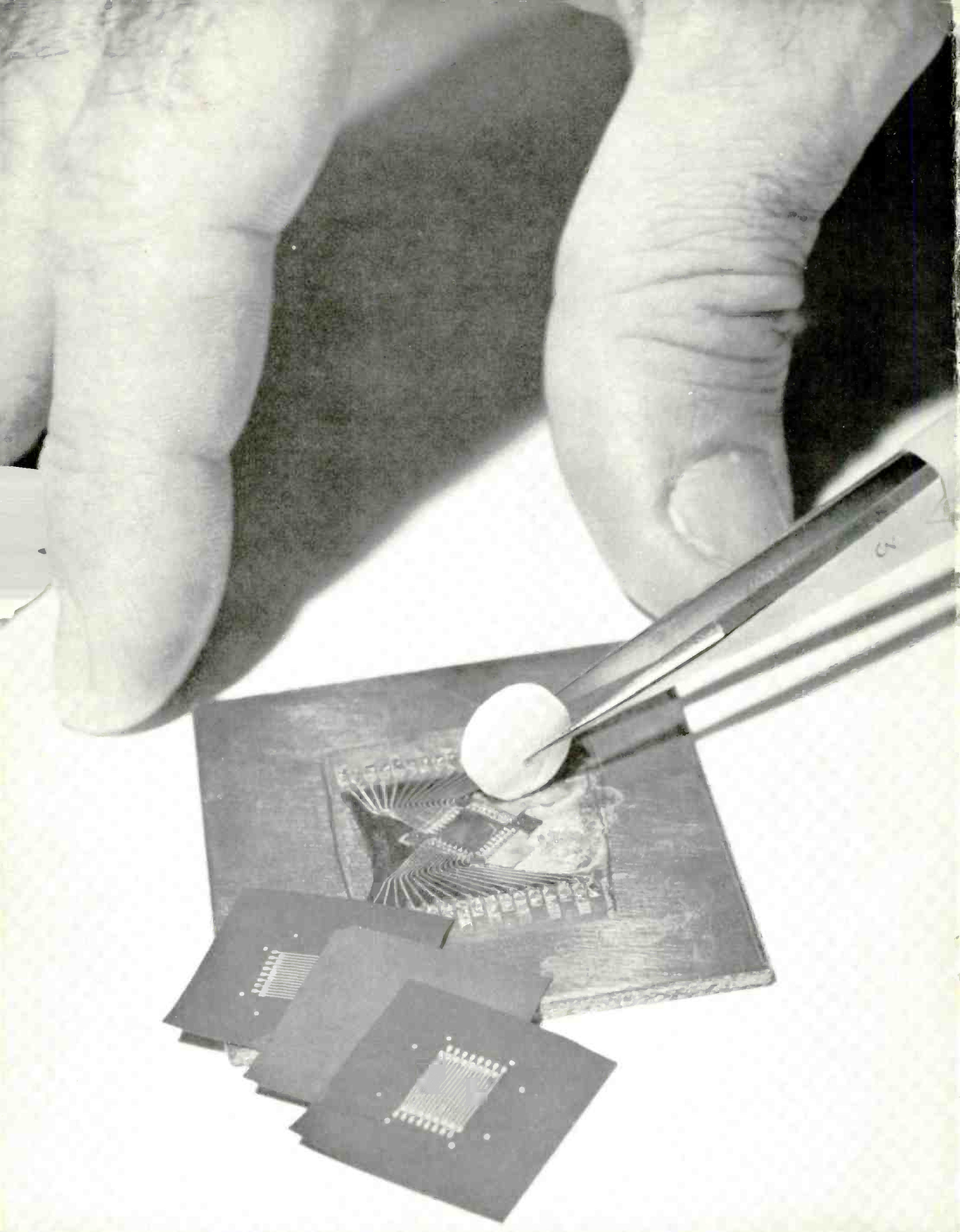
ELECTRONIC AGE

Winter 1963/64

Computers and People



ELECTRONIC AGE

Winter 1963/64
Vol. 23/No. 1

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Published quarterly by
RADIO CORPORATION OF AMERICA
30 Rockefeller Plaza, New York, N.Y. 10020

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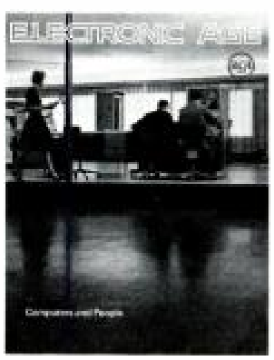
◀ Diamond-shaped high-speed computer memory is dwarfed by tweezer-held aspirin tablet. The unit, produced by a manufacturing process borrowed from the plywood industry, incorporates thin laminated sheets of ferrite and is capable of storing up to 256 bits of information permanently or of processing 10 million bits per second. In the foreground are typical ferrite sheets in "green" or unfinished form from which the memories are built.



COVER: The new RCA 3301 Realcom computer. Located at Cherry Hill, N. J., it is the first computer to span the full range of data handling in a single package. A photographic essay on the relationship of computers and the people who operate them starts on page 15.

RCA in '63

by David Sarnoff
Chairman of the Board • Radio Corporation of America

Color television, broadcasting, and electronic data processing contributed to peak sales and profits, marking the second consecutive year of all-time highs in RCA's history.

The Radio Corporation of America, for the second consecutive year, achieved all-time sales and profit records in 1963.

Figures for the year are as follows:

Gross income	$1,789,277,000
Profits before federal income taxes	$ 135,633,000
Federal taxes	$ 69,600,000
Profits after taxes	$ 66,033,000

Earnings per common share $3.61 compared with $2.84 from operations in 1962.

Profits from operations in 1963 increased 28%, and gross income increased 2% over 1962.

RCA has now had eleven consecutive quarters of increased profitability over the same periods of the previous years. The final quarter of 1963 was the single best profit quarter in the forty-four-year history of the company.

Against this background of progress, the RCA Board of Directors on December 6, 1963, proposed a three-for-one split of RCA common stock. The proposal was approved by the shareholders at a special meeting held in New York on January 29, 1964.

At its December 6 meeting, the Board also increased the quarterly dividend from 35 to 45 cents per share. During 1963, the quarterly cash dividend on common stock was raised by 80 per cent. The Board announced its intention to declare in March, 1964, the first quarterly dividend on the split shares at the rate of 15 cents per share, equivalent to an annual rate of $1.80 per share on the common stock prior to the split.

PRINCIPAL GROWTH ELEMENTS

In the expanding catalog of RCA products and services, which are created and marketed on a world-wide basis by 89,000 capable employees, no single product or service can be responsible alone for the company's progressively strengthened performance. Yet, in the life cycle of every successful diversified business, certain products and services provide at certain times a decisive impetus to growth. With RCA, three broad lines of products and services reflected this status in 1963:

1. *Color Television*—Profits from the sale of color apparatus and related color services increased by 70 per cent over the previous year. Color accounted for a major share of the record earnings from the sale of all RCA consumer products.
2. *Broadcasting*—The National Broadcasting Company earned substantially greater profits than in its previous record earnings year of 1962. In terms of diversified service to the viewing public, NBC had its most successful year.

Color television sets undergo inspection at RCA's Bloomington, Ind., plant.

3. *Electronic Data Processing*—Revenue from the sale and lease of standard RCA computers and peripheral equipment, in this country and abroad, increased by more than 50 per cent in 1963. We are holding firmly to our projected cross-over into profitability in data processing in the fourth quarter of 1964.

The convergence of these favorable developments was paralleled by an increasingly effective management operation in research, engineering, production, marketing, and servicing. RCA today possesses management in depth to a greater extent than ever before; its executive group includes more than 60 key line and staff officials below the age of 45.

