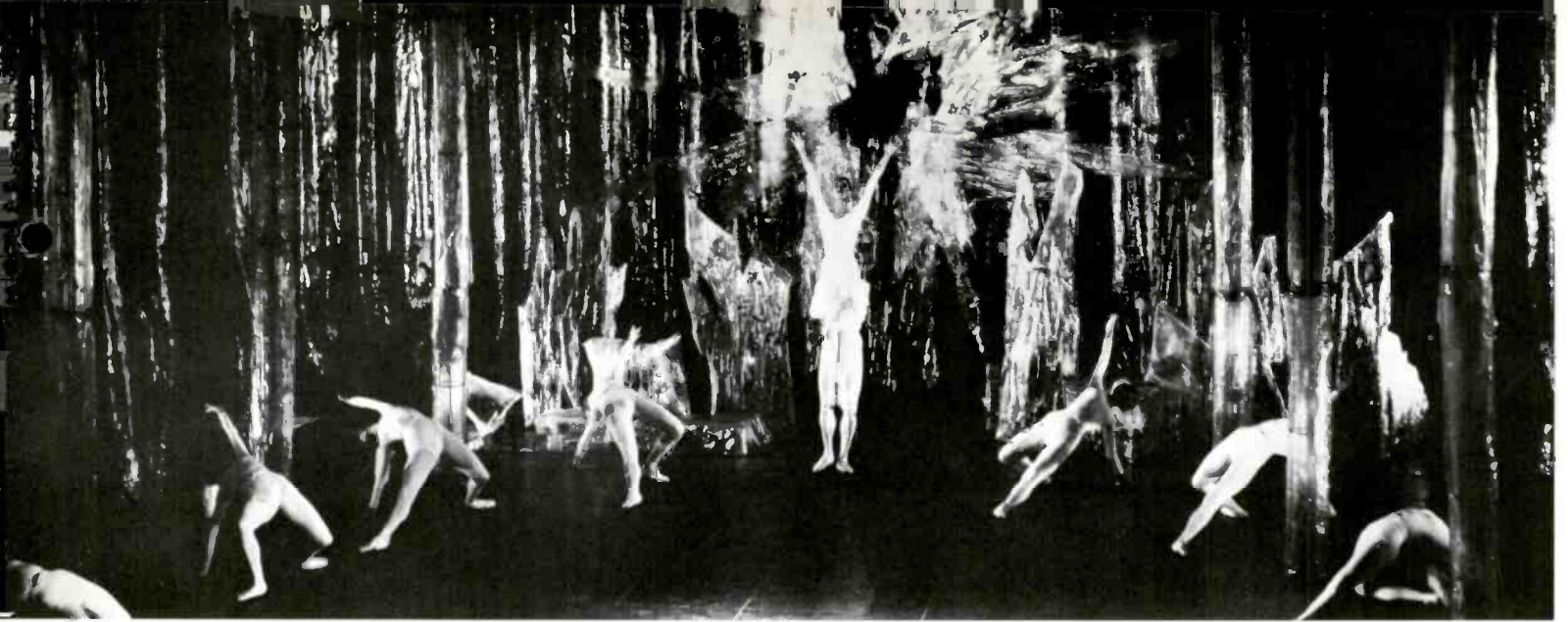
The introduction of electronic music does not mean that in the near future symphonies by Beethoven or Tchaikovsky will be discarded. Richard Rodgers, Samuel Barber, Aaron Copland, Dmitri Shostakovich, and Benjamin Britten are not going to abandon their characteristic styles of composition. The orchestras and the opera companies are not going to close down. The machine will not become king.

However, it is most likely that audiences will hear an increasing amount of music that is either partially or entirely electronic in origin. To some listeners, electronic music now seems merely a whoosh, a beep, a bloop, and a hum — no more musical than the sounds emanating from the radio shack at the nearest airport. Admittedly, a lot of electronic music is inferior stuff, worth no more artistically than the Morse code. But much of it is valuable and has a flair, coherence, and profundity all its own. It may not be long before the works of Beethoven, Tchaikovsky, Copland, Shostakovich, and other traditional composers will be presented in conjunction with the works of such leading electronic composers as Karlheinz Stockhausen, Edgar Varèse, Babbitt, Vladimir Ussachevsky, Otto Luening, and Luciano Berio. In some musical centers of the world, this is already fact, not mere prediction.

Will this present an insurmountable problem for the 20th-century listener? It shouldn't. Even the most casual music lover will go to a concert and hear music of the 18th, 19th, and 20th centuries in one sitting and think nothing of it. It matters not to him that Mozart turned his back on the baroque style of Bach, or that Wagner and Debussy many years later had to chart new paths as well, each in his own way. The 20th-century listener takes them all in one gulp and loves it — because of familiarity. The difficulty lies in developing that familiarity. It is primarily a question of attitude, as Jacques Barzun, author, critic, and Columbia University Provost and Dean of Faculties,



Composer Milton Babbitt with the RCA Electronic Music Synthesizer.



New York City Ballet premiere of "Electronics." Choreography by George Balanchine was inspired by electronic music of Remi Gassmann.

remarked to an audience attending a concert of new electronic music produced at the Columbia-Princeton Electronic Music Center in New York:

"What then is the decent, reasonable attitude to adopt? Very simple: make the assumption, first, that the old style — whatever it is — has exhausted its possibilities and can only offer repetition or trivial variations of the familiar masterpieces. I do not suggest that you should be convinced that your favorite music is obsolete. I invite you to assume that it may be: for by trying to think that it is, as the new composer has obviously done, you will begin to discover what he is up to."

The principal obstacle to the progress of electronic music at the present time is that most major commercial concert halls are inadequately equipped to present the considerable repertory of electronic music that already exists, much of it on four-track tapes. For example, the majority of these halls have either inferior tape recorders or no tape recorders at all. The young, knowledgeable audiences that are willing to travel to out-of-the-way locations to hear the latest electronic-music creations are, of course, smaller and less influential than audiences at conventional concerts, but electronic composers are confident their day will come.

Proof of the advance of electronic music is everywhere to be seen. One prominent instance, of course, is the existence of the Columbia-Princeton Electronic Music Center itself, established in 1959 with the aid of a \$200,000 grant from the Rockefeller Foundation. Its three studios operate round the clock at full capacity, turning out new music, performing and recording it, accomplishing some very important and exciting experiments in the electronic medium, and bringing new laurels to the Ivy League for its role in educating the young. One of these studios houses the \$250,000 RCA Electronic Music Synthesizer, which was developed primarily as a research tool but is now one of the most vital pieces of equipment in the whole sphere of electronic music.

The Columbia-Princeton Center, with its many panels of futuristic electronic equipment, has a strong resemblance to the space-age control centers at Cape Kennedy, Fla. It is located in a gloomy, white, four-story converted milk plant by the Hudson River on West 125th Street in Manhattan, which the Center shares with the Columbia Univer-

sity Chemical Engineering Research Laboratories. The directors of the Electronic Music Center are Ussachevsky and Luening, representing Columbia, and Babbitt and Roger Sessions, representing Princeton. The Rockefeller grant has expired, and the Center's operations are now financed by both universities. Guest composers, fellowship and enrolled students at both schools, and some faculty members use the Center. But its capacities are not unlimited. As Babbitt says: "Three composers are now using the Synthesizer, and that's too many."

The existence of the Columbia-Princeton Center is only one proof of the progress of electronic music. Abroad, there are electronic-music studios in such diverse locations as Cologne, Tokyo, and Milan. There is a definite audience for electronic music on records. The Phillips Petroleum Company commissioned Varèse to write his "Poème Électronique" for performance over 400 loudspeakers inside the company's Le Corbusier-designed pavilion at the Brussels World's Fair in 1958. Ussachevsky wrote what was probably the first all-electronic music score for the Sartre film "No Exit." The New York City Ballet presented a ballet entitled "Electronics" with choreography by George Balanchine and an electronic score by Remi Gassmann. The New York Philharmonic's precedent-shattering and controversial avant-garde festival in 1964 included electronic music, though hardly at its best. The Music Critics Circle of New York in 1964 cited electronic compositions for the first time in its history. And dancer-choreographer Alwin Nikolais even borrows Ussachevsky's studio to compose electronic scores for his avant-garde dance events at the Henry Street Playhouse in Manhattan.

Many composers and critics believe electronic music has established itself as part of the cultural community and is definitely here to stay. This does not mean that its advocates are pressing for a musical *coup d'état*.

"We're not interested in supplanting anything or anybody," Babbitt says. "We're interested in supplementing what already exists."

Says Ussachevsky: "Like any other composer, the composer of electronic music is still faced with the eternal problem of finding that magic ratio between color, duration, and rhythm that makes a given piece of music great. But the opportunity to find out new things about music's

fundamentals is the 'why' of electronic music. We now have complete freedom of rhythmic opportunity, and new, previously nonexistent timbres. Certainly, these are advantages that should be of interest to any composer. As the novelty wears off, and it is beginning to, we are going to have more and more responsibility to produce better and better music that will endure."

Divergent styles and attitudes are represented at the Columbia-Princeton Center. Babbitt, the most prominent figure to use the RCA Synthesizer and one of the composers cited last year by the Music Critics Circle, is a pitch composer and organizes his compositions around the 12-tone principle (pioneered by Arnold Schönberg) he formerly employed as an instrumental composer. Others, like Ussachevsky, put stress on color and timbre. In addition to using electronically produced sounds, they work with tape recordings of real (or concrete) sounds that can be manipulated. These are primary interests and do not mean that Babbitt is not concerned with color or Ussachevsky with pitch.

Babbitt once taught mathematics, but he is understandably annoyed at any suggestion that his music is mathematical or that he composes by formula. Actually, he composes by ear. With the RCA Synthesizer, he can test a composition as he goes along, and if he does not like what he hears he can erase it. This offers obvious advantages. One disadvantage, however, is that the Synthesizer is not transistorized and its vacuum tubes take time to warm up.

"But it is a remarkable machine, and we know it can do anything in the world," says Babbitt. "The only limitation upon it is our knowledge of the analytical components of sound. You tell me what the components of a violin passage are, and I will reproduce it with the Synthesizer. But no one has yet analyzed violin sound to that degree. We've discovered that we know very little about how we hear. And in our efforts to get back to the fundamentals of sound, we are asking ourselves important questions. What are the limits of audibility? Can the ear be trained beyond certain thresholds?"

"We know for certain that we can play passages too fast for the ear to hear, and we know that we can fool the ear about such matters as duration. We also know that the ear can hear certain trills with absolute clarity, and yet these trills are so fast that they cannot be duplicated by the best singers or instrumentalists. We've discovered that there is a vast difference in sound characteristics between the opening fraction of a second of any sound — known as the attack characteristic — and what follows.

"Ussachevsky and I once heard a violin sound that had been shorn of its attack, and we mistook it for an oboe. But the attack characteristic is only one of an array of sound behavior patterns that determine what we hear — like the factor we call the sound's envelope, that is, the sound's rise and fall characteristic, or the shape of the sound's volume as the sound comes on. The envelope can actually determine timbre. Knowledge like this is profoundly important to us."

All of this obviously makes musical composition a complicated business. Some composers, such as Stockhausen, use graph paper to record their works of art. And a disciple of his is said to have spent close to a year writing down "Kontakte" — after Stockhausen had composed it on tape.

In the United States, the Patent Office demands that all music must be submitted on regular music paper with regular musical notation. This is difficult for electronic composers to do, because the new electronic scores have left conventional notation far behind. For example, the score for "Stereo Electronic Music No. 1," by Bülent Arel of Istanbul, Turkey, has five separate sets of instructions: 1. "The pitch element," 2. "The noise element," 3. "Duration independent of reverberation or feedback," 4. "Amplitude wave," and 5. "Time in seconds." They are written down on conventional music paper all right, but obviously because of tradition only.

What it all means from the composer's point of view is that rich, new natural resources of sound await him, and that complex and exciting ways of using them are at his fingertips. From the other side of the footlights, it means that the listener is going to have to do some hard listening



Record album covers of electronic-music repertoire.



and allow himself to be exposed to the new music. This is not a new phenomenon; for generations, audiences have had to get used to new composers, many of whom ultimately became world famous. In return for all this, the listener will be entitled to enjoy the good music and reject the mediocre when it is performed. In any age, the only enduring characteristic is genius.

Is there any validity in the fear that the individual is going to wake up one morning and find that he no longer counts for anything, that automation has taken over? On this subject, Dean Barzun says:

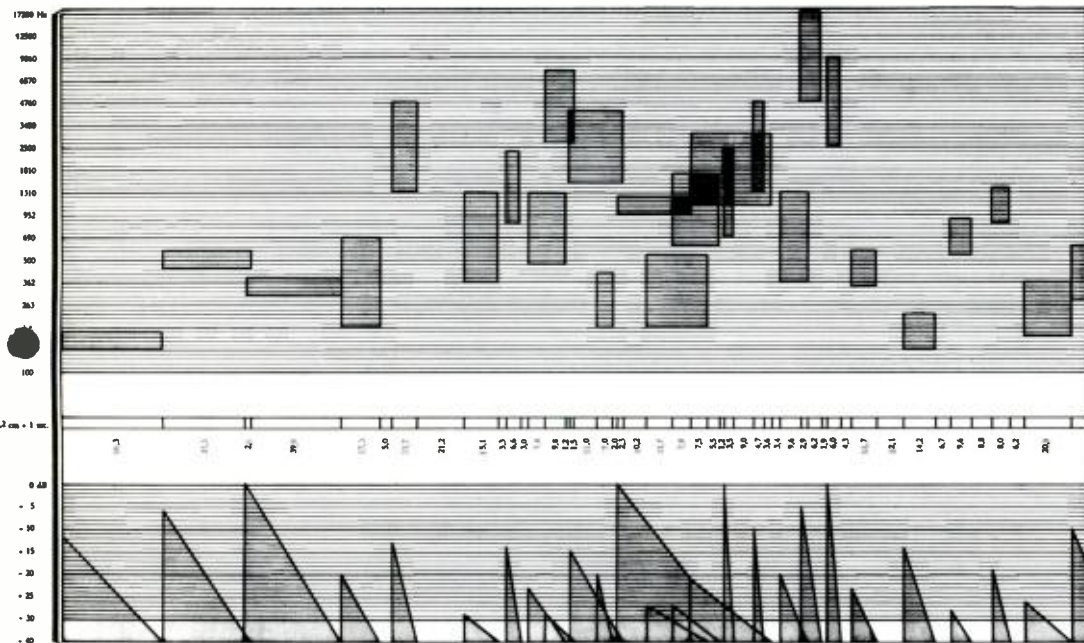
"Most people of artistic tastes share the widespread distrust and dislike of machinery and argue that anything pretending to be art cannot come out of a machine: art is the human product *par excellence*, and electronic music, born of intricate circuits and the oscillations of particles generated by Con Edison, is a contradiction in terms. Here again the answer is simple: the moment man ceased to make music with his voice alone the art became machine-

ridden. Orpheus's lyre was a machine, a symphony orchestra is a regular factory for making artificial sounds, and a piano is the most appalling contrivance of levers and wires this side of the steam engine."

How did it come about, this revolution in musical composition? Well, electronic or mechanical equipment is really nothing new in music. The musical history books are full of mechanical or electronic gadgets of unbelievable variety, ingenuity, and, often, impracticability.

One of the most intriguing of these was the theremin, named after the Russian scientist Leon Theremin who invented it in the mid-1920s. It consisted primarily of two oscillators and a loudspeaker and was played by moving the hands back and forth near a vertical rod antenna on the right and a horizontal loop antenna on the left. The movements of the right hand determined pitch, and the left hand governed loudness. For a time, the theremin

lished. Meanwhile, exciting things were taking place at the Acoustical and Electromechanical Research Laboratory of the RCA Laboratories at Princeton, N. J., under the guidance of Dr. Harry F. Olson, Director, and Herbert Belar, Fellow. Complex and exhaustive studies were being made of the characteristics of musical instruments to provide improved means for the reproduction of sound. One thing learned from these studies was that the horizons of sound were a lot broader than the area embraced by the familiar strings, woodwinds, brass, and percussion instruments. As a result, Olson and Belar decided to develop a system for the production of music without limitations. The RCA Electronic Music Synthesizer was the result. Initial experiments with the Synthesizer included analyzing recorded selections by famous artists and then reproducing them with startling likeness. Some of these synthesized selections were heard in a demonstration record produced by Olson



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What is reproduced here is a page from the score of Karlheinz Stockhausen's "Electronic Study Two."

The heavy concentration of horizontal lines at the top half of the score represents pitch, or frequencies per second. The pitch range is 100 to 17,200 cycles, the lowest represented by the bottom parallel line at the middle of the score and the highest by the top line. The shaded portions indicate overlapping note mixtures.

The horizontal lines at the bottom represent the volume, or decibel range. The highest parallel line is the loudest, and the lowest line the softest. It should be noted that the shapes in the volume group correspond horizontally to the shapes in the pitch group. The descending lines leading away from the jagged points show that the volume of the sound is decreased almost as soon as it is produced.

Between the pitch and volume groups are two parallel lines representing duration of the musical notes. These durations, indicated in centimeters, also correspond horizontally to the shapes of the pitch and volume groups.

Universal Edition, Ltd., published the score in 1956.

was manufactured by RCA. The instrument's essential drawback was that it could not go from one pitch to another without an intervening glissando.

Musical Rube Goldbergs popped up everywhere. There were even color organs with which performers seated at keyboards could project color patterns on screens to accompany chosen pieces of music. The clavilux, invented about the same time as the theremin, made possible color recitals without music. But the most important precursor of electronic music was *musique concrète*, a Parisian flowering of the late 1940s during which composers first began to combine in aural montages real sounds such as those produced by machines, instruments, and voices. And near the end of that decade came the introduction of magnetic tape recording machines, a development that helped to insure the future of electronic music.

In the early 1950s at Columbia University, Ussachevsky and Luening began to experiment with recorded sound and tape recorders, and an electronic studio was estab-

lished. Meanwhile, exciting things were taking place at the Acoustical and Electromechanical Research Laboratory of the RCA Laboratories at Princeton, N. J., under the guidance of Dr. Harry F. Olson, Director, and Herbert Belar, Fellow. Complex and exhaustive studies were being made of the characteristics of musical instruments to provide improved means for the reproduction of sound. One thing learned from these studies was that the horizons of sound were a lot broader than the area embraced by the familiar strings, woodwinds, brass, and percussion instruments. As a result, Olson and Belar decided to develop a system for the production of music without limitations. The RCA Electronic Music Synthesizer was the result. Initial experiments with the Synthesizer included analyzing recorded selections by famous artists and then reproducing them with startling likeness. Some of these synthesized selections were heard in a demonstration record produced by Olson

and Belar, "The Sounds and Music of the RCA Electronic Music Synthesizer," RCA Victor record LM-1922. Several composers, including Babbitt and Ussachevsky, heard about the RCA Electronic Music Synthesizer and went to Princeton for a look and listen and were enthusiastic. As a consequence, the RCA Laboratories were asked to build a second and more elaborate instrument. The second RCA Electronic Music Synthesizer was placed in use at the Columbia-Princeton Music Center at its inception in 1959.

Whether the electronic composer employs the RCA Synthesizer or whether he uses other devices for transforming and modulating concrete sounds, he is the first composer in history to work directly with his materials, as does the painter. This is an exciting step forward. No longer does he have to depend on the whims of interpretation. And, from a larger point of view, the possibilities now available to him are endless—limited only by the depth and range of his creative being. ■

Since 1955, NBC Radio Network's "Monitor"—specifically designed for America's on-the-move audience—has been the only full-length weekend radio program furnishing a combination of news, entertainment, sports, and music.



# “MONITOR”

by Alan Ebert

“Beep . . . beep . . . beep . . . beep.” This is the sound of the “Monitor Beacon,” the distinctive symbol of the NBC Radio Network program, which will celebrate its tenth anniversary in June.

But what is the real sound of “Monitor”?

It is the joyous shout of Pamela Jackson, of Springfield, Ill., who had a simple wish transformed into a cherished memory of a visit to the Presidential inauguration in Washington because of “Monitor.”

It is the sigh of relief from the inhabitants of Rib Lake, Wisc., who were without a physician until “Monitor” mentioned their plight.

It is the sound of gunfire in Saigon, of a bulldozer clearing the debris from an earthquake-wrecked block in Anchorage, of a festive Mardi Gras in Rio de Janeiro.

And it is the sound of a “Monitor” reporter describing the event accurately and articulately.

In the past decade, “Monitor” has furnished over 11,000 hours of service, more than any other radio show in the history of broadcasting. The program has recorded more than 60,000 remote broadcasts from all over the world and has presented more than 75,000 interviews with a variety of personalities, including world leaders and celebrities of every description. More than 150,000 musical selections have been played — enough to keep a discothèque party dancing all year long.

But what is “Monitor”?

“Monitor” is the forerunner of talk radio. Today, it has evolved into entertaining and informative mobile radio, unique in that it is specifically designed for America's on-



the-move audience. The person who tunes in his car radio while en route to the shopping center; the handyman on a brief do-it-yourself spree in his workshop; the vacationer relaxing with a transistor radio on the beach — these are the people who are among the program's audience.

Mobile radio on "Monitor" means each interview or feature is designed to be brief, concise, and informative so that anyone may tune in at any time and instantly be drawn to an event somewhere in the world.

Of "Monitor" and its creation, Robert Wogan, Vice President, Programs, NBC Radio Network Division, says: "How can network radio again be important and indispensable to both listener and advertiser? That was the question in 1955 that led to a re-examination of radio and created 'Monitor' — a revolutionary new concept in weekend radio

"Weekends are different — so is 'Monitor.'" This statement has long been the slogan for "Monitor." No other radio show (or television show) can do what this program does in bringing the world into focus within minutes.

For example, let's assume there is a government upheaval in a foreign country. The NBC News correspondent assigned to the area phones his story into "Monitor" at Radio Central at NBC, New York. There, tape machines are able to record his on-the-spot report and play it back within seconds for broadcast over the network.

Through the years, "Monitor" has had more than its share of "newsbeats" and eyewitness reports.

James Hagerty, when press secretary to President Dwight D. Eisenhower, learned of the President's heart attack while listening to "Monitor."



The late George Clay, NBC News correspondent, taping a broadcast for "Monitor." Clay was killed while on assignment in the Congo.

programming. 'Monitor' would capitalize on what network radio could do best — mobility and immediacy.

"Today," continues Wogan, "10 years later, 'Monitor' is still unique and still the only full-length radio network program in existence furnishing a combination of news, entertainment, sports, and music."

The American audience is significantly aware of the program's ability to reach anyone with an ear attuned to radio. Thirteen per cent of all adult Americans (15.7 million) listen to it each weekend. Combining that figure with the teen-age audience adds up to a total listenership of about 20 million. With 228 million radios owned in the United States today and 28 million radios purchased in 1964, who can predict what "Monitor's" audience will be on its 20th birthday.

On January 11, 1964, "Monitor" had the first interview with U.S. Surgeon General Luther Terry shortly after he released his report on smoking. On March 28, 1964, "Monitor," broadcasting the first eyewitness report originating from Anchorage, described the devastation of the Alaskan earthquake, which resulted in millions of dollars of property damage.

In its current framework, the program is heard in five blocks over the weekend (three on Saturday, two on Sunday). Total air time is 16 hours. On Sunday night, there is a comprehensive examination and wrapup of the week's news. It is an annual award winner, last year garnering the coveted Peabody Award.

Each segment of "Monitor" has a different host. Currently, the five anchormen are David Wayne, Ed McMahon,

Gene Rayburn, Barry Nelson, and Frank Blair. Each segment also has features and interviews that differ in theme, length, and mood. "Monitor" has been a belly dancer revealing how her torso-twisting was enabling her to obtain credits toward a college degree in home economics; and an Elizabeth Taylor or Rock Hudson giving an inside look at film-making or providing a more personal insight into their background.

And "Monitor" moves to where the story happens to be. With NBC newsmen assigned throughout the world, the program can originate from all points of the globe.

On a typical weekend, "Monitor" moved to Nairobi where NBC newsmen George Clay (subsequently killed by snipers while on assignment in the Congo) reported on "short skirt" politics — the increasing participation in politics of women in the new Africa. From Nairobi, the program sped to Boston where singer Patti Page discussed a performer's obligations or lack of same to her fans. "Monitor" traveled from Boston to Chicago for an interview with



Film star Robert Mitchum (left) is interviewed by "Monitor" host Ed McMahon at NBC's Radio Central, New York.

"Winston Churchill Mulholland" — a talking myna bird. Then, the program journeyed to Buenos Aires for an introduction to the proprietor of the world's largest pawnshop, Dr. Damien Beccar-Varela, president of the Buenos Aires Municipal Bank, which specializes in lending money on goods. "Monitor" sped north to Alaska for an intensive examination of the 49th state, and then moved down to the South Seas for a concert by a local Tahitian band.

"Monitor" reporters, stringers, and interviewers are scattered throughout the world. The domestic features for which "Monitor" is noted, however, are arranged largely through the 199 NBC Radio affiliates broadcasting the program each weekend. In "Monitor's" eighth-floor offices at 30 Rockefeller Plaza, N.Y., three people are in constant touch with station representatives throughout the country. News and feature stories are fed to feature editors Gordon Frazer and Constance Petrash and news editor Fitzgerald Smith.

But the exact number of people connected with assembling the material for "Monitor" has never been deter-

mined since the figure changes weekly. According to Robert Maurer, the show's executive producer, the figure is estimated in the hundreds, more than any other radio or television program. If the NBC News correspondents heard regularly in such weekend features as "Ring Around the World" and "Focus on the News" were added to the staff total, the gross figure for all types of participants would be nearly 1,000.



Barry Nelson



Jonathan Winters



Frank Blair



Al Capp

Maurer's responsibilities include the over-all programming of the weekly 16 hours, plus approval of all interviews, features, and special packages. "Monitor's" New York staff consists of five units (one for each segment of the program), each with three people — a producer-director, a writer, and a production assistant.

The producer-director is responsible for the production of his segment, including the editing of tapes and the coordinating of all material into his three-hour segment (there is one four-hour block on Sunday afternoon). His in-studio work involves pretaped interviews and, of course, his entire broadcast segment with the individual host from studio 5B in Radio Central in New York.

The writer is in charge of preparation of all scripts and the introductions to taped features and special features. His in-studio work on the day of broadcast involves rewriting of scripts to include breaking news stories that may replace scheduled material.

The production assistant is in charge of the music for his segment. In the studio on broadcast days, the production assistant takes charge of all tapes and records. He also cues the turntable engineer regarding the playing of records and commercial disks.

There are other specialists also directly involved in

the success of "Monitor." The program coordinator of operations schedules and coordinates the elements of programming into appropriate units. The commercial manager schedules, coordinates, and distributes commercials for the segments. The manager of special projects supervises all music as well as the production of special features within the program.

"Monitor" is actually five shows within a show, all working separately but interdependently to achieve the same over-all sound and purpose. Its effects have been far-reaching.

On Saturday, January 16, 1965, Pamela Jackson, a 12-year-old girl from Springfield, Ill., had a wish fulfilled thanks to "Monitor." The youngster had written President Johnson asking for his photograph, explaining how she had missed an opportunity to snap his picture during his

Pettera was attracted to the new medical building. For three years, he served the town and the surrounding countryside. When Dr. Pettera was called into active service with the National Guard, Rib Lake once more became a town without a physician.

Dr. Pettera was interviewed on "Monitor" on a Sunday night. By Monday morning, a listener, Dr. Frank Hesse, was on his way to Rib Lake to pay a "house call." Shortly thereafter, Dr. Hesse took up permanent residence in the doctorless town.

There are other entertaining elements to "Monitor's" effectiveness. Balance in broadcasting is attained by "lightening the load" with mayhem and merriment as provided by such comics as Jonathan Winters, Phyllis Diller, Selma Diamond, and the team of Nichols and May. They receive a strong assist from iconoclast Al Capp.