It is a measure of RCA's diversified strength that a reduction of approximately 9 per cent in defense business during 1963 was more than offset by our commercial and industrial gains. RCA earned (after taxes) less than 2 per cent profit on its military and space business for the full year. While the company continues to contribute importantly to the nation's defense and space programs, it derives from them only a small percentage of its total earnings.

HIGHLIGHTS OF PROGRESS

RCA's continuing advance in over-all strength and profitability, stemming as it does from the broad base of the company's operations, produced these highlights of progress in 1963:

Data Processing — By year end, a cumulative total of 650 RCA computer systems had been installed or were on order. Domestic bookings of RCA systems in 1963 were about 50 per cent higher than in 1962.

The first computer to span the full range of data handling in a single package — the RCA 3301 Realcom — was introduced in 1963 and has received good acceptance.

During the year, several major American publishing enterprises had in operation or on order a revolutionary computerized typesetting system developed by RCA.

Consumer Products — RCA Victor home instruments achieved a record 15 per cent sales increase over the previous high of 1962. Dollar volume in TV set sales was the highest of any year in RCA history.

With RCA still the only company producing color picture tubes in large quantity, production continued on a three-shift-per-day, six-day-a-week basis throughout the year, and tubes were allocated to our customers and our own set-manufacturing plants. Manufacturing facilities were increased during 1963, and action has been taken to increase production of color tubes in 1964.

Broadcasting — Record-breaking profits were contributed by the NBC Television Network, the NBC-owned stations, and NBC Enterprises. The NBC Radio Network recorded its highest profits since 1950.

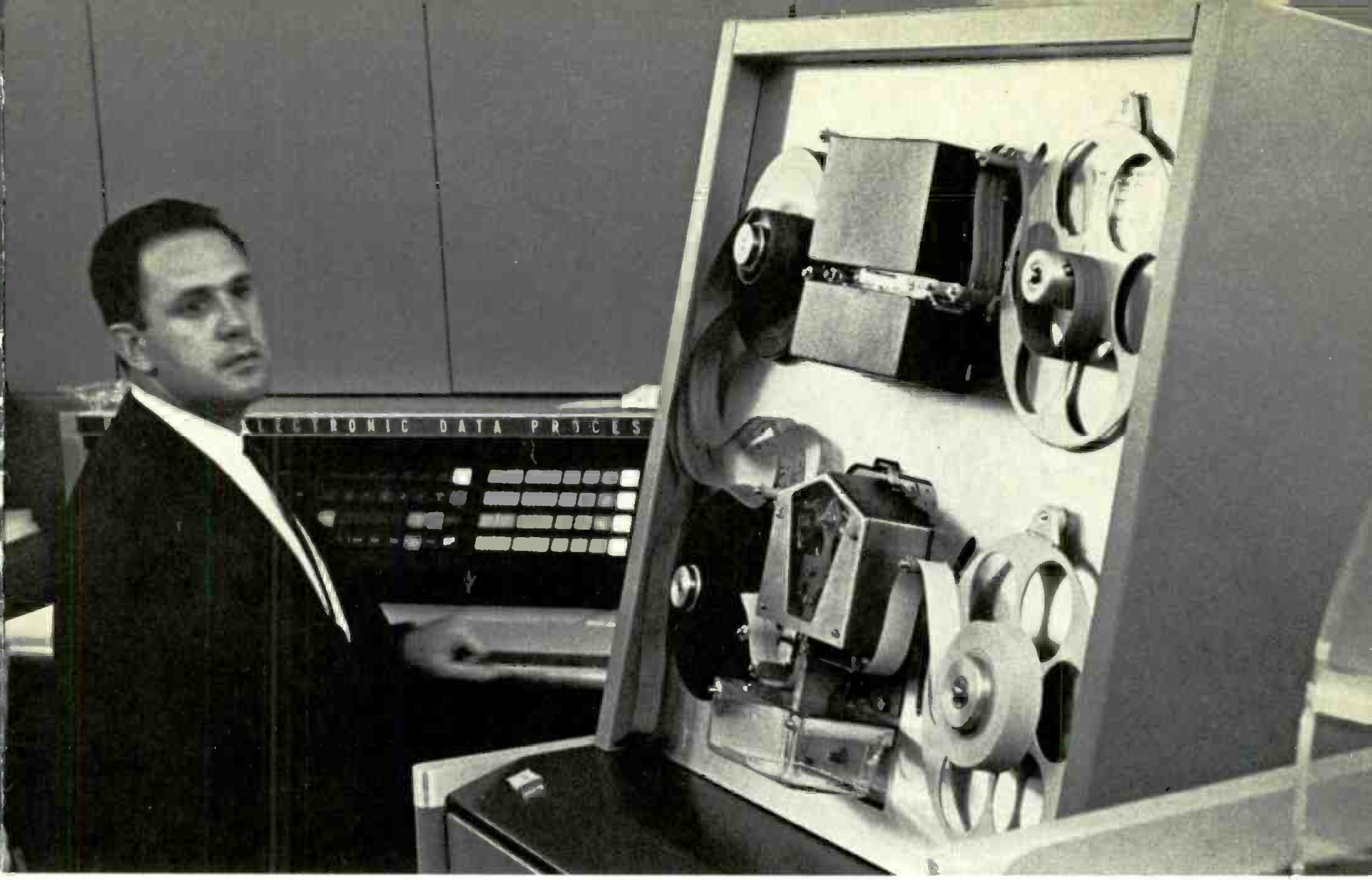
NBC strengthened its color programming leadership with more than 2,200 hours in color, including 70 per cent of its total nighttime schedule.

NBC News continued to set the pace in broadcast journalism.

Research and Technology — Among major RCA research accomplishments during the year were: a new type of semiconductor for integrated circuitry; a superconductive computer memory which can store over 16,000 bits of information on a four-inch square 120-millionths of an inch thick; and a simple and practical method employing magnetic fields to put information onto a laser beam.