"Monitor" staff meetings are held every Wednesday in office of executive producer Robert Maurer.

campaign tour in Illinois. A few days later, Pamela received from the White House an autographed picture of President Johnson and his personal invitation to attend the inauguration.

In a "Monitor" interview, Pamela's father revealed that, although they were overjoyed to have received the invitation, the family's finances prohibited such a costly trip.

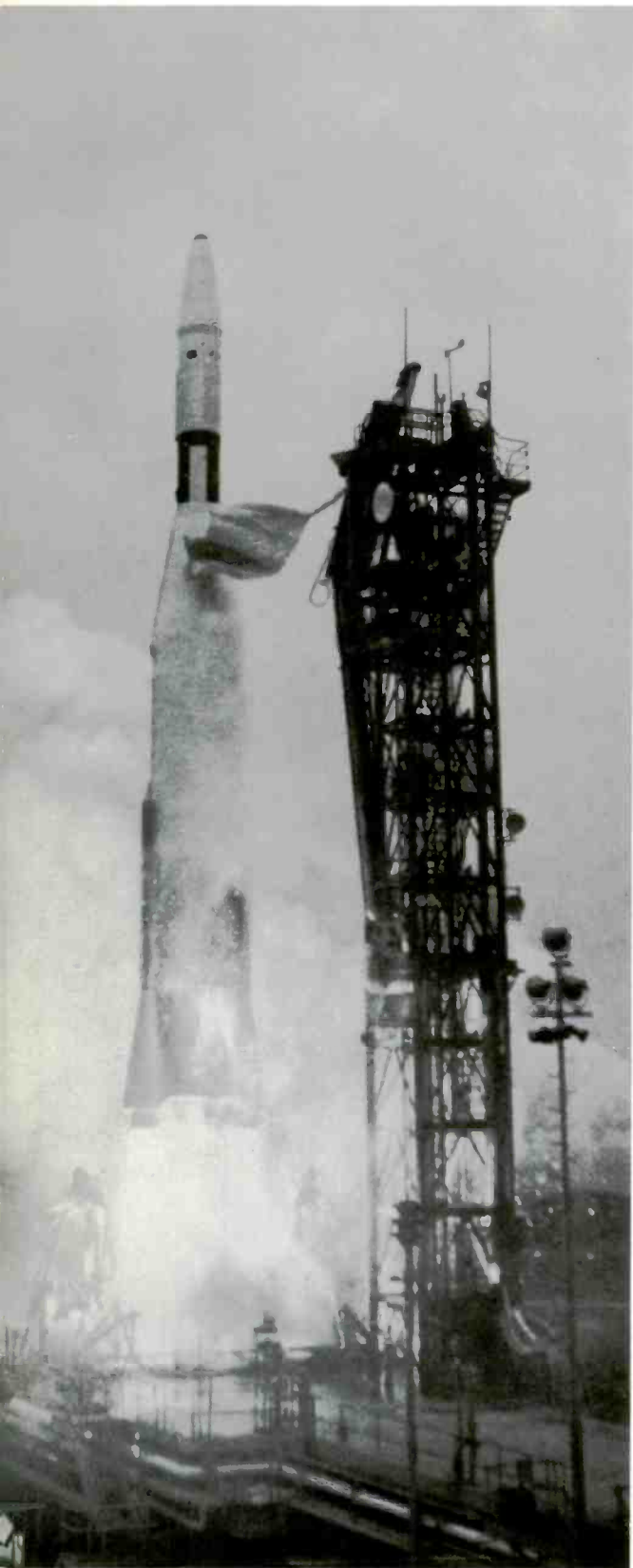
Immediately following the interview, NBC's switchboards were flooded with offers of housing assistance for the Jackson family while in Washington. In addition, the American Motors Corporation volunteered to underwrite full transportation expenses for the family's trip to the inauguration.

The extent of "Monitor's" impact on its listeners was also demonstrated a few years ago.

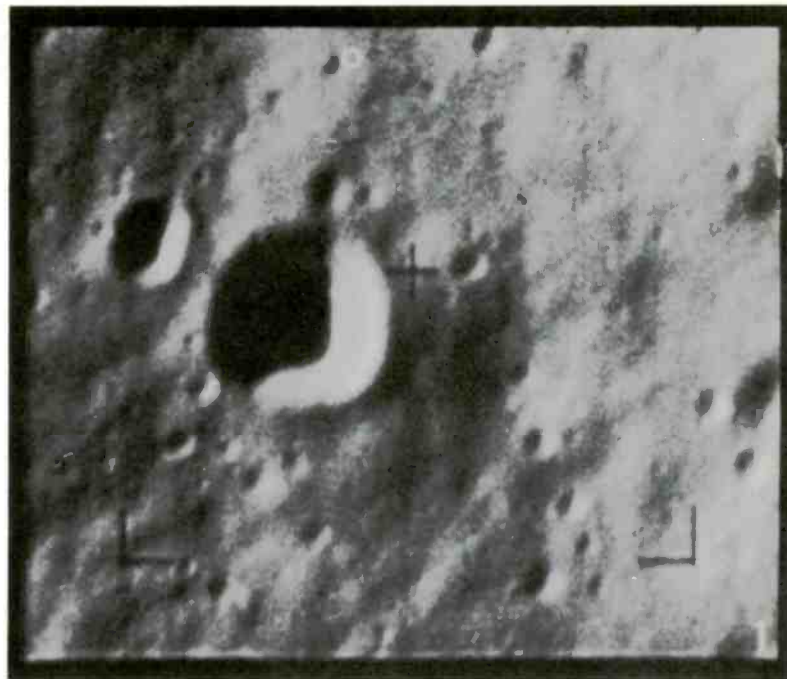
For eight years, Rib Lake, Wisc., was a community without a doctor. Then the town built a clinic. Dr. Robert

The mainstay of "Monitor," however, continues to be public service. "National Alert" is just one of the award-winning "Monitor" public-service features heard each weekend that are designed to inform Americans of the workings of their government. Also, each weekend Arlene Francis' "Home Show" and the "At Home with Hugh Downs" programs instruct listeners on how to cut corners while making those corners more attractive. Sports are comprehensively covered throughout the weekend by a large staff of sportscasters headed by Joe Garagiola and Mel Allen.

Though 10 years old this June, "Monitor" is still the pioneer of on-the-move broadcasting. Stephen B. Labunski, Executive Vice President in charge of the NBC Radio Network Division, succinctly sums up the program's distinction: "Monitor's uniqueness has provided NBC Radio with one of the most emulated programs in radio today and with its highest source of advertising revenue." ■



Propelled by the Atlas-Agena launch vehicle, Ranger 9 starts its historic trip to the moon. By the time the spacecraft landed on the moon 64 hours and 31 minutes later—within four miles of its preselected impact point—its RCA-built cameras had sent back 5,814 photos of the lunar surface.



## RANGER: TV EYE ON THE MOON

When the Ranger 9 spacecraft crashed in the crater Alphonsus on the moon's surface at 9:08 A.M., Eastern Standard Time, on March 24—exactly as planned—millions of Americans witnessed the historic event on live television.

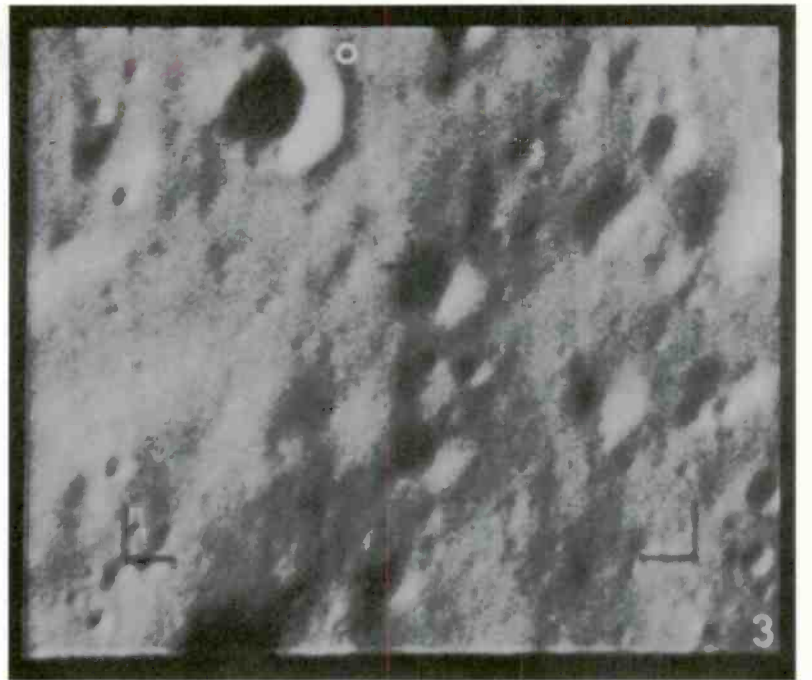
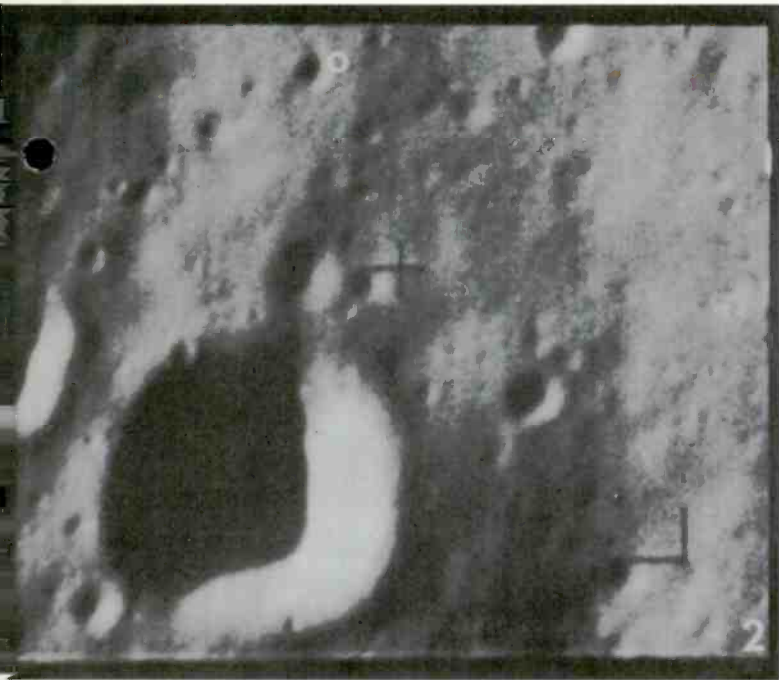
The RCA television camera system aboard Ranger 9 transmitted 5,814 quality pictures more than 240,000 miles from the moon, thus bringing to more than 17,000 the number of high-resolution photographs returned by Rangers 7, 8, and 9 within an eight-month period. These pictures have given scientists a means to transcend the earth-bound limits of human vision and to study objects and scenes never before viewed by man.

Photographs taken by the 18 RCA cameras on the last three Ranger spacecraft showed craters and objects no bigger than a peach basket; in contrast, scientists using earth-bound instruments would have difficulty detecting an object as large as an aircraft carrier on the lunar surface.

Designed by NASA to help determine a landing site for the Apollo manned moon mission, the Ranger program was managed for NASA by the Jet Propulsion Laboratory of the California Institute of Technology.

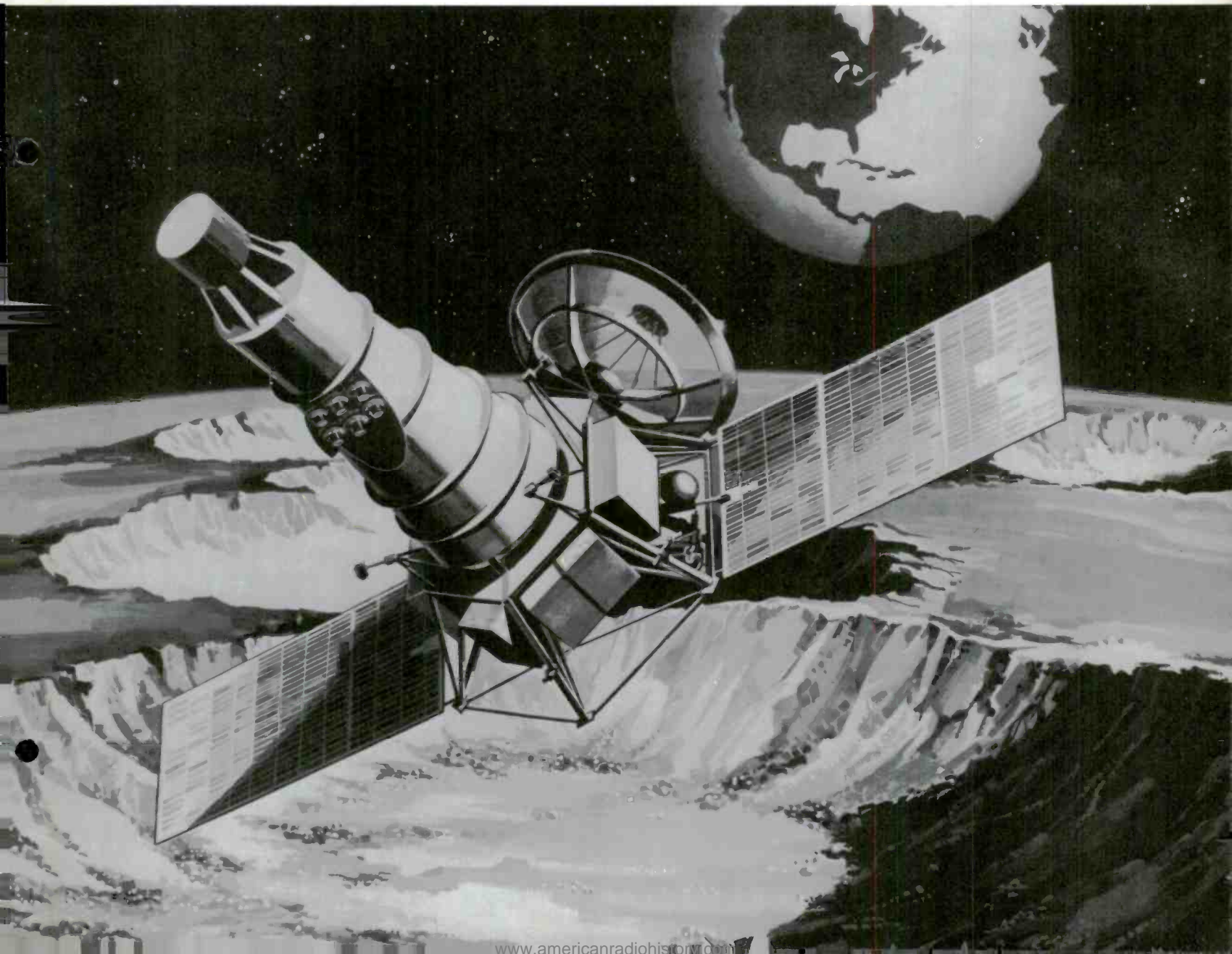
The television camera systems for all the Ranger spacecraft were designed and built by RCA, and RCA built the ground-based receiving equipment for the Ranger television signals and the television recording and display equipment.