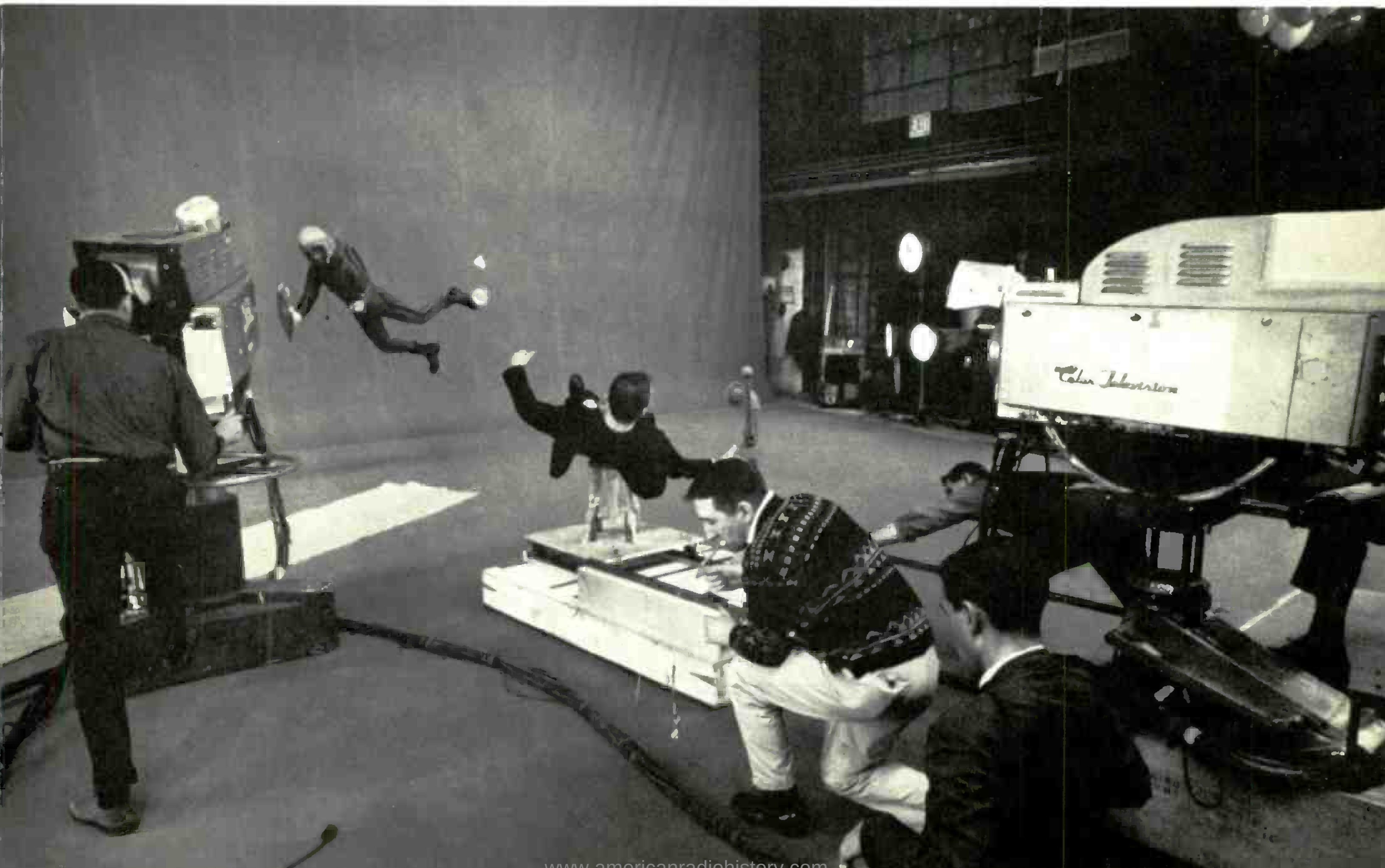
Components and Devices — The former Electron Tube Division and the Semiconductor and Materials Division were merged into a new Electronic Components and Devices organization to provide greater market and technical concentration and operating economies.

A major program also was instituted to develop a production capability in integrated circuits.



Sale and lease of RCA computers (above) increased in 1963.

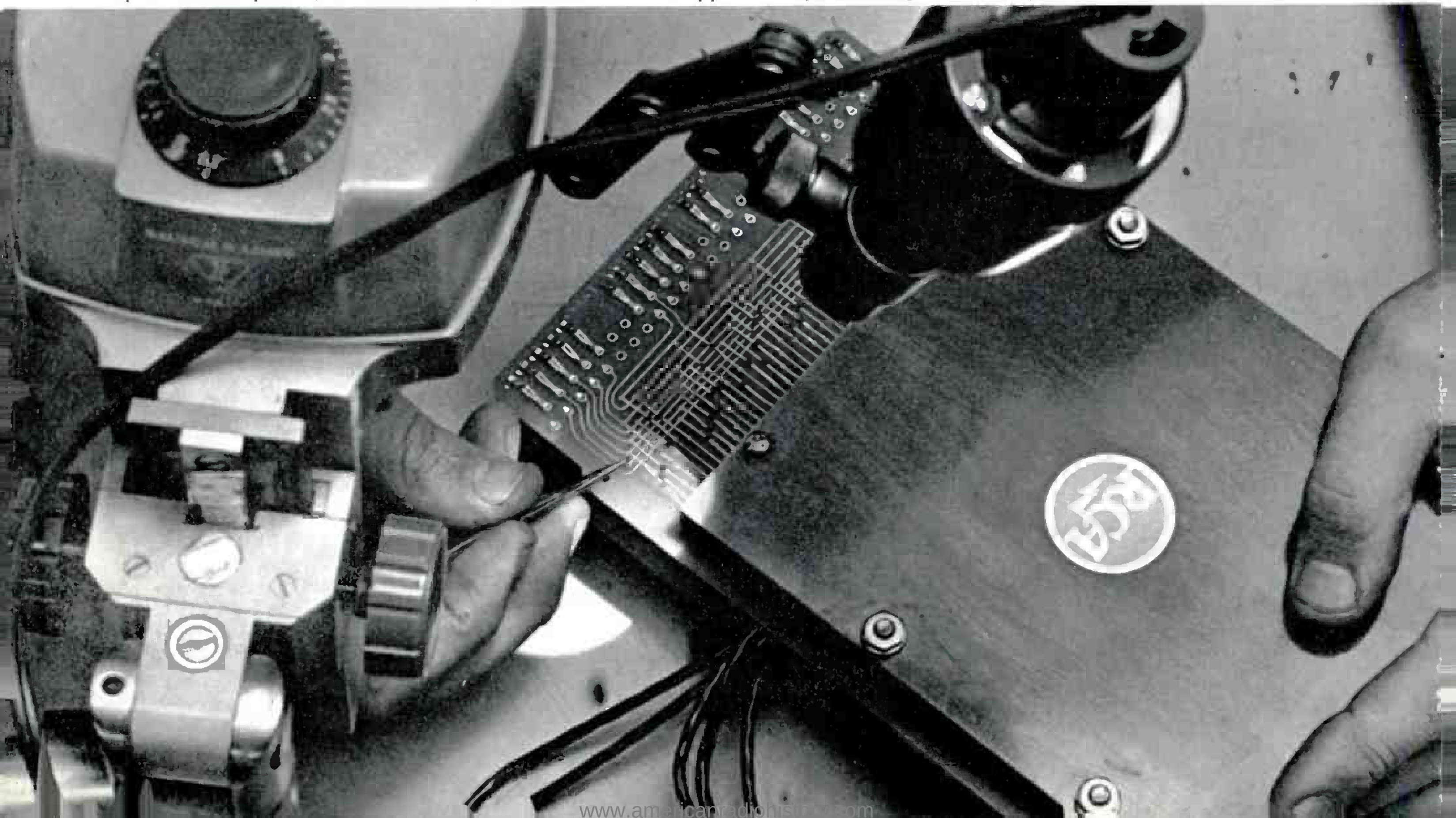
Color telecast of "Labyrinth" was an NBC-TV highlight.



Production of videotape recorders reached an all-time high.

Operation of telex at RCA Communications, Inc., New York.

Unprecedented speed of 250 billionths of a second marks this supplementary "scratch-pad" memory for an RCA 3301 computer.



A Direct Energy Conversion department was organized to speed development of electronic power-producing devices working directly from heat and other radiant energy sources.

Space and Defense — RCA has scored eight TIROS weather satellite successes in eight launches. All of them achieved gratifying results.

The Relay II communications satellite, designed and built by RCA for NASA, was successfully launched and put into operation on January 21, 1964. The first RCA-built Relay completed its assigned mission after establishing records for reliability and versatility.

RCA is well along in the production of the communications and controls systems for the Minuteman missiles. Its defense engineers also are pushing forward on such projects as laser communications, optical radar, miniaturized field computers for the Army, thermoelectric air conditioners for submarines, and the most advanced tracking radar for missiles and satellites.

Communications—RCA Communications, Inc., again was the leading U.S. international telegraph carrier in traffic volume and revenue. Sales rose to a new high of $40,000,000 — 9 per cent over the 1962 record.

Broadcast Equipment — The growth of color, the development of advanced broadcast equipment, and new TV tape recorders have brought increased sales of these RCA products at home and abroad.

Service — The RCA Service Company achieved peak profits for the year. Its space-age operations at Cape Kennedy, where more than 3,000 RCA skilled employees provide a broad range of electronic services, were expanded with a prime contract for operation of the communications complex at the Merritt Island launch facility.

International — The company's leading foreign subsidiary, RCA Victor Company, Ltd., of Montreal, achieved the greatest sales in its history. The Canadian Government has awarded the company a contract to build a satellite communications ground station that is designed to be the world's most advanced upon its completion in 1965.

THE OUTLOOK FOR 1964

The calm, steadfast manner in which our nation weathered tragedy in 1963 augurs well for the future. There is a basic strength to an economy that can progress relatively undisturbed through events of such shattering magnitude.

I believe that 1964 will be a year of economic advance and heightened business activity in both domestic and foreign markets. Electronics will be in the forefront of this advance.

In the nation's consumer market, the most vigorous single growth product in 1964 will be color television. I believe color set sales for the year will total between 1,200,000 and 1,500,000. The public demand for color sets has been established, and the total volume of sales will depend largely on the industry's ability to increase its tube-making capacity fast enough to meet that demand. In all its aspects, from manufacturing to broadcasting to servicing, color at the retail level promises to become a billion-dollar industry in 1964.

Electronic data processing should continue, in 1964, to rival color as a principal growth segment of American industry. The sale, lease, and servicing of data processing systems probably will expand from 15 to 18 per cent annually. RCA expects to continue as one of the major computer manufacturers and to benefit from the industry's growth.

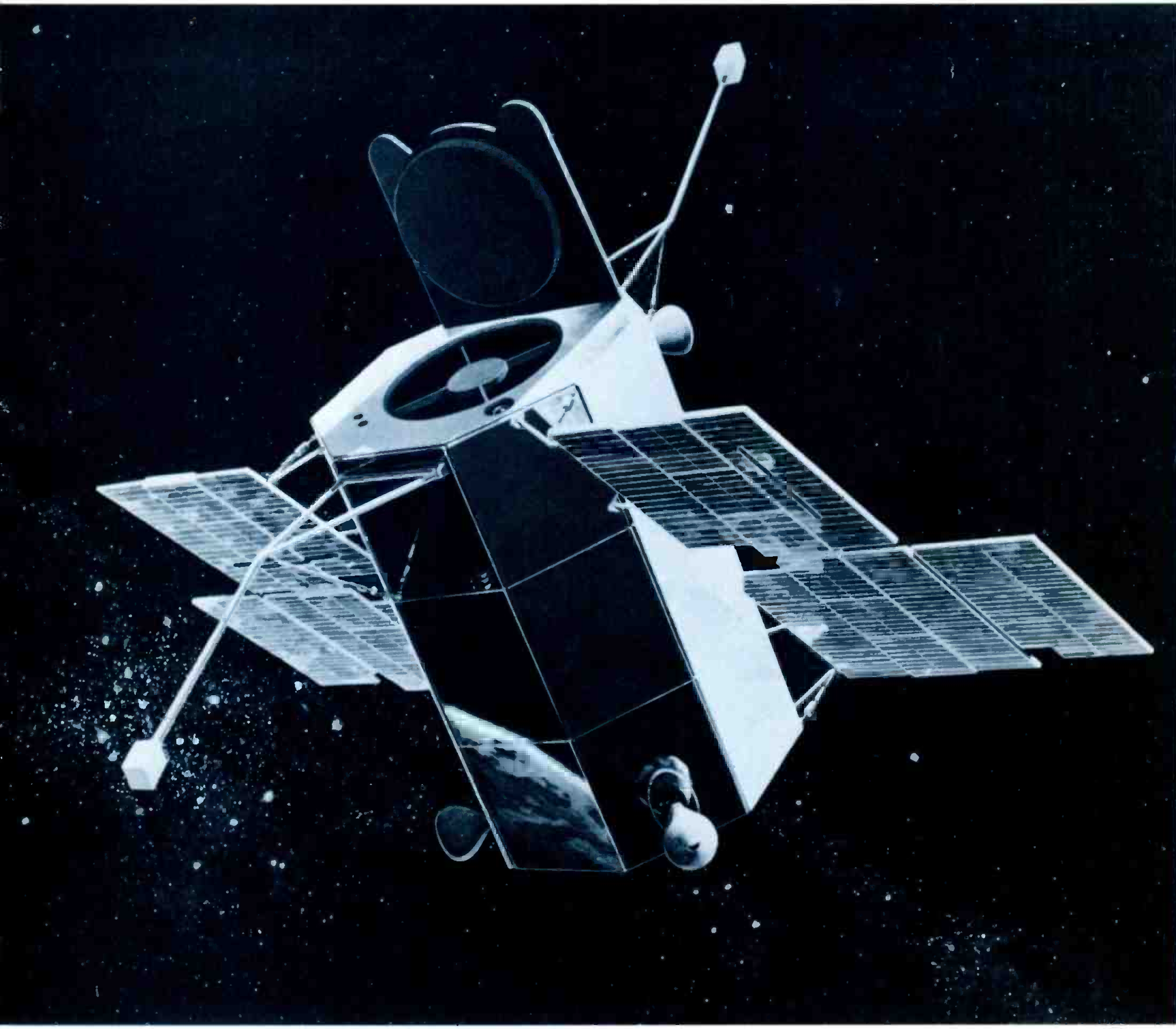
In the steadily expanding electronics industry, positive trends are now clearly visible in rising color sales, in data processing, in broadcasting and communications, and in industrial applications.

The year ahead should prove to be a year not of boom but of stable growth for the economy of the United States. My associates and I look with confidence to 1964 as a third consecutive year in which RCA expects to achieve record business and profits. ■

Electronics and Astronomy

by Willy Ley

A space expert reports on the contributions of electronics to astronomy.



The Orbiting Astronomical Observatory (OAO) will be a versatile 3,600-pound research vehicle orbiting the earth every 101 minutes.

A little over a hundred years ago the various sciences led separate and neat existences: botanists studied plants, zoologists studied animals, astronomers studied the sky, and geologists were occupied with rocks. Only at a few points did the sciences interact as, for example, in a certain sub-discipline of chemistry where chemical reactions were brought about by electricity, a physical force. Since this interaction was a fact, it had to be accepted, but some scientists were vaguely unhappy about it — the existence of a sub-discipline like electrochemistry seemed to spoil the general orderliness of things.

Today, interactions between the various sciences are the rule, and nobody is unhappy about it any more. On the contrary, it is the overlapping of the fringe areas of the various disciplines that yields results. Even astronomy, which had always been regarded as a science apart — not too practical except for navigational purposes, but undeniably beautiful — has been drawn into the fold of multiple interdependence. And the "other science" that is doing most to create a new astronomy is electronics.

It began with the device generally known as a radio telescope.

For many decades, astronomers used to explain to nonastronomical audiences that they were in a peculiar position. Radiation of all kinds could be assumed to strike the top of the earth's atmosphere, but the atmosphere was opaque to most kinds of radiation. It was transparent only to the comparatively narrow band of wave lengths dubbed "visible light," and all astronomy therefore depended on observations made with visible light. Astronomers said that they were observing through a narrow window.

Then something interesting happened.

In 1932, the physicist Karl Jansky investigated static in radio receiving equipment and found — no doubt to his dismay — that his equipment produced a faint hiss most of the time even when there was no ordinary static. After a while, he also noticed that the hiss was strongest at intervals of *almost* 24 hours. It was this "almost" that provided the clue — there was a difference of four minutes. The time that elapses between two passages of the sun through the meridian (its highest point in the sky) is 24 hours, the ordinary day. But the time that elapses between two meridian passages of a star, any star, is 23 hours and 56 minutes. Jansky's "peak noise" had to originate somewhere among the fixed stars.

The next step was taken by a radio amateur in Illinois, Grote Reber. If radio waves from the stars reach the ground, he thought, it should be possible to concentrate them for better investigation. He built a 31-foot parabolic dish antenna for this purpose. It was the world's first radio telescope, and it is located at the entrance of the National Radio Astronomy Observatory at Green Bank, West Virginia.