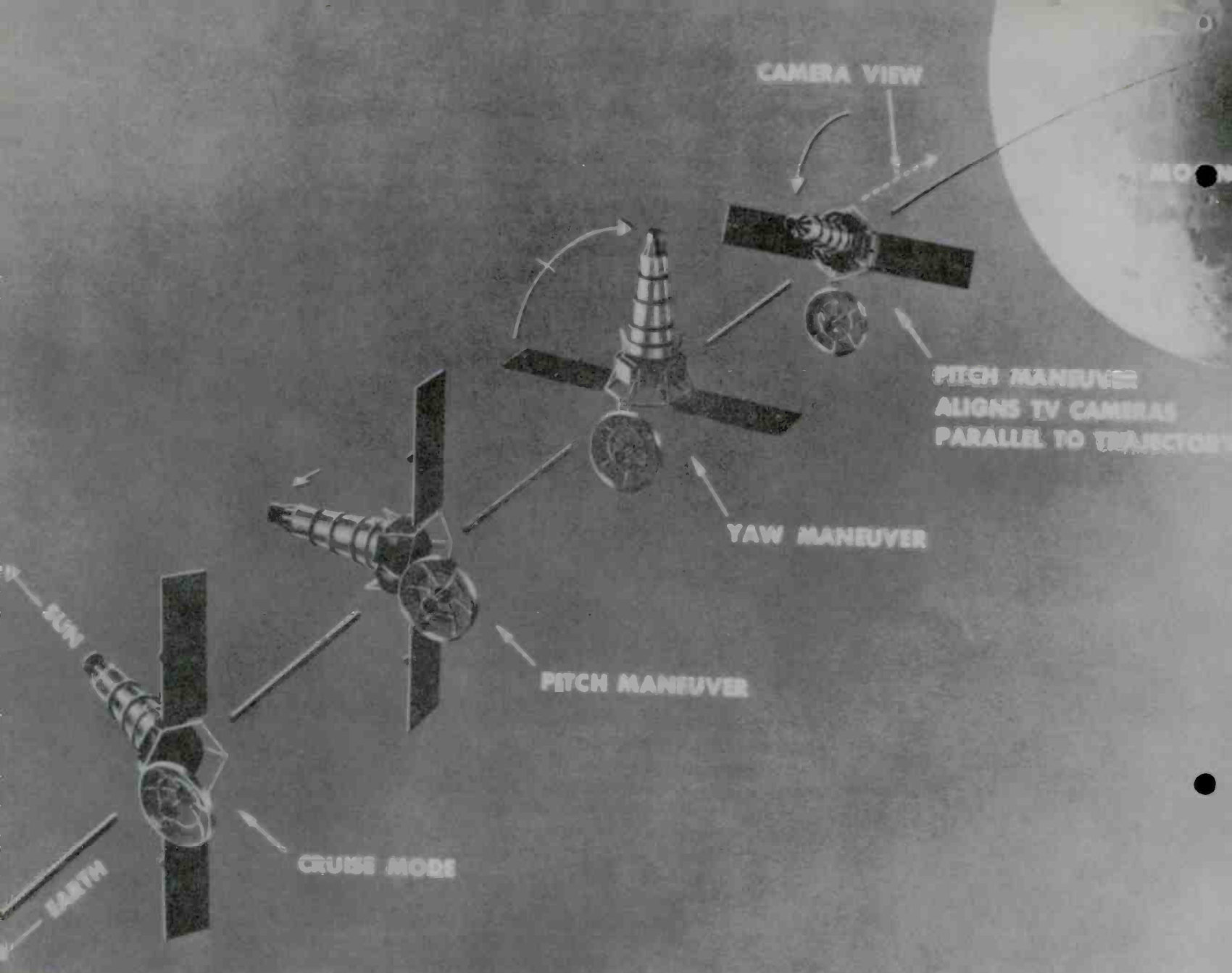
Artist's conception of Ranger spacecraft nearing impact on moon. The "eyes" of the spacecraft, six specially designed television cameras, were built by RCA in Princeton, N.J.



As Ranger 9 approached its impact point, television viewers across the nation saw a dramatic series of still photographs that appeared to bring the lunar surface closer to their TV screens. Picture 3, above,

was taken .453 seconds before impact from an altitude of three-fourths of a mile above the moon. Circle on edge of 25-foot crater near upper margin marks spot where Ranger 9 landed.

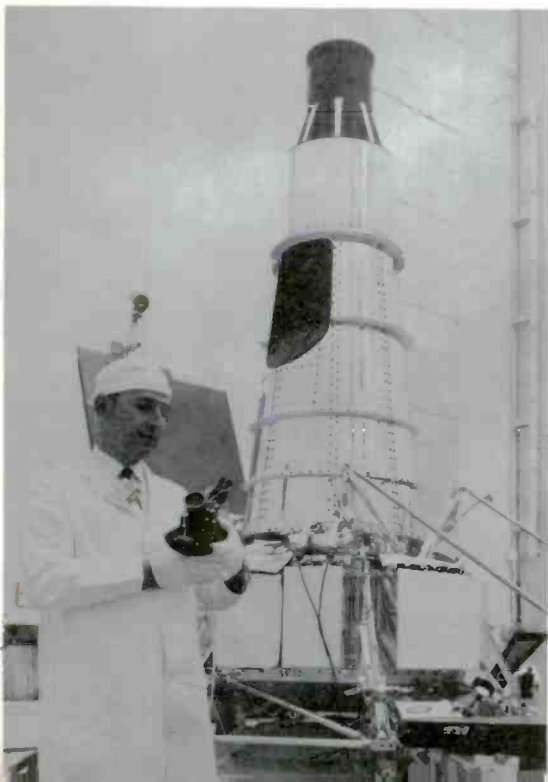




▲ Illustration shows how three separate maneuvers in space changed attitude—but not trajectory—of Ranger 9 to bring cameras in better alignment with the spacecraft's flight path. This "terminal maneuver," never before attempted, was carried out in response to radio signals from the ground. It was so successful that all the pictures taken by Ranger 9's two full-scan cameras were completely "nested"—that is, the impact area was visible in each of them.

◀ RCA engineer holds full-scan camera like those in Ranger 9 in the background.

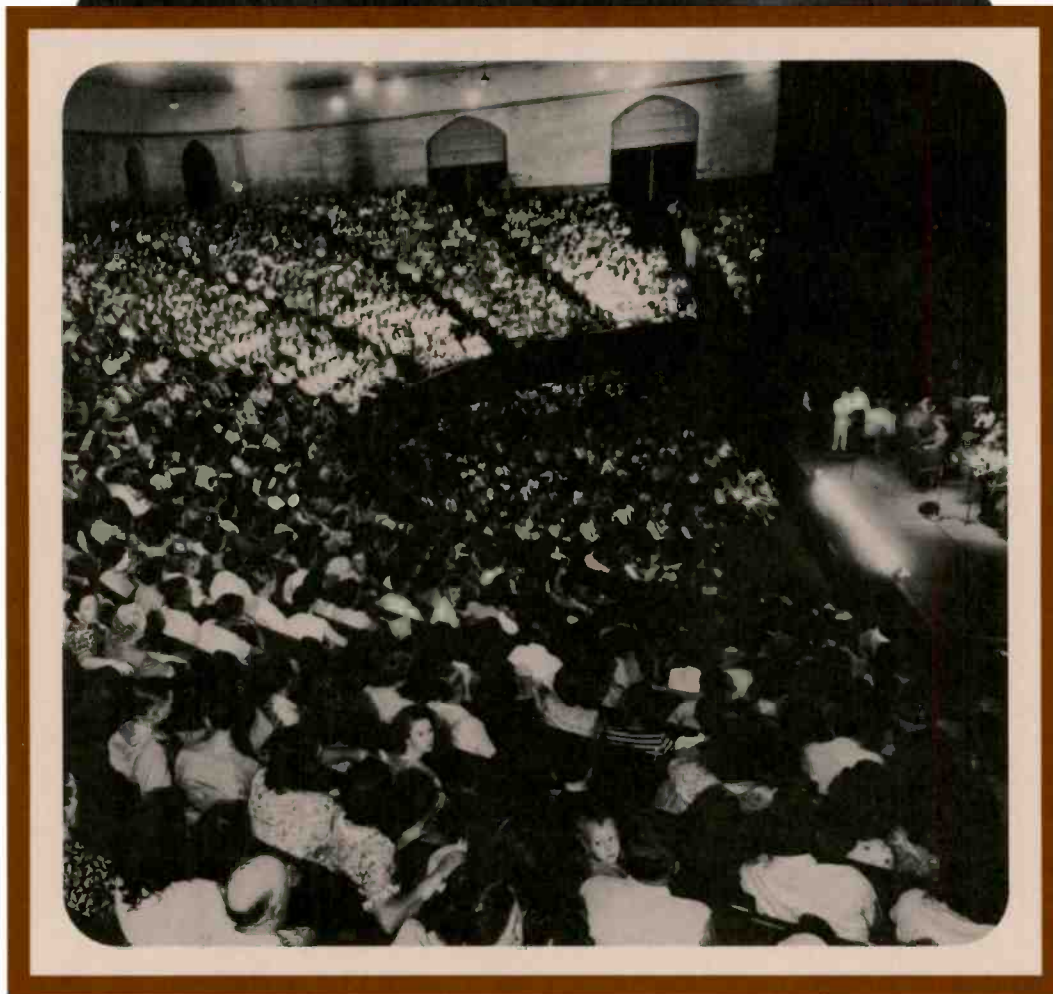
Specialists doublecheck RCA television system for Ranger spacecraft. ▼



# "The Nashville Sound"

by Bob Shelton

*The capital of Tennessee is also the capital of country music. Recording artists from New York, Hollywood, even Europe, go there to take advantage of the famous "Nashville Sound."*



Audience packs Ryman Auditorium for broadcast of the "Grand Ole Opry."

**N**ashville, the gracious capital of Tennessee, is the heart of a metropolitan district in the central part of the state with a population of nearly half a million. The city is known as an educational, medical, and publishing center and also as the place that sent Andrew Jackson and James Polk to the White House.

Less well known about Nashville is that it is the capital city of a \$100-million international music industry. It has become the vortex of a recording, publishing, broadcasting, and personal-appearance network that spreads around the world. Some music fans in Tokyo, West Berlin, and Dublin may know more about Nashville than many otherwise well-informed residents of Manhattan or Minneapolis.

Nashville is known by many soubriquets: Music City, U.S.A.; Tin Pan Valley; the Capital of Country Music. Although many people still think that the popular-music industry is centered in Hollywood, Manhattan's Tin Pan

Alley, or, more recently, in Liverpool rock 'n' roll clubs, in actuality, Nashville is probably the center of more musical activity than are any of these other metropolises.

The statistical evidence is impressive: there are probably more than 25 million country-music fans in the world. To serve their tastes, Nashville is the center of a personal-appearance empire that sends out performers for a total of nearly 15,000 performances annually. Nearly one out of every two popular-music recordings made in the United States is made in Nashville. Some 500 song-writers live in or near Music City, U.S.A., and more than two dozen recording studios are in operation here.

This year marks many events and anniversaries of consequence to Nashville. Forty years ago, the radio show "Grand Ole Opry," which was to be the chief reason for the development of the Nashville industry, started to broadcast. Twenty years ago, the first commercial record-

## "The Nashville Sound"

ing was made there. In addition, it was just 40 years ago that the first country-music hit, Vernon Dalhart's "Prisoner's Song" on RCA Victor, swept the nation.

To show that the Nashville story is not just one of a past glory but rather one of a continuing spiral of growth, this year also marks the opening of a major new studio by RCA Victor, and, before this year is past, at least one other major record company will have a new studio in operation here.

All of which adds up to a portrait of the Tennessee capital as a sort of show-business boom town. The spirit of the musicians and officials who staff the Nashville industry is not the least of the city's subjects of pride. For there is a certain sense of pride in the "underdog" music that helped to make Nashville the thriving music center it is today.

Although the city's industry was built upon country music, the last 15 years have seen another phenomenon here. The relaxed atmosphere of the town, the availability of able accompanists and sidemen, the resources of excellent recording studios have made many pop-music stars gravitate to Nashville. One recording director has described the town as a "Mayo clinic" for performers whose careers are lagging; they go to Nashville to change their luck, to start off on a new rise to stardom.

But Nashville is not only a haven for singers in trouble. Burl Ives, Perry Como, Rosemary Clooney are a few of the successful ones who have recorded here. Interestingly enough, two European singing stars, Rita Pavone and Sylvie Vartan, recently came to the United States, and journeyed to Music City for recording sessions.

The origin and the exact definition of "The Nashville Sound" cannot be established. More than anything, it seems to connote a quality of ease and relaxation, an unhurried, unpressured atmosphere that the Southern center offers to performers, and that they, in turn, pass on to their fans.

Long before the phrase "Nashville Sound" entered the language of the music business, the town started on its destiny as a music center. On November 28, 1925, the first "Barn Dance" program was presented on the newly established radio station WSM. The announcer-host was a former newspaperman named George D. Hay, who had earlier helped station WLS in Chicago start its "Barn Dance." The performers on that first show were an 80-year-old bearded fiddler named Uncle Jimmy Thompson and his niece Eva Thompson Jones who played piano and sang. Uncle Jimmy scraped out an hour's worth of old jigs, reels, and sentimental parlor and country songs. After only a few minutes, requests began to pour into the station from listeners by wire and telephone. The new show was a hit.

Two years later, George Hay, known by his nickname, "The Solemn Old Judge," renamed the show "Grand Ole Opry," and it has become the grand old dinosaur of American radio. Having missed air-time only during a few of the late President Franklin D. Roosevelt's "Fireside Chats," the "Grand Ole Opry" is the oldest continuous broadcast in radio. Either directly on its clear-channel station or through subsidiary syndicated shows, the country music on the "Opry" reaches some 10 million persons each week.

When the "Opry" started, country music was also in its infancy. It was then just a rural folk music, instrumentally and vocally, that was finding an outlet over the young media of disk recording and radio. (The first country recording of consequence was Fiddling John Carson's Atlanta session of 1923.) Thus, it was two electronic media, recording and radio, that were to transform a regional folk music into an international industry.

The "Opry" today and the music recorded in Nashville reflect how comprehensive the term "country music" has become. It includes ballads, heart songs, Bluegrass, Western songs, train songs, breakdowns, fiddle and guitar tunes, hoedowns. Country music embraces a wide range of styles, from the strictly traditional folk-oriented to the bright, urbane love ballads or novelty or sacred tunes that have a distinctly modern flavor. As in jazz and pop music, there are a variety of styles and approaches to country music, and the fans will often debate the merits of one over another with considerable passion.

Today, the "Opry," held in a former tabernacle called Ryman Auditorium, has grown to a four-and-one-half-hour marathon. As many as 5,000 persons will turn out on a Saturday night to watch the colorful, seemingly chaotic performance. The "Opry" is a tourist attraction in its own right, having already drawn more than 7.5 million visitors. Among its stars have been Hank Snow, Ernest Tubb, Cousin Minnie Pearl, Roy Acuff, Webb Pierce, Eddy Arnold, the Carter Family, Bill Monroe, Flatt and Scruggs, Pete Drake, and a host of others.

The 40-year history of country music has seen a long and distinguished roster of performers who have helped to set fashions and styles. Among these are Jimmie Rodgers, Hank Williams, and Jim Reeves.

Recording in Nashville started sometime in the spring of 1945, when Paul Cohen ran a session with Red Foley, one of the stars of the World War II era. The recording companies, during the 1920s and 1930s, had made disks in such places as Atlanta, Fort Worth, Chicago, and, of course, New York. But it was becoming apparent that each Saturday's "Opry" broadcast was bringing the stars through Nashville and it would be only natural to record them there. By the early 1950s, every major label and many minor labels had their recording officials on the job in Nashville.

Record Row in Nashville today is a gleaming street of publishing companies, recording studios, talent agencies, management headquarters, and the like.

The new RCA Victor studio, which opened on March 29, is considered one of the best in the world. The three-story building houses a studio that can comfortably accommodate 100 performers at a time. The facility, which is 75 feet by 50 feet, has up to 20 separate microphones and nearly a mile of color-coded wire connecting the microphones to the control room. At the opening of the studio, which is eight times the size of the company's original Nashville studio, George R. Marek, Vice President and General Manager of RCA Victor Record Division, said:

"This structure is a testament to our faith in the future of the industry and a vivid acknowledgment of the essential part Nashville plays as one of the most creative and profitable centers of the recording phase of the world's entertainment complex."

The euphoria that Nashville's steadily spiraling music industry seems to engender has now established itself overseas. The trend began in World War II. Just as many a

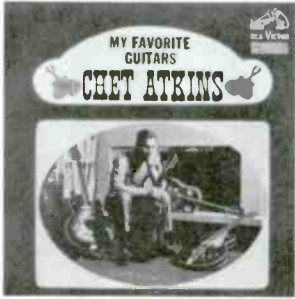
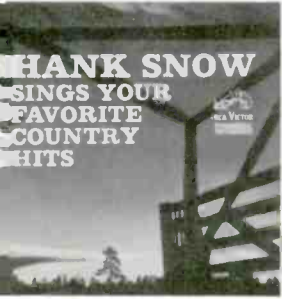




Spacious new RCA Victor recording studio in Nashville.



Recording star Chet Atkins is also Nashville Operations Manager for RCA Victor.



Anita Kerr Singers, Eddy Arnold, and Chet Atkins (above).  
Rita Pavone and Al Hirt (below).



RCA Victor recording stars Hank Snow (above) and Elvis Presley (below).



## "The Nashville Sound"

city-bred American first became aware of songs like "The Wabash Cannonball" and "Tennessee Waltz" in an Army barracks, so did many listeners overseas. Broadcasts of country music on Armed Forces Network stations in Europe and Asia greatly helped to disseminate "The Nashville Sound" to foreign listeners.

As a consequence, Tokyo now boasts its own "Grand Ole Opry" show plus many country bands and singers. The recordings of Jim Reeves, who died in a tragic air crash in the summer of 1964, have been consistently strong sellers in such places as Britain and Scandinavia. In Canada and Australia, the variants of the music from Nashville are so widely known that many fans there, if asked for the name of a top American singer, might name Hank Snow rather than Frank Sinatra.

Elements of country music have so thoroughly entered the mainstream of American pop music that it is often difficult to say where country leaves off and pop begins. The major revolution in pop music in recent years was, after all, started by a country singer from Tupelo, Miss., named Elvis Presley.

The distinctive style of song-writing from Nashville has been a source of endless fascination to music students. They can discern many characteristics in the content and form of the country song — a closeness to reality, a willingness to face life's problems head-on, less fantasy, and more basic coping with such subjects as poverty, infidelity, death, rejection, and so on.

Interestingly enough, the urban folk-music revival of the last eight years has also spurred the popularity of much of Nashville's music among collegians and city youth. The whole trend toward country music can be properly assessed as a change in values in which the sophisticated life of the alienated city dweller has found a sense of loss, a sense of loneliness that the down-to-earth values of country life and country music can assuage. It is, indeed, a reflection of the values of American life that some people find reflected in country music, and that is what is conceivably making it "the folk music of tomorrow."

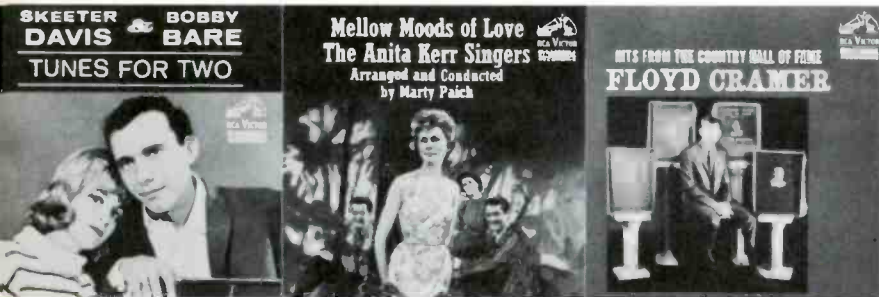
For many sophisticated city listeners, Nashville music is an acquired taste. The nasal sounds, the twang, the simplicity, the lack of subtlety are at first forbidding. Later, they can become the very source of the charm and appeal of country music. In Bluegrass — the sprightly, jazzlike string-band music — many city dwellers have found an exciting element of movement and interplay. In the event or saga songs ("Battle of New Orleans"), they have found Americana brought back to life. In some country ballads ("Saginaw, Michigan" or "Big, Bad John"), they have found the delights of tall tales or legends set to catchy music.

Not the least that can be said in favor of the music streaming out of Nashville onto some 1,500 radio stations in the United States is that the ironclad grip of cultural centralization has been broken. America has at least two popular musics now, and Nashville is the steadily growing center of one of them. It has a vast audience around the nation and around the world.

Country music has put Nashville on the map, and today Nashville is putting a vital form of popular culture into the ears and hearts of millions of listeners. ■



Skeeter Davis and Bobby Bare at recording session.



Anita Kerr Singers are among the many "Nashville Sound" artists.



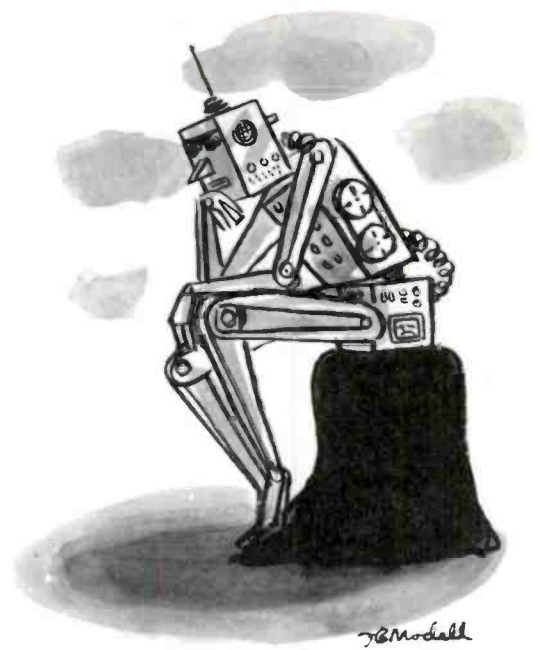
Floyd Cramer, an outstanding personality of country music.





*Interslandi*

"He made it, whatever it is. I suppose it's all right to let him play with it."



*J.C. Modell*

# THIS ELECTRONIC AGE...



*Redini*



*Richard  
Dicker*

"A TV rental won't be available for a day or two. In the meantime. . ."

# Computers and the Humanities

by Jane A. Shaw

Like their counterparts in the sciences, scholars in the humanities are increasingly using computers for a wide range of research projects.

The venerable amanuensis laboring away in a musty medieval monastery would indeed be amazed at the work methods of his modern counterpart. For scholars in the humanities have in recent years made perhaps the most important discovery in centuries. They have begun to realize the marvels of the electronic computer in its application to research in their fields.

The computer's speed, accuracy, memory, and print ability combined with a new availability to the humanists have opened limitless fields of study in the humanities. Scholarly aids such as concordances, indices, and collations that would have taken several lifetimes to complete are now possible in a remarkably short period of time. Much-needed studies formerly thought impossible are now becoming realities.

In Gallarate, Italy, near Milan, a Jesuit priest, Father Robert Busa, and his staff of 60 aides have, by using a computer, completed a concordance to the writings of St. Thomas Aquinas. An inventory of 15 million words has been put on tape ready to answer in a few minutes questions that would have taken scholars years to answer.

In Budapest, at the Computing Center of the Hungarian Academy of Science, studies are under way in linguistics, including translation from Russian to Hungarian, semantic distinctions, and morphological and syntactical analyses of word forms.

At Princeton University, the music of Josquin Deprès has been coded and stored in the computer for long-term study and analysis.

Cornell University has revived its tradition of concordance making and has published four computer-made poetry concordances since 1959.

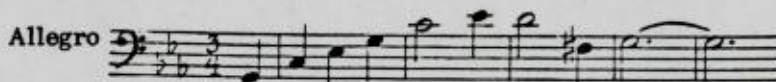
The disputed authorship of the Federalist papers was explored by a statistical study of certain key words, and Frederick Mosteller of Harvard and David Wallace of the University of Chicago, aided by a computer, determined that James Madison was the probable author.

A more recent development was the establishment this year by New York University of the first Institute for Computer Research in the Humanities. The Institute's initial program includes projects in literature, linguistics, musicology, library indexing, and information retrieval. Interdisciplinary in concept, the Institute will provide an opportunity for scholars working independently or in collaboration but using the same tool — the computer — to meet and discuss their research. It will encourage scholars and graduate students to undertake research projects, inform them of the varied facilities available at NYU, and provide a central agency to support current and future research. The new Institute at present includes 20 scholars in its membership.

The need for such an Institute is apparent considering

## NOTATING MUSIC WITH ORDINARY TYPEWRITER CHARACTERS

by Barry S. Brook and Murray Gould (1)



III (All bBEAm 34) ,4G /C E G /2C 4E /2D ,4#F /2.G\_ /G /

The code system presented here is designed to provide an accurate shorthand for musical notation, especially useful for incipits and excerpts. It is not intended to replace conventional notation, although it must be capable of doing so. To put it more dramatically: if the system has validity, Beethoven could have written the above line of symbols instead of the notes without risking the slightest misunderstanding.

Portion of a report on a system of music bibliography. Scholars plan to have bibliographical information transferred to electronic data processing equipment.

the comment of the Commission of the Humanities in its recently submitted report to Congress: "As yet we simply do not have enough evidence about the potentiality of various mechanical processes to speak with authority. Some scholars feel that computers will transform the making of concordances; they have been used with varying success in problems of textual analysis. All these aids and techniques are still new to most of us. The main problem is to permit interested humanists to investigate the potentialities of such tools. This means detailed instruction and study. Only a large-scale program of financial assistance could make such a study as rewarding as it might well prove to be."

Financial support for research in the humanities has come in increasing amounts from private industry, foundations, government agencies, and from the universities themselves. Last spring, the American Council of Learned Societies established a new program of grants-in-aid and fellowships to encourage scholars to experiment with the use of computers in research in the humanities. Projects already approved range from studies in the structure of atonal music to a study of the text history of Cassiodorus' *Psalm Commentary*.

As one scholar has said, "Who would venture to match his powers of measurement and his memory against those of an electronic computer? Study by computer techniques has indeed made obsolete the studies that rely on the memory of the individual, fallible human scholar." The computer, on the other hand, by supplying vast amounts of information can enhance the individual scholar's judgment and analytical power.