Jansky's discovery, and Reber's subsequent work, proved that our atmosphere is transparent also to radio waves of certain wave length. There was a "second window" through which one could observe. In one respect that "second window" was even superior to the first one, the optical window. When the sun is above the horizon, its radiance interferes with the observation of virtually everything else. But the sun's light does not interfere with the reception of radio waves from space; radio astronomers can work in daylight if they elect to do so. Nor are the radio astronomers as dependent on a clear sky as are the optical astronomers; a cloud cover or haze does not block out the radio waves.

Naturally, there are drawbacks, too. Because of the great wave length of radio waves, the receiving "telescope" must be large. Grote Reber's 31-foot dish is about the equivalent of a pocket telescope, while an 8-inch optical telescope is a very fine large instrument for most purposes. The other drawback is that human beings have no organ that responds to radio waves; electronic equipment first has to translate the radio impulses into something we can comprehend, like graphs on paper. This precludes a quick look — the scanning of an area of the sky for sources of radio noise is a time-consuming process.

Before discussing forthcoming contributions of electronics to astronomy, a standard electronic device — namely, the digital computer — has to be mentioned. Maybe it has to be pointed out that any astronomical calculation can be done — and *was* done in the past — just with pencil and paper. But because such a calculation is a tedious and

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Willy Ley has been associated with space and space travel since 1929. Author of the authoritative book, *Rockets, Missiles and Space Travel,* his most recent book is *Watchers of the Skies,* a history of astronomy.

time-consuming job, nobody liked to tackle one unless there was a very good reason for doing it. In fact, in some cases it was hopeless to try a calculation since it was clear from the outset that no human computer could do the work in the time available.

One example of what a digital computer could do, and what no human computer could have done, must suffice.

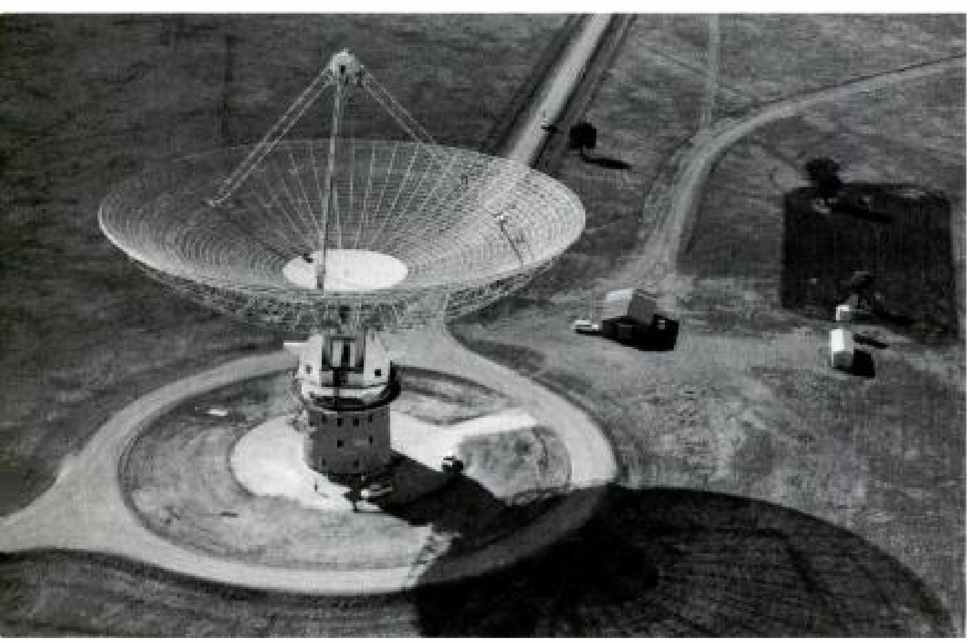
In 1951, the planet Jupiter — the largest planet of our solar system — was known to have 11 moons. Four of them are large and present no special problems, neither does the fifth which is smaller and happens to be the one closest to the planet. But the outer moons, beyond the four big ones, are difficult. They are quite small and hard to see, and at least some of them move in orbits that mathematicians call a varying ellipse. (This means that each orbit is more or less elliptical, but the ellipse does not return to the point of origin — it is not a closed curve.) Under these circumstances, it is not too surprising that satellite No. VIII was "lost" in 1941. Ten years later, a search was started — and then a curious thing occurred. Satellite No. X seemed to be where orbital prediction said it should be, but then it was seen to move in the wrong direction! What had really happened was that satellite No. X was not in the predicted position but elsewhere in its orbit, while up to that moment unknown satellite No. XII occupied the position predicted for No. X.

A new discovery had been made, but No. VIII had still not been found. But, in 1954, a properly programmed computer needed just two and one-half hours to calculate ten different possible orbits for satellite No. VIII, and it was found again in January, 1955. Then, knowing which of the ten possible orbits applied, the computer quickly extended the prediction for No. VIII until the year 1980, giving the positions of the satellite for every tenth day!

So far, electronics has supplied the astronomers with a second window for observation and has given them aids in computing that past generations could not even have dreamed about. The next step will be to get rid of the windows altogether and, so to speak, go up on the roof of the building, which means in this case to go outside the atmosphere.

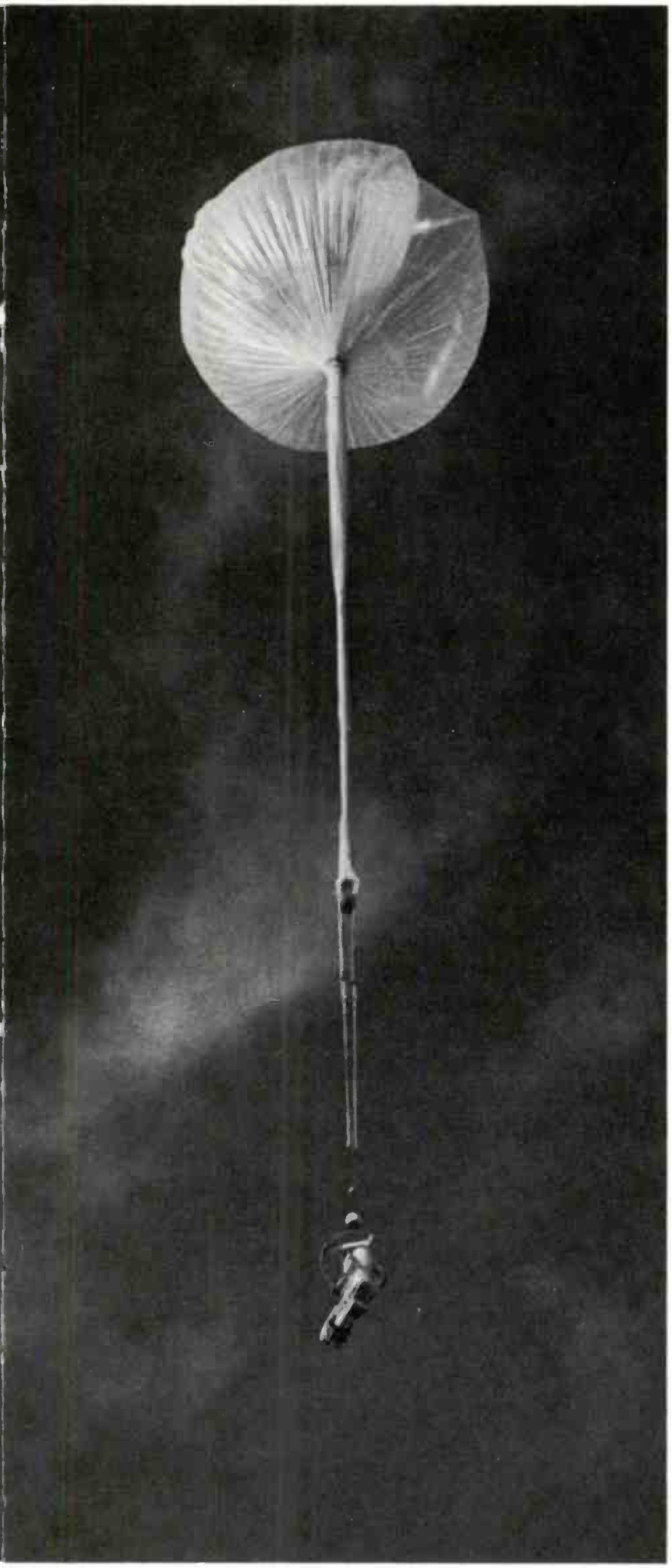
Our atmosphere is generally considered to have a total height of about 100 miles, but most of it is concentrated in the bottom layers. At 20 miles up, 99 per cent of the atmosphere is "below," so that instruments operating from this altitude are literally above most of the problems. And the invention of thin but reasonably tough plastics has made it possible to construct balloon envelopes of very little weight, so that they can go much higher than the old balloons made of rubberized silk.

Project Stratoscope took advantage of these facts by carrying a telescope with a 36-inch mirror to 80,000 feet — an altitude that eliminates all but 4 per cent of the earth's atmosphere. In principle,



This 210-foot radio telescope in Australia is representative of the transition from optical to electronic astronomy.

Project Stratoscope's telescope operates at an altitude that eliminates 96 per cent of atmospheric distortion.



A plastic balloon lifts a Stratoscope telescope to 80,000 feet. Electronic controls keep telescope trained on stellar objects.

the telescope is a reflecting telescope of the type first built by Sir Isaac Newton, with an astronomical camera attachment. The pictures taken have to be recovered to be developed, but the whole project would be impossible without electronics. There is a specially designed RCA television system that includes wide-field TV pickup as well as a fine TV pickup for acquiring the object to be photographed and electronic aiming controls for keeping the telescope trained on the object. The aiming controls are so accurate that the stratoscope, floating in the upper atmosphere, can take an exposure of several hours, if desirable.

But the final goal is to get completely outside of the atmosphere.

As early as 1837, the astronomer Heinrich von Mädler, in a book about the moon, wistfully wrote about the advantages of an astronomical observatory *on* the moon, preferably on the lunar hemisphere away from the earth. Twentieth-century technology will make this 19th century dream come true in a decade or so, but, in the meantime, a great deal can be accomplished by unmanned orbiting astronomical observatories.

A specialized satellite of this type was successfully orbited on March 7, 1962. Its designation was OSO-I. The letters stand for Orbiting Solar Observatory, for this satellite was designed to observe the sun. It was highly successful and obtained information about the sun's output of X rays of wave lengths that never reach the ground, though a few such measurements had been obtained earlier from high-altitude rocket shots. How meager the earlier observations had been can be shown by a simple comparison. In three months of operation, OSO-I obtained more than three times the data for the X radiation measuring between 1 and 10 angstroms than had been previously accumulated, and it obtained over four thousand times the data previously gathered for the sun's spectrum in the region from 50 to 400 angstrom units.

OSO-I was a comparatively small satellite, weighing 440 pounds. The new astronomical satellites — now being built — will be considerably larger and heavier. Their designation is OAO (Orbiting Astronomical Observatory), and their weight is 2,600 pounds without the scientific instruments to be carried. Weight allowance for the instruments is 1,000 pounds. The OAO is octagonal in shape, with a diameter of 80 inches and a length of ten feet. The central cavity of the OAO can accommodate optical systems up to 48 inches in diameter and a length up to the full length of the satellite. In addition to the main optical system, numerous small scientific instruments can be carried in a number of bays formed by the vertical trusses and horizontal shelves of the satellite's structure. Because of this arrangement, the OAO is going to be a versatile research vehicle. Power for the instruments and transmitters will be supplied by two large panels — folded up during the ascent into orbit — covered with silicon solar cells. The total area of these panels is 111.5 square feet.

The OAO will be orbited by an Atlas-Agena D rocket. Final separation of the OAO from the Agena D will take place about 55 minutes after take-off. The orbital distance will be 500 miles, so that the OAO will be a considerable height above the atmosphere but still inside the Inner Van Allen Belt. At that distance, the orbital period is 101 minutes. For 65 minutes of each orbital period the OAO will be in sunlight, and for 36 minutes it will be in darkness — that is, in the earth's shadow. During the period of crossing the earth's shadow, power will be supplied by nickel cadmium batteries, which are then recharged when the satellite emerges from the shadow cone.

After separation, the OAO will orient its attitude in such a way that the panels obtain as much sunlight as possible. But the sun must not be permitted to shine into the main optical system. For this reason, there are two sunshades — one at each end — which will begin to close when the angle of the main optical system and the direction to the sun approach 45°. The shades will be completely closed when that angle has diminished to 30°. A total of 32 pounds of gaseous nitrogen is carried under a pressure of 3,500 psi to adjust the attitude of the OAO when that becomes necessary. Of course, astronomical work requires high accuracy in pointing the main system. The OAO's control system can point the satellite within one minute of arc and maintain the position within 15 seconds of arc for 55 minutes of time.

The first OAO will carry a sky survey instrument — called Celescope — of the Smithsonian Astrophysical Observatory. Celescope will produce a star map similar to the Palomar Sky Atlas, but it will make this map *using ultraviolet light only.* The Celescope consists of four electronically recording telescope cameras. The same OAO will carry an experiment prepared by the University of Wisconsin; its main purpose will be to measure stellar energy in the 800 to 3,000 angstrom range. But the Wisconsin instrument can be used to follow up on discoveries made by the Smithsonian instrumentation.

Satellites of the type of the OAO, being free of the necessity of observing through "windows," will mark the beginning of a new era of astronomical work. ■

Cylindrical object is a television camera designed to help orient the Orbiting Astronomical Observatory (OAO) satellite by detecting second to fifth magnitude stars.

Image intensifier orthicon electron tube makes it possible to photograph stars millions of times dimmer than the naked eye can see.

"Drive-In" Banking by TV

by Edward J. Dudley

The growing use of closed-circuit television visually links the banking customer in his car with a teller inside the bank.

The motorcar, once simply a conveyance for moving people from one place to another, has become a kind of rolling base of operations where the motorist and his family can buy and eat meals, watch movies, or run errands without ever leaving its lounge-like comfort.

Some motorists find the automobile a handy place to shave on the way to the office. Others mail letters or make telephone calls from it, or stretch out in its fold-back seat for a rest. The modern auto is, in sum, a marvel of passive usefulness.

The moving force behind this "stay-in-the-car" mood is, of course, the drive-in. In this automobile age, its rise was as clearly foreseeable as the stop sign and the medial strip. For, as the gas buggies began swarming over what is fondly remembered as the Open Road, it was to be expected that trade and service businesses would set up shop along the highway. With the drive-in, they could cater to the American's great attachment for his machine. He could munch a hamburger or order all manner of services performed and never leave it.

Drive-in banking, though not a new in-car activity, is experiencing a decided upswing at the moment. For those persons who remember the formal and rather forbidding facade that banks once presented, the profusion of drive-in banks suggests that the industry is making a near turnabout in its public image. Many banks are extending this kind of customer convenience to the pedestrian by installing "walk-up" windows where he can do his banking from the sidewalk.

In planning such changes, banks have been quick to recognize the value of electronic equipment. Computers, with their insatiable appetites, are biting into the mounds of paperwork that accumulate in a bank on any given working day. Closed-circuit television systems appear more frequently, for surveillance of the public banking area and for internal communications. A growing use of closed-circuit TV, for example, is to link a drive-in station or walk-up window with the bank's central files. Thus, signatures can be compared quickly and other visual information exchanged.