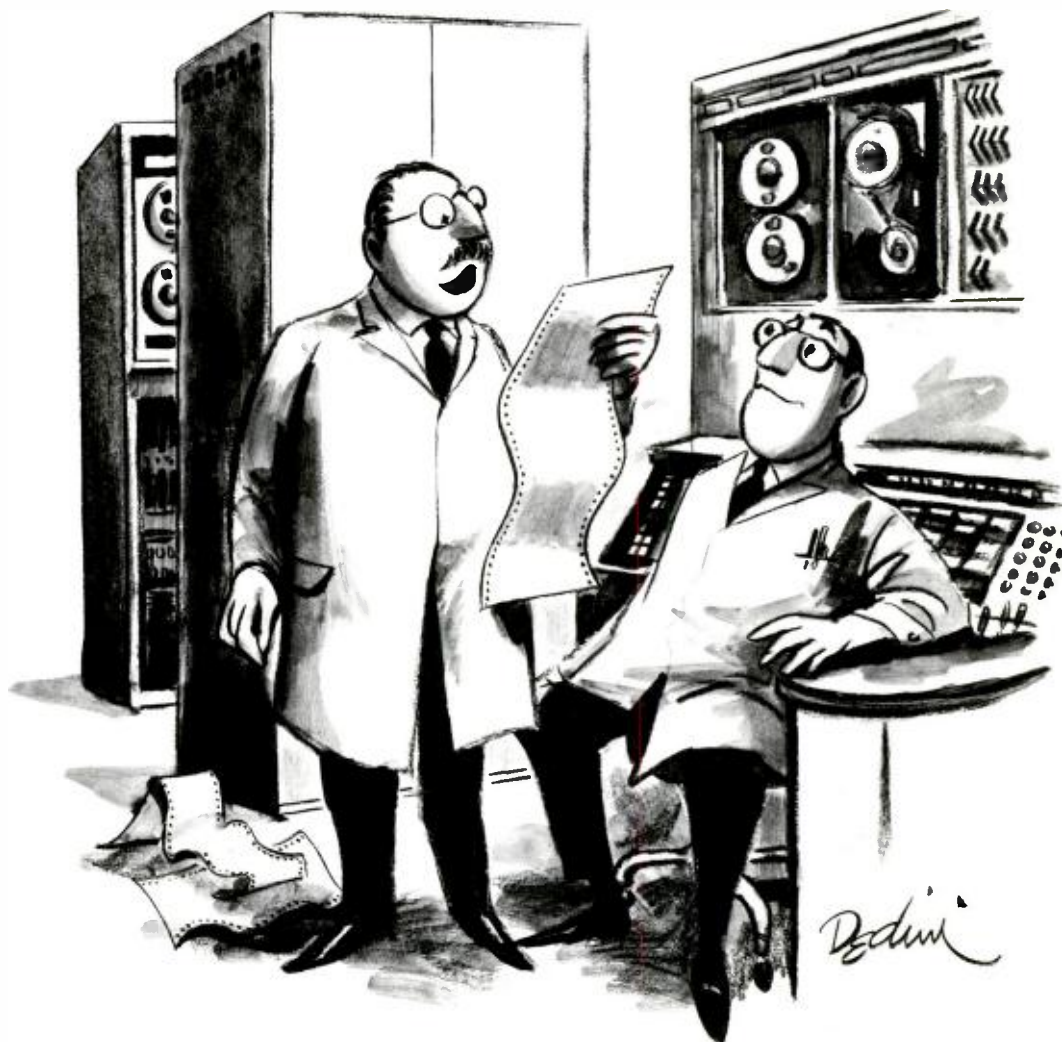
It is this new research tool for the humanist that is gradually closing the much discussed and written-about gap between the two cultures — the scientist and the humanist. In using computers, the humanist must make clear to the mathematician what he wants to achieve and the mathematician must meet the challenge by devising new methods of using the computer to solve the problems that are unique in the study of humanities.

On the surface, nothing seems less compatible with a computer than Homer's *Iliad*, or the poems of Emily Dickinson, the music of Wagner, Mozart, or Beethoven; yet a computer has been used in various ways to study all of these and many more.

In 1892 when F. S. Ellis published a concordance to the poems of Shelley, it was the result of six years of work. This January, when *A Concordance to the Poems*

of *Emily Dickinson* was published, editor S. P. Rosenbaum estimated that major machine operations — input, output, and corrections — took about a month.

In the preface of the first computer concordance in the Cornell series, S. M. Parrish, the editor, recalls the method used by Professor Lane Cooper in 1911 when the first Cornell concordance to the poems of Wordsworth was published. The only method then available was cutting out lines of printed texts and pasting them on 3x5-inch slips of paper, each bearing an index word written in the upper left-hand corner. Sixty-seven people worked for seven



"'Twas brillig, and the slithy toves  
Did gyre and gimble in the wabe."

months on the project that involved 211,000 slips of paper; it was a year before a publisher could be found and another year before it was actually printed.

The computer concordance to Matthew Arnold's poetry took 129 hours to prepare for publication by photo-offset. The step-by-step procedure and breakdown of time have been described by the editor. First, the lines of Arnold's verse were punched on cards, one line per card by key punch operator (69 hours); then line numbers were printed automatically by running through a reproducer the deck of cards representing each poem along with a numbering

“The computer is without parallel as an instrument for organizing the masses of material from which the significant may be drawn.”

deck on which the numbers 1-999 had been punched in fixed locations; page numbers were gang-punched, and one title card was punched for each poem (11 hours). The entire deck of 17,000 cards was then fed into a card reader which transferred the data to magnetic tape (one hour). Meanwhile, a program had been written instructing the computer to search the tape and to index alphabetically every significant word on it by listing the entire line in which the word occurred together with identifying information. The computer reads 15,000 characters per second and makes 42,000 logical decisions per second; the computer run took 38 hours, the printing 10 hours.

The format for the computer concordance to Arnold is the same as the format determined by Professor Cooper in 1911, but the drudgery has been eliminated.

The computer's capacity to produce finished pages ready for offset reproduction is a remarkable aid to scholars in literature. A recent survey by Dr. Gary Carlson of Brigham Young University indicates nearly 200 literary works in many languages, including classical Greek, Latin, and Chinese and ranging from one act of a Shakespeare play to the complete works of Tolstoy, now are available in machine form.

A machine-form, printed, 835-page annotated index in Spanish was the first research project to be completed and published under the new New York University Institute for Computer Research in the Humanities. Of invaluable use to students of Spanish literature and linguistics, the indexing and publication of it could never have been undertaken without the aid of a computer. It is the work of Dr. Alice Pollin and Dr. Raquel Kersten who completed the first index to the initial 46 years of publication (1914-60) of the *Revista de Filología Española*, the most important scholarly journal in Spanish linguistics and literature.

Explaining the need for such an index, Dr. Pollin pointed out that the quarterly RFE contains articles and “incredibly rich” bibliographical materials presented by the most eminent Hispanic scholars in linguistics, literature, history, archaeology, and art. “Until the publication of a cumulative index, though,” she said, “the usefulness of the RFE was severely limited.”

Preparing the index involved reading and analyzing the 43 volumes of RFE, breaking down the information into usable and readily identifiable categories, and key-punching all relevant information for each article (such as volume, number, page, author, title, category of article,

SENTENCE REFERENCE NOT IN SEQUENCE.  
PG 205 LN 18 INDUERANT. 8. +DEHINC, SICUT IPSE ENARRAT, ASCENDIT +HIEROSOLY- 005410  
1

MISSING PAGE NUMBERS BETWEEN 224 AND 227.

GREEK  
PG 235 LN 33 EQUESTRIS EST, QUEM +GRAECI +@HIPPON+@ APPELLANT. 3. +DE IUGO UERO 014070

CONFUSION SYMBOL.  
PG 249 LN 18 HISTRIONEM FATIGARE +- +EX ORE QUO ,+AMEN+ IN +SANCTUM PROTULE.. 018380  
1

NUMBER NOT FOLLOWED BY PERIOD OR BLANK. DELETED.  
PG 305 LN 81 EST +- 23. +EXINDE CUM 3BLITUS BRACHII CAELESTIS QUO +AEGYPTIIS 033810  
1

LINE NUMBER IN ERROR.  
PG 1107 LN 24 25 SINT AUTEM ET HOMINIBUS COMMUNIA SAEPE QUAE ET IDOLIS, HOC 089010

CARD OUT OF SEQUENCE AFTER CARD NO. 089010. SET SWITCH B DOWN TO IGNORE, UP TO REREAD CARD.  
PG 1107 LN 24 25 SINT AUTEM ET HOMINIBUS COMMUNIA SAEPE QUAE ET IDOLIS, HOC 089010  
PG 1107 LN 25 QUAE IDOLUM QUIDEM ET QUAE IDOLO COMPETUNT NON ADTINGANT, 089000

TO INTERRUPT, SET SW G UP AND START.

LONG WORD  
PG 1110 LN 25 25 NIBUS, DE DISCURSIBUS NEGOTIATIONIBUSNE INSTRUUNTUR, QUID ALIUD 090250  
1

Corrections printed by electronic proofreader after it had scanned information for computer-produced concordance.

reference, reference page) on sets of cards. By using the computer, information from 100,000 data cards was sorted and re-sorted into more than 300 categories. The final copy was printed on the Courant Institute's computer.

With the help of the computer, the NYU project was completed in two years using about 40 machine-hours.

It is only natural that the pioneering efforts in the humanities should have been in literature and in the preparation of concordances and indexes to literature. Further developments in computer methods to meet the needs of humanists have devised ways of automatic abstracting, determining the effect one author has had on another, and of statistical means of establishing author identification, and of built-in proofreading. In musicology, attempts are being made to develop languages and devices applicable to both bibliographical and analytical research. In linguistics, major steps have been made in the area of machine translation and information retrieval.

It is impossible to determine the extent and range of research now under way in the humanities using computers. No such complete survey has been made, and this newly opened area of study is developing at such a rapid rate it is difficult to keep pace with it.

Speaking to the round table of scholars that make up the NYU Institute, George Winchester Stone, Jr., Dean of the Graduate School of Arts and Sciences, emphasized the humanists' responsibility in research and the valuable tool the computer can be.

"The great task of the humanists is to evaluate and interpret the significant. The computer is without parallel as an instrument for organizing the masses of material from which the significant may be drawn. And without the basic research for which the computer is a main aid, scholarly criticism and interpretation in many a field reduce themselves to whim and opinion."

#### COMPUTERS AND THE HUMANITIES AT NEW YORK UNIVERSITY

*The New York University Institute for Computer Research in the Humanities is an example of the broad spectrum of research in the humanities that is under way or planned with the aid of computers. The Institute's program includes:*

- A concordance of medieval Hebrew poetry and an annotated catalog of 25,000 rare Hebrew manuscripts (planning stage): Dr. Abraham I. Katsh, professor of Hebrew culture and education and chairman of the department.
- A concordance to the poetry of the Spanish poet Eugenio Florit, a pilot project. Concordances are planned for the poetry of Federico García Lorca, Jorge Guillen, and Unamuno; an inquiry into the relationship between the traditional *dances* of northern Aragon and selected sacramental plays of the seventeenth century by comparing words, phrases, lines, meter, themes, character types: Dr. Alice M. Pollin, associate professor of Romance languages, with Dr. Maria Soledad Carrasco, associate professor of Romance languages, Hunter College.
- An attempt, by using as a pilot project Henry James's *Daisy Miller*, to find a speedier, more accurate, and less time-consuming way of constructing collated editions of literary texts (in progress): Dr. William M. Gibson, professor of English.
- A comparison of the major stylistic patterns in Daniel Defoe's known writings with those anonymous writings with which he is often credited, to determine authorship (planning stage): Dr. Edward L. McAdam, Jr., professor of English and chairman of the department at NYU's University College of Arts and Science.
- A concordance to include lesser known Latin and Greek authors (in progress): Dr. Charles W. Dunmore, assistant professor of classics and acting chairman of the department at NYU's University College of Arts and Science.
- A critical edition of the four installments of Robert Browning's *The Ring and the Book*, indicating the changes and revisions made by the poet (planning

stage): Dr. Edward C. McAleer, professor of English and chairman of the department at Hunter College, in collaboration with the department of English at NYU.

- An annotated bibliography of significant criticism of and allusion to the life and work of William Godwin (in progress): Dr. Burton R. Pollin, associate professor of English at Bronx Community College, in collaboration with the department of English at NYU.
- Preparation of a Welsh etymological dictionary and an analysis of consonant clusters and their frequency of occurrence in various languages as well as in various periods of the same language (planning stage): Dr. Robert A. Fowkes, professor of German and acting head, all-University department of Germanic languages and literatures.
- A study of certain areas of Russian verb morphology, traditionally called "fluid"; a computer analysis of three million words of Russian text (near completion): John E. Allen III, instructor in Russian.
- A machine translation project involving linguistic analyses of modern scientific Russian and the creation of a "string grammar" (in progress): Mr. Allen.
- A Union Catalogue of eighteenth-century symphonic themes of the period from the death of Bach in mid-eighteenth century to the advent of the mature works of Haydn some 30 years later (in progress): Dr. Jan LaRue, professor of music.
- Application of computer analyses to the pursuit of factors of musical style (in progress): Dr. Harold J. Heeremans, professor of music and chairman of the department, University College of Arts and Science.
- A technical and stylistic analysis of the contrapuntal music of the period of sixteenth-century composer Orlando Lassus (in progress): Dr. Stephen Jay, professor of music.
- The study of existing reference and information retrieval systems (e.g., KWIC, WADEX, etc.) with the view to developing the best system for a total bibliography of musical literature (in progress): Dr. Barry S. Brook, visiting associate professor of music.

# RCA AT THE 1965 NEW YORK WORLD'S FAIR



An exhibit of dramatic photos transmitted from space by RCA television cameras aboard the Ranger moon vehicles and the TIROS weather satellites is one of the new features that will greet visitors to the RCA Pavilion at the 1965 New York World's Fair.

The "Television in Space" exhibit will show how the far-seeing eye of television is increasing man's knowledge of the universe by enabling him to study scenes and objects never before seen with the human eye. The exhibit will include the most recent close-up photos of the moon's surface and spectacular photos of the earth and its weather formations.

In an effort to maintain activity in the color TV studio at a high level throughout the day, RCA has added a professional entertainment group to supplement the daily array of guests and

celebrities that is scheduled to appear before the color cameras. The RCA Pavilion once again in 1965 will lay claim to the title of "World's Busiest Color TV Studio."

An extensive library of new and entertaining color films also has been obtained for broadcast over RCA's closed-circuit color TV network at the Fair. The library includes many "featurettes" based on the most important new color films of the year, including "The Sound of Music," "Lord Jim," "Cheyenne Autumn," and "My Fair Lady." Major Hollywood studios also have agreed to send top stars to the RCA Pavilion for appearances in the color studio and on the closed-circuit network.

Outside the pavilion, RCA has erected a row of circular sunshades to protect waiting crowds from sun or rain. Color-

ful panels showing the many products and services of RCA will be prominently displayed under the sunshades.

During the 1964 season of the Fair, the RCA Pavilion attracted capacity audiences. More than 1.3 million visitors went through the pavilion to see themselves on color television and to watch actual programs being produced in the glass-enclosed color TV studio.

Between the "live" studio operation and the closed-circuit network, both of which operate 12 hours a day, seven days a week, RCA will originate approximately 4,000 hours of color programming at the World's Fair during the 1965 season. For many visitors, the RCA Pavilion provides their first opportunity for a behind-the-scenes look at the activity involved in staging and transmitting color TV programs. ■



# NASA'S SPACEPORT: GATEWAY TO OUTER SPACE

by Edward W. Atkinson

On an 88,000-acre site in Florida, the National Aeronautics and Space Administration is building a port for tomorrow's space ships.

"We're going to do a fantastic thing here; we're going to put men on the moon."

The words were uttered calmly, simply, sincerely. The speaker was neither a wild-eyed visionary nor a science fictioneer. He was Dr. Kurt H. Debus, director of the National Aeronautics and Space Administration's John F. Kennedy Space Center. The "here" he was speaking about is NASA's Spaceport on Merritt Island, Fla.

The Spaceport, immediately adjacent to and northwest of Cape Kennedy, consists of 88,000 acres of Florida lowland and swamp that are rapidly being transformed into a scientific metropolis worth nearly a billion dollars; by 1967 it will be completed. From this verdant island between the Banana and Indian rivers on the east coast of central Florida, the United States plans to send men to the moon before the end of this decade.

Artist's conception of Launch Complex 39 at the John F. Kennedy Space Center.





The Crawler-Transporter, world's largest land machine, will haul the Saturn 5/Apollo and the Mobile Launcher from the assembly point to the launch site.

The National Aeronautics and Space Administration has been charged with the responsibility of landing men on the moon and returning them safely to earth. The vehicle NASA has selected for lunar flight is the gargantuan Saturn 5. It will carry the Apollo spacecraft moonward with a thrust of 7.5 million pounds. To enable it to do so, and to prepare for similar flights in the future, is the justification for the existence of the Merritt Island launch area. The whole mission is keyed to men in space.

Merritt Island, in Brevard County, has long been a bucolic, semitropical retirement haven. Since 1868, when the Sanders brothers, T. H. and W. R., came from Georgia with their families and built homes there, the economy has been based principally on cattle, pineapple, sugar cane, and — later — citrus. (Citrus still figures prominently in the island's economy, and some 3,400 acres are leased from NASA by citrus growers even today.) Nowhere does the island rise very far above the level of the sea; the county's elevation varies from sea level to 81 feet. Its sandy loam soil is especially suited to the production of such subtropical fruits as mangoes, avocados, guavas, papayas, and bananas.

And there is something especially appropriate about the fact that the biggest "birds" in — or out of — the world will have their nesting place on Merritt Island. For this relatively untouched spot is the natural home for more species of birds than any other part of the country. Brevard County has an active Audubon Society, and its monthly bulletin pays serious attention to such events as the arrival of a pair of spice finches (duly identified as "native to India and Ceylon") and a male paradise widow bird ("a native of tropical Africa").

Everything about the work now under way at Merritt Island is big. To begin with, the very concept of men leaping free of their terrestrial bonds and landing on the lunar surface is a king-size exercise in audacity and vision. The landing of a United States astronaut on the moon in this decade has been described as "the most challenging technical program ever undertaken by this country."

Mind-boggling figures are required to describe the mammoth vehicles that will carry men to the moon: the Saturn 5/Apollo will stand approximately 360 feet tall

and will weigh 6,102,000 pounds when fueled for flight. Equally imposing are the physical facilities needed to maintain and launch these giants. The Merritt Island launch area dwarfs any space installation the free world has known. Its dimensions are prodigious; they must, as one observer has remarked, "be seen to be disbelieved." For example, the Vehicle Assembly Building on Launch Complex 39, near the Spaceport's northern boundary, will be, in terms of volume, the largest building in the world. It could contain the volume of the Pentagon and still be one-third empty. This structure, set on 4,300 huge piles, will be 716 feet long and 515 feet wide and 525 feet high. On clear days, it will be visible from 40 miles away.

Since most stages of Saturn 5 and other large pieces of equipment are too big to be delivered by land or air, they will arrive at the Spaceport by barge. To accommodate this traffic, there will be a barge terminal facility consisting of five slips and a turning basin 10 feet deep and 1,200 feet across.

In the past, vehicles have been erected and checked out on the launch pad, a process that necessarily occupied the pad for several months prior to a launch. The magnitude of the Saturn 5/Apollo program and the size and complexity of the launch vehicle make this procedure impractical. Consequently, an entirely new procedure has been developed for the Saturn 5/Apollo program.

Within the Vehicle Assembly Building, the Saturn 5/Apollo will be assembled on a Mobile Launcher, which serves as the actual launch platform. (Three of these are under construction; two of them are nearly completed.) The Mobile Launcher, 446 feet high and covering half an acre, houses computer facilities, instrumentation equipment, and communications distribution systems. It resembles a conventional launch pad except in two very important particulars: it is larger and it is movable. Its mobility, in fact, is the key to the operation of Launch Complex 39. This new mobile launch concept influences all the design considerations at the Spaceport.

After the vehicle has been assembled and checked out in one of the Vehicle Assembly Building's four high bays, it will be taken through a 460-foot-high door, ready for the 3.1-mile trip to the launch pad. The whole assembly, still on the Mobile Launcher, will be moved by the Crawler-

These three Mobile Launchers, towering above the flat Florida landscape, will serve as assembly and launch platforms for the Saturn 5/Apollo.



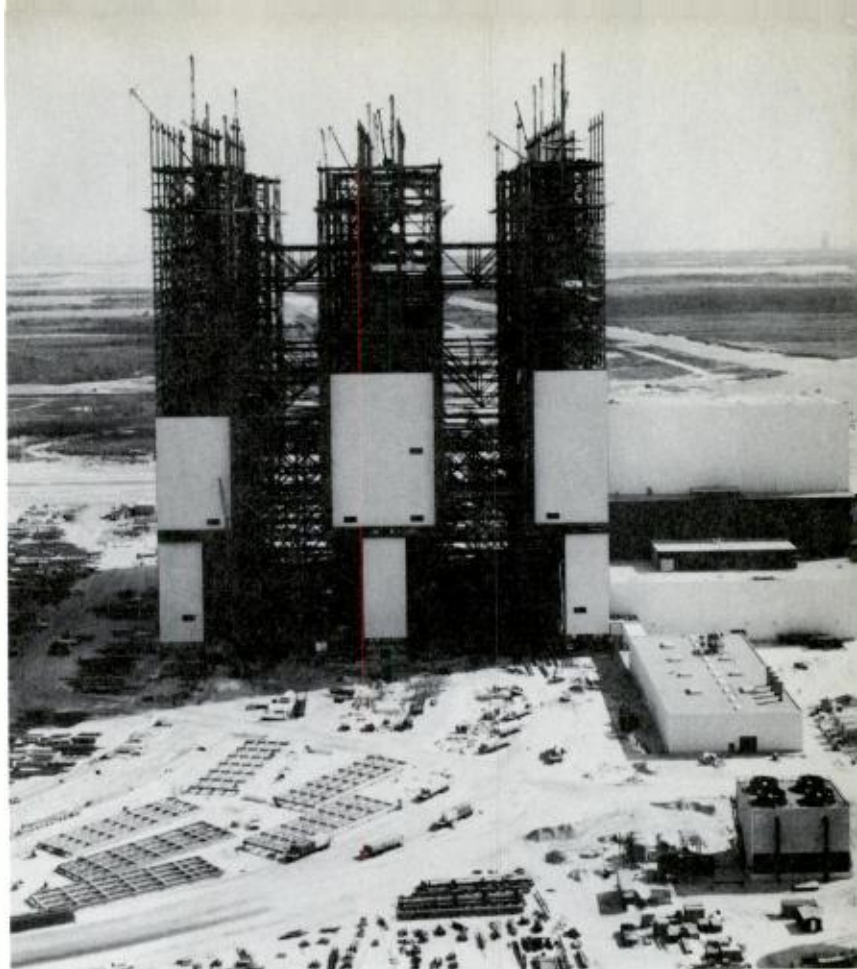
Transporter at a top speed of one mile per hour. This vehicle, the world's largest land machine, weighs 5.5 million pounds and can carry 12 million pounds. Its base, upon which the Mobile Launcher and the Saturn 5/Apollo will rest, is approximately half the size of a football field. The Crawler-Transporter will move on eight gigantic tracked crawlers, two at each of its four corners. It will, naturally enough, require a special roadbed to carry its moon-bound target. This roadbed, or crawlerway, will be as wide as the New Jersey Turnpike, an eight-lane thoroughfare. Moving the 40-story Mobile Service Structure into position at the launch site is another task the Crawler-Transporter will perform. Technicians will use the Mobile Service Structure to make final checks of the Saturn 5/Apollo immediately prior to launch, and the Crawler-Transporter will remove it to a safe position before blast-off.

The nation's first spaceport will consist essentially of two major sites, both of which are now under construction: the Industrial Area and Launch Complex 39. The former will comprise more than 50 structures (20 are already completed) that will house administrative, engineering, laboratory, and spacecraft assembly and checkout facilities. At the latter will take place the final assembly and launch of the Saturn 5/Apollo.

The Kennedy Space Center Headquarters Building will be located in the Industrial Area and will serve as the administrative center for the entire Merritt Island launch area. The Industrial Area will include the Fluid Test Facility, the Pyrotechnic Installation Building, and the Information Systems Building. The Fluid Test Facility is composed of buildings designed to provide for the checkout of environmental control systems, cryogenic fuel cell systems, and hypergolic propulsion systems. (Hypergolics are materials that ignite spontaneously upon contact with each other.) In the Pyrotechnic Installation Building, spacecraft will be balanced before being mated with their launch vehicles. Instrumentation data from spacecraft missions will be received and processed at the Information Systems Building. Also in the Industrial Area will be the Manned Spacecraft Operations Building, where the Apollo spacecraft will be assembled and inspected before being mated with the Saturn 5 launch vehicles. This structure will contain office and shop space for more than 1,800 persons. There, too, the Apollo astronauts will live for several weeks prior to each flight.

To convert thousands of acres of swampland into a true gateway to outer space is itself a colossal job. It requires nothing less than the construction of a scientifically sophisticated community, a city of amazingly intense and massive activity, in an area that previously has known no more frenetic enterprise than citrus farming. To tie this city together, to give it coherence, to make it live — these are the functions of communications. This is the case with any city, but at the Spaceport the very nature of the endeavor makes communications extraordinarily significant.

The importance of NASA's mission at the Spaceport imposes special communications standards. Rigid schedules must be maintained at all times. Circuits must be available, often on very short notice, to meet last-minute require-



Within the massive Vehicle Assembly Building now under construction on Launch Complex 39, the Saturn 5/Apollo will be assembled and checked out prior to launch.

ments. These circuits must provide the ultimate in reliability. Television pictures must be transmitted with the best detail possible. Voices must be transmitted with perfect clarity so that the speaker is readily recognized and so that only the desired speaker is heard. In hazardous areas, special communications instruments are required. These instruments must be specially shielded so that they are not the cause of danger in explosive atmospheres created by highly volatile rocket fuels. Supporting personnel must be thoroughly familiar with safety procedures and must constantly follow them.

Prior to a launch, special precautions must be observed. Inspection of communications circuits must be sufficiently frequent that such maladies as loose connections, frayed wires, and corrosion simply do not occur. Before each launch, there must be assurance that each item of equipment in critical areas is operating at maximum efficiency. Technicians must be stationed in each of the critical areas to guard against mechanical damage to equipment and to be available for trouble-shooting. Spare equipment must be available at all times.

During the launch countdown, the cable system routes must be patrolled in a radio-dispatched vehicle to spot any impending circumstances that might cause mechanical damage to cables.

NASA has assigned the RCA Service Company the job of planning, installing, operating, and maintaining the Spaceport's technical communications. No stranger to the intricacies of space-age communications, RCA has 3,500 employees at nearby Cape Kennedy; and the company has

been represented there for 12 years. In that time, RCA has operated the base communications at Cape Kennedy and at the Air Force Eastern Test Range. "When NASA chose RCA as the communications contractor for the Spaceport," observes J. F. Murray, vice president of Field Projects for RCA's Government Services organization, "it knew that RCA was in a position to understand the mission and to accomplish it. Nevertheless, to get the Spaceport job, RCA had to survive intense competition from other contractors."