There is no better illustration of how TV can contribute to better banking service than the drive-in banking "kiosks" manufactured by Diebold, Inc. The kiosk, which is an unmanned customer station installed out-of-doors, and the inside control console for the teller each are equipped with a TV camera and a monitor. The two units make up Diebold's new Vue-Matic drive-in banking system.

When customers drive up to the kiosk, they see the bank teller on the TV screen. The teller, seated before a monitor inside the bank, sees the customer. The two points also are connected with a sensitive sound system so that two-way "hear and see" communications are immediately established.

Through the television medium, the bank can maintain the familiar face-to-face relationship with its customers even though the customer and the bank employee are separated by some distance. A pneumatic tube carries bankbooks, currency, and other items between the two points at a fast clip.

The TV system is capable of a "see yourself" condition so that, when the bank customer drives up to the kiosk, he sees his own image on the screen. A touch of a signal bar and the teller inside switches to two-way operation. The chance to "see yourself

Customer's Eye View: *Out-of-doors, customer in auto sees teller inside the bank on TV monitor and converses over two-way voice circuit.*

Teller's Eye View: *Hundreds of feet apart, teller completes bank transaction over closed-circuit TV with customer.*

on TV" has proved to be a top attraction for children at many of the banks using the Vue-Matic system. One bank, on the day it opened its TV drive-in, delivered lollipops for the kids via the pneumatic tube.

A distinguishing feature of the outdoor kiosk is that it can be located in a parking lot or at any distance from the bank building that can be bridged, or more likely tunneled by the pneumatic tube. This flexibility is especially important in multiple-unit installations such as the five-kiosk arrangement at the First National Bank of Kenosha in Wisconsin.

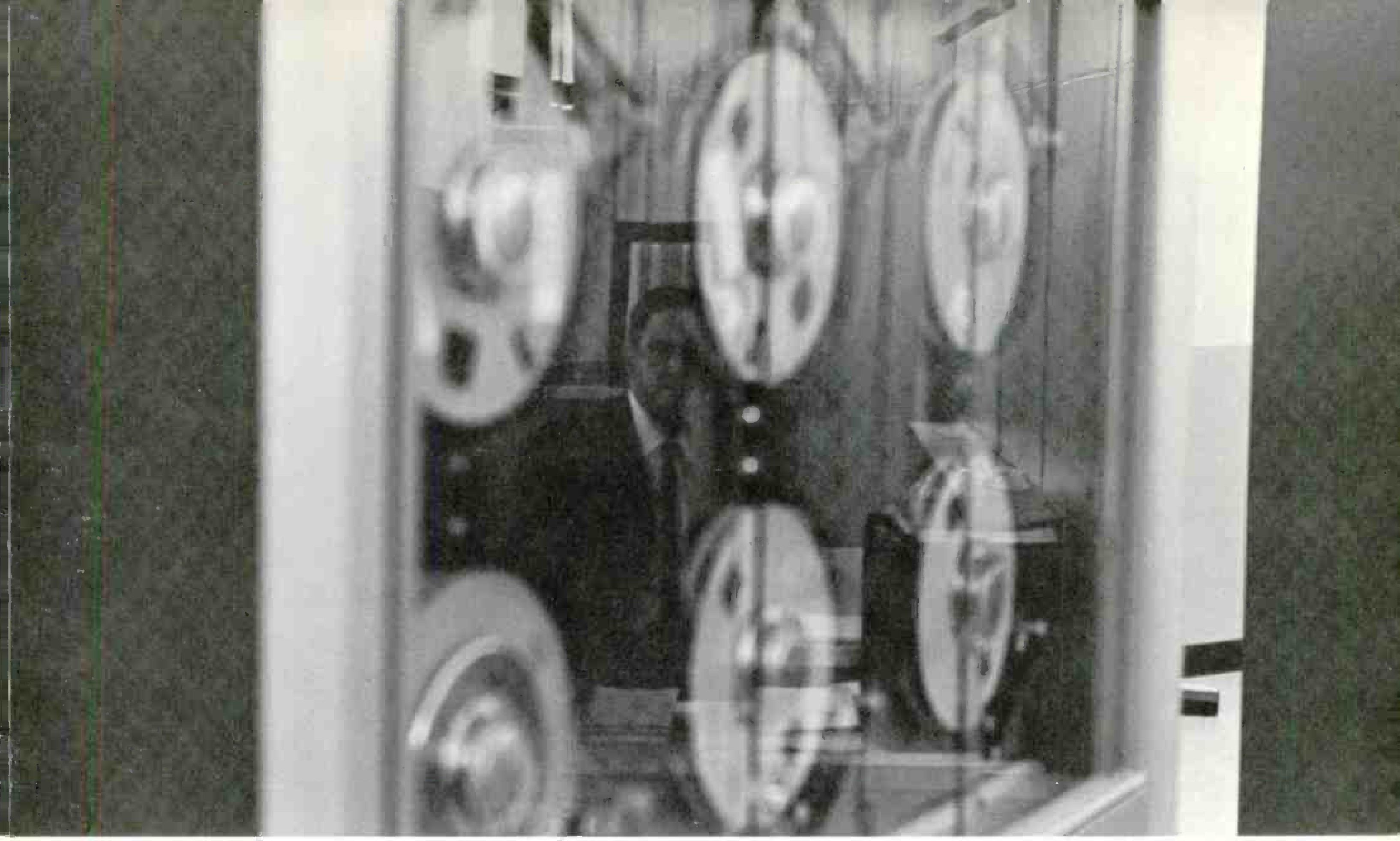
Normally, the teller's console is placed in the bank's main business area where the teller has easy access to central records. The cash supply is there, too, well isolated from the drive-up bandit.

The drive-in station without TV is, in most cases, an extension of the bank building and must be manned full time by a teller, with separate cash drawer and records, during business hours. The TV teller can perform other general duties during slack periods at the drive-in.