Having negotiated that hurdle, the company was only at the beginning of its Spaceport undertaking. That undertaking includes installation, operation, and maintenance of the telephone system in areas that NASA designates as "mission facilities" and that are thus "operationally critical." The central telephone switchboard is equivalent to



Aerial view of NASA's Spaceport on Merritt Island, Fla. Since photo was taken, steel work has been completed on the third of the Mobile Launchers, shown at center right.

that required for a town of 50,000 persons. In addition, RCA is responsible for the administrative intercom system, the public address and paging systems, the security police communications system, point-to-point telephones, mobile radio, operational intercom systems, operational TV systems, data transmission systems, communications centers, and others. The fulfillment of this contract involves RCA in virtually every building, launch complex, mobile tower, and test stand at the Spaceport. And it calls for a considerable amount of communications hardware, including a 6,000-line telephone exchange, 55 intercom systems consisting of 3,281 instruments, 300 video circuits, 191 TV cameras and 398 monitors, 47 public address systems with a total of 875 speakers, and eight mobile radio networks having a total of 202 mobile units. These and other communications facilities will utilize 520,011,000 conductor

feet of copper wire, more than enough to encircle the equator three times. All of this equipment will be installed and in use by the summer of 1966. Approximately 60 per cent of the hardware is already in operation. RCA is also responsible for communications plans and programs and for engineering assistance to NASA as required. The work statement spelling out RCA's duties and responsibilities is 70 pages long. The man who is responsible for making that work statement come true is Edward Sears, manager of RCA's Kennedy Space Center Communications Project and a veteran of more than 20 years' experience in the communications field.

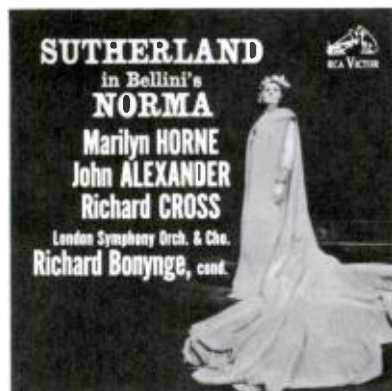
To carry out the myriad functions required to handle communications for the Spaceport, nearly 200 RCA people — mostly technicians — are currently on the scene; the number will approach 300 later this year.

The total number of people engaged in making the Spaceport a reality is 15,000. Of these, about 4,600 are construction workers; 3,000 are employees of the Federal Government, including 500 who work for the Corps of Engineers; and the remainder are concerned with "flight hardware" or support functions. It is in the last category that the RCA people labor.

While the glamour inherent in the space program is usually associated, quite naturally, with the astronauts and scientists, the essential tasks performed by others in advancing the program are often overlooked. It was with this thought in mind that James E. Webb, Administrator of NASA, wrote: "It is something of a paradox that our schedule for Project Apollo, the landing of a team of American astronauts on the moon before 1970, has been paced, not by scientific or technological problems, but by the requirements to build massive engine test stands and other engineering installations on the ground. Thus, in a very real sense, the road to the moon is paved with bricks, steel, and concrete here on earth."

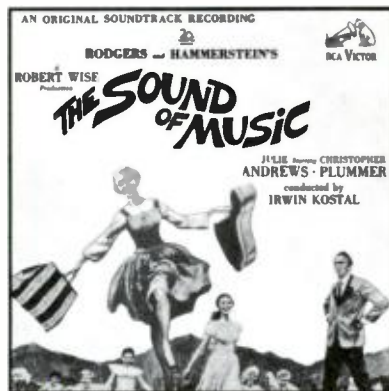
These words might well be applied to the RCA employees who are providing communications for the blockhouses and the offices and all the other facilities that comprise NASA's Spaceport. As they go about their daily work, the nation's first spaceport rises toward completion; and Merritt Island is a scene of constant and purposeful activity. There the mammoth buildings are taking shape, the road networks are being built, the intricate communications systems are being installed. There men go about the business of preparing to put other men on the moon. And from there, in due course, dedicated men will orchestrate the implements, the instruments, the machines, the scientific know-how, and the human courage into a symphony that will reach a crescendo when Saturn 5 boosts the Apollo spacecraft on its historic voyage to the moon. ■

**RIMSKY-KORSAKOFF: "LE COQ D'OR" SUITE; STRAVINSKY: "FIREBIRD" SUITE**—*Boston Symphony Orchestra, Erich Leinsdorf, Musical Director (RCA Victor LM/LSC-2725)*. A Dynagroove sound recording by Erich Leinsdorf and the Boston Symphony Orchestra of Rimsky-Korsakoff's bird, The Golden Cockerel ("Le Coq d'Or"), and Stravinsky's bird, The Firebird. Both of these concert hall hits possess scores of dazzling color. The excitement Leinsdorf has created in the past with his performances of Russian music indicates his affinity with the repertoire of this album.



**BELLINI: NORMA:** Joan Sutherland, Soprano (RCA Victor LM/LSC-6166). It was Lilli Lehmann who said that Norma is more demanding than the three Brünnhildes. Sympathetic with this description is Joan Sutherland who stated, "It is the most difficult role in my entire repertoire." In this album of "Norma," Miss Sutherland's performance is a full realization of a role considered to be the ultimate test of a dramatic coloratura and one that has been eagerly awaited by opera lovers the world over. The opera was recorded in Walthamstow Town Hall, London. Included with the recording is a 38-page booklet that contains a profile of Miss Sutherland, photographs and reproductions of paintings that document historic performances of "Norma," and an Italian-English libretto.

**"THE ROAR OF THE GREASE-PAINT—THE SMELL OF THE CROWD":** *Original Broadway Cast Recording Starring Anthony Newley and Cyril Ritchard (RCA Victor LOC/LSO-1109)*. It is a rare occurrence to jump the gun of a Broadway opening in order to record a cast album. However, in the case of "The Roar of the Greasepaint," there was so much excitement engendered by favorable reaction by both critics and audience from the show's pre-Broadway engagements that, three months prior to the Broadway opening, RCA Victor brought the "Greasepaint" cast from Philadelphia to New York to record the album in Webster Hall. Book, music, and lyrics are by Leslie Bricusse and Anthony Newley, creators of "Stop the World—I Want to Get Off."



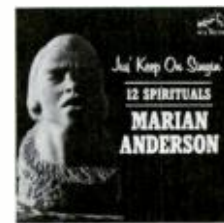
**"THE SOUND OF MUSIC":** *Original Soundtrack Recording Starring Julie Andrews and Christopher Plummer (RCA Victor LOC/LSO-2005)*. The RCA Victor soundtrack recording of the 20th Century Fox film version of the delightful Rodgers and Hammerstein musical includes two songs written especially for the film by Richard Rodgers—"I Have Confidence in Me" and "Something Good." The motion picture and recording bring to even wider audiences than the stage production the original music, which consists of such outstanding tunes as "My Favorite Things," "Climb Ev'ry Mountain," and "Do-Re-Mi."

**VERDI: LA FORZA DEL DESTINO:** Leontyne Price, Soprano (RCA Victor LM/LSC-6413). Miss Price's opera recordings are a modern legend. In the last two years, her RCA Victor releases of "Madame Butterfly" and "Aida" have been named Best Opera of the Year by the Recording Industry Association of America, and her recent recording of "Carmen" was hailed as the best opera recording of 1964 by American critics. "La Forza del Destino" is yet another operatic triumph. Feature performers, in addition to Miss Price, are Richard Tucker, tenor; Robert Merrill, baritone; Shirley Verrett, mezzo-soprano; Giorgio Tozzi, bass; and Ezio Flagello, bass. Thomas Schippers conducts the RCA Italiana Opera Orchestra and Chorus.



**"DEAR HEART" AND OTHER SONGS ABOUT LOVE:** *The Orchestra and Chorus of Henry Mancini (RCA Victor LPM/LSP-2990)*. "Dear Heart" was written for the Warner Brothers motion picture starring Glenn Ford, Geraldine Page, and Barbara Nichols. The film company was so impressed with Mancini's song that the movie's title was changed from "The Out of Towners" to "Dear Heart." For the rest of the album, Mancini plotted a difficult course for the chorus in his arrangements. There is a wordless vocal in "Soldier in the Rain"; in "Dream" the chorus sings in a relaxed, romantic mood; and perhaps the most demanding selection for the vocalists is "The New Frankie and Johnnie Song," which is a tour de force of singing and speaking pyrotechnics.

For  
The  
Records...



OTHER CURRENT RELEASES

### LASER DUST DETECTOR

Historically, the most efficient dust hunters have been the assiduous housewife and the eagle-eyed army sergeant. Now, however, scientists have developed a laser device that outstrips even the herculean efforts of the classical dust-hunting champions. With it, they expect to learn more about the composition of the upper atmosphere.

The high-power laser transmitter, to be used essentially as the active element of an optical radar, is capable of detecting minute particles of dust and micrometeorites and will be used in upper-atmosphere geophysics research.

The high power of the laser — 10 million watts peak power at a rate of one pulse per second — was achieved by the development of a new, highly efficient weather-tuning system for both the flash tube and the ruby laser.

The laser transmitter was built by RCA's Aerospace Systems Division for the University of Adelaide, Australia. It is similar to the one RCA built for the Massachusetts Institute of Technology in 1963. The M.I.T. laser, one of the highest powered lasers in operational use at that time, was also used in an optical radar. It was able to detect dust believed to have originated from fragmented meteors, and could do so at a distance of 85 miles into the stratosphere. The new University of Adelaide laser transmitter has approximately twice the capability of its predecessor.

### OPOSSUMS TO TRAVEL IN SPACE?

The lowly opossum, long a favorite subject of cartoonists and tellers of folk tales, may soon be aiding man in quite a different and more meaningful way. He may, in fact, abandon his familiar swamp, at least temporarily, and become a pioneer in space.

Scientists of the Radio Corporation of America and the Marquardt Corporation have proposed orbiting a biological satellite containing as many as 24 opossum embryonic fetuses for as long as 90 days to obtain televised and telemetered observations of the possible effects of long-term weightlessness on living organisms.

In a paper delivered at a Conference on Civilian and Military Uses of Aerospace, sponsored by the New York Academy of Sciences, the scientists said that the opossum is especially well suited to such an experiment. Like man, the opossum is a mammal; and it exhibits an accelerated biological growth cycle that can be observed in the relatively short time of 10 to 90 days. Its use thus provides a means for studying physiological development in a telescoped time interval.

The paper contends that the experiment would be a valuable adjunct to the man-in-space program, and that it offers the oppor-

tunity to observe, under zero-gravity conditions, sequential physiological development on a compressed time scale without parallel in our space program.

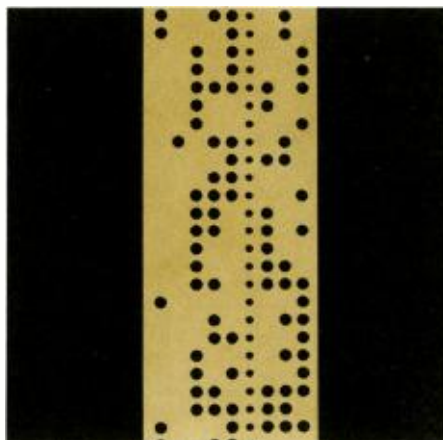
### TV CAMERA SEES IN THE NEAR-DARK

A camera has recently been developed that can automatically view scenes in light ranging from daylight to starlight. The new camera system, designed primarily for military field use, has been built with all solid-state components for compactness and light weight.

Developed by RCA's Aerospace Systems Division, the "ruggedized" camera employs a new intensifier vidicon pickup tube instead of the image orthicon usually found in low-light-level television applications.

Capable of broad nighttime usage on tactical missions involving helicopters and other aircraft, the vidicon camera is also well suited for television missile guidance applications

## Electronically



## Speaking...

because of its ruggedness, wide dynamic range, and sensitivity.

The camera affords the armed services the means for extending reconnaissance and surveillance capability into the hours of twilight, dusk, and darkness. It offers the additional tactical advantage of "real time" operation — the ability to witness an event at the moment it happens instead of viewing it later on film.

### MEASURING THE BOUNDING MAIN

An ultrasonic device for measuring ocean waves, the first to give point-by-point measurement of wave height from ships, is undergoing tests to determine its possible use as a new tool in oceanography, meteorology, and antisubmarine warfare.

The shipboard device, mounted on the bow of a vessel, is a self-contained electronic wave-recording system designed to measure the height of waves up to 40 feet with an accuracy

of at least 95 per cent, regardless of the ship's motion.

The profiles of the waves are printed out on paper so that an analysis can be made of various wave frequencies. From this analysis, scientists can determine how far away, how intense, and how long-lived was the storm that produced the waves.

The device determines wave heights by use of an echo-ranging sound sensor, which operates essentially like radar. It bounces its 38,000-cycle sound signals off a point on the wave and measures the distance by timing the echo. The variation in height due to the ship's motion is compensated for by a gyroscopic and inertial device. The end result is a true indication of the height of the point on the wave above sea level. The points are recorded by a print-out device to show wave profile. They are fed into a computer, separate from the wave-height sensor system, that acts as a spectrum analyzer to determine the frequencies of the wave.

### NEW PORTABLE RADAR SYSTEM

A powerful portable radar system with "hit-and-run" tactical capability has been designed for transport by helicopter, truck, or landing craft. Designated AN/UPS-1, the quick-reaction tactical radar system is only half the weight of comparable systems and is extremely versatile.

It has the power, sensitivity, and resolution to handle many kinds of missions, including aircraft detection, surveillance, gap filler radar, and air-traffic control. The UPS-1 operates well in arctic or tropical environments.

The UPS-1 is highly sensitive, has a useful range of 200 miles, and can track low-flying aircraft through ground clutter to within five miles of the radar site. Its accuracy is rated at plus or minus 1.0 degree in azimuth.

Field utility was of prime importance in the design of the radar, which was developed by RCA for the U.S. Marine Corps.

### ABOUT OUR WRITERS

DAVID LACHENBRUCH is editorial director of *Television Digest* . . . BRUCE SHORE is the staff writer at RCA Laboratories . . . WILLIAM BENDER, associate music critic of the *New York Herald Tribune*, has followed the progress of electronic music for many years . . . ALAN EBERT is with the National Broadcasting Company . . . BOB SHELTON, folk and country music critic of the *New York Times*, is author of *The Country Music Story* to be published in the fall . . . JANE A. SHAW is a representative of the Office of University Relations at New York University . . . EDWARD W. ATKINSON is on the RCA corporate staff.



Hundreds of color-coded panels above the production line at RCA's Palm Beach Gardens, Fla., computer plant identify domestic and overseas customers. Here, a new panel representing the Chase Manhattan Bank in New York City is put into place. Chase Manhattan has ordered five RCA Spectra 70 computer systems to handle the paperwork associated with the bank's corporate trust operations.

# ELECTRONIC AGE

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