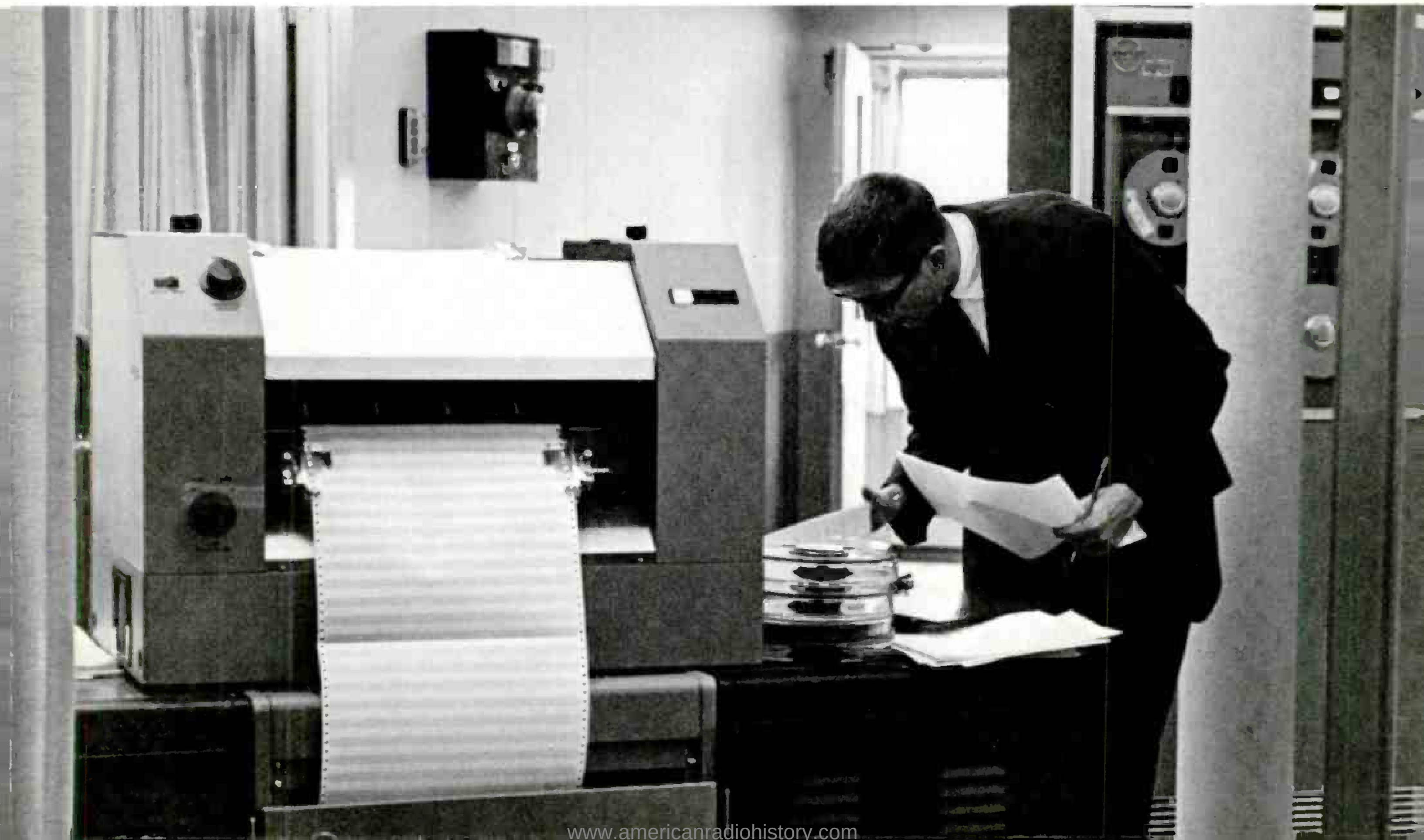
The Diebold system uses RCA's industrial-type closed-circuit camera which was engineered for top performance over extended periods of time, as required for drive-in banking. Cameras installed in the outdoor kiosks have automatic sensitivity control which maintains a uniform camera signal, or picture level, over the wide range of lighting conditions encountered out-of-doors.

By the end of 1963, the Diebold system had been installed in more than 30 banks around the country. Moreover, the popularity of drive-ins is stimulating other ideas for convenience banking. A department store is considering a walk-up TV station inside its store, connected to the bank across the street. In a New York office building, thought is being given to installing a TV banking station 40 floors up so that tenants can do their banking without taking the elevator to the bank at street level. There are possible uses outside the banking field, too. One major city may install a drive-in station outside its police headquarters where the motorist can pull up and drop off his traffic fine!

In banking circles, the television-equipped drive-in is sometimes called "the teller with the long arm." If the TV reach is extended to its ultimate in other trades and services, it may never again be necessary to get out of the family car. ■



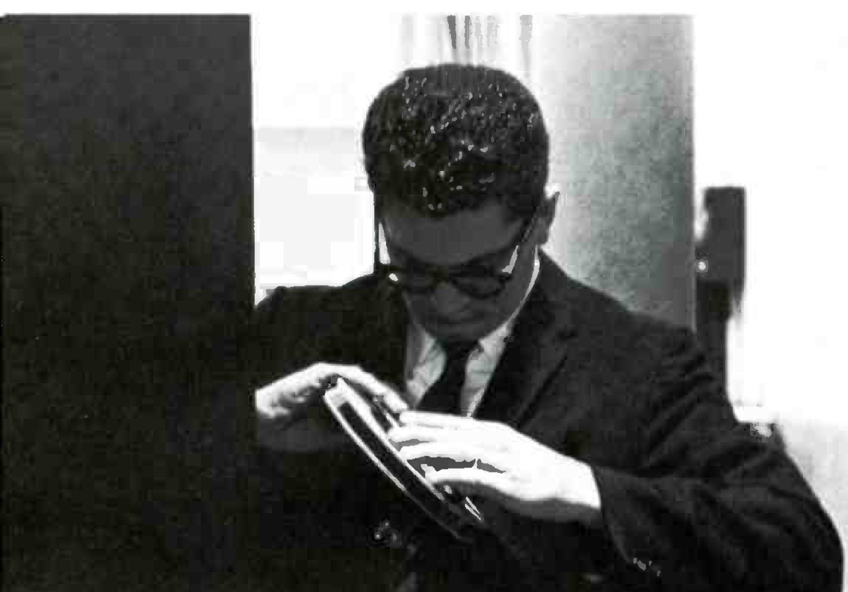
Computers and People... *A PHOTO ESSAY*



strategy plan…

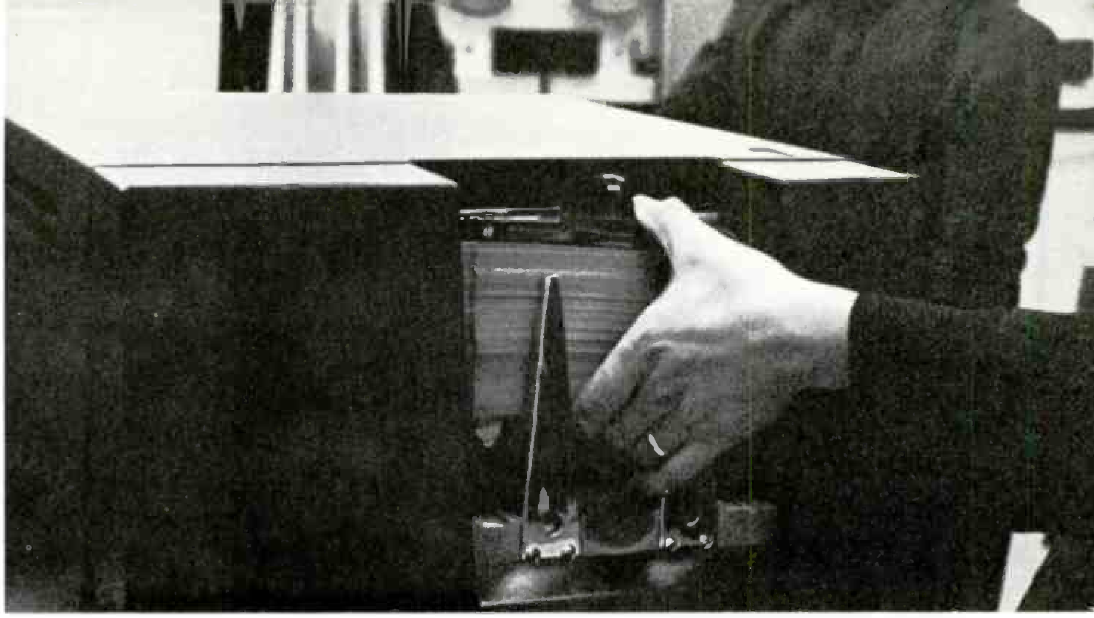
motivated motion…

study in paper work…



reel change: accounts receivable to accounts payable…

impe–



equipment check... *the punched word...*

translation problem...

ıtience with the instantaneous... *end product.*

The Space Link

by Romney Wheeler

The construction of an experimental communications satellite ground station in Canada marks the beginning of the establishment of a new facility in world-wide communications.

In a remote area of Nova Scotia, almost within hailing distance of Cape Sable, giant bulldozers will begin shortly to build a highway leading into space. It will mark the start of Canada's entry into satellite communications—an experimental ground station that will go into operation sometime in the fall of 1965. Located in this area because of minimum electrical interference, the station will enable Canada to be linked by satellite to at least half the world. Eventually, it will become a major permanent installation for all types of commercial satellite communications.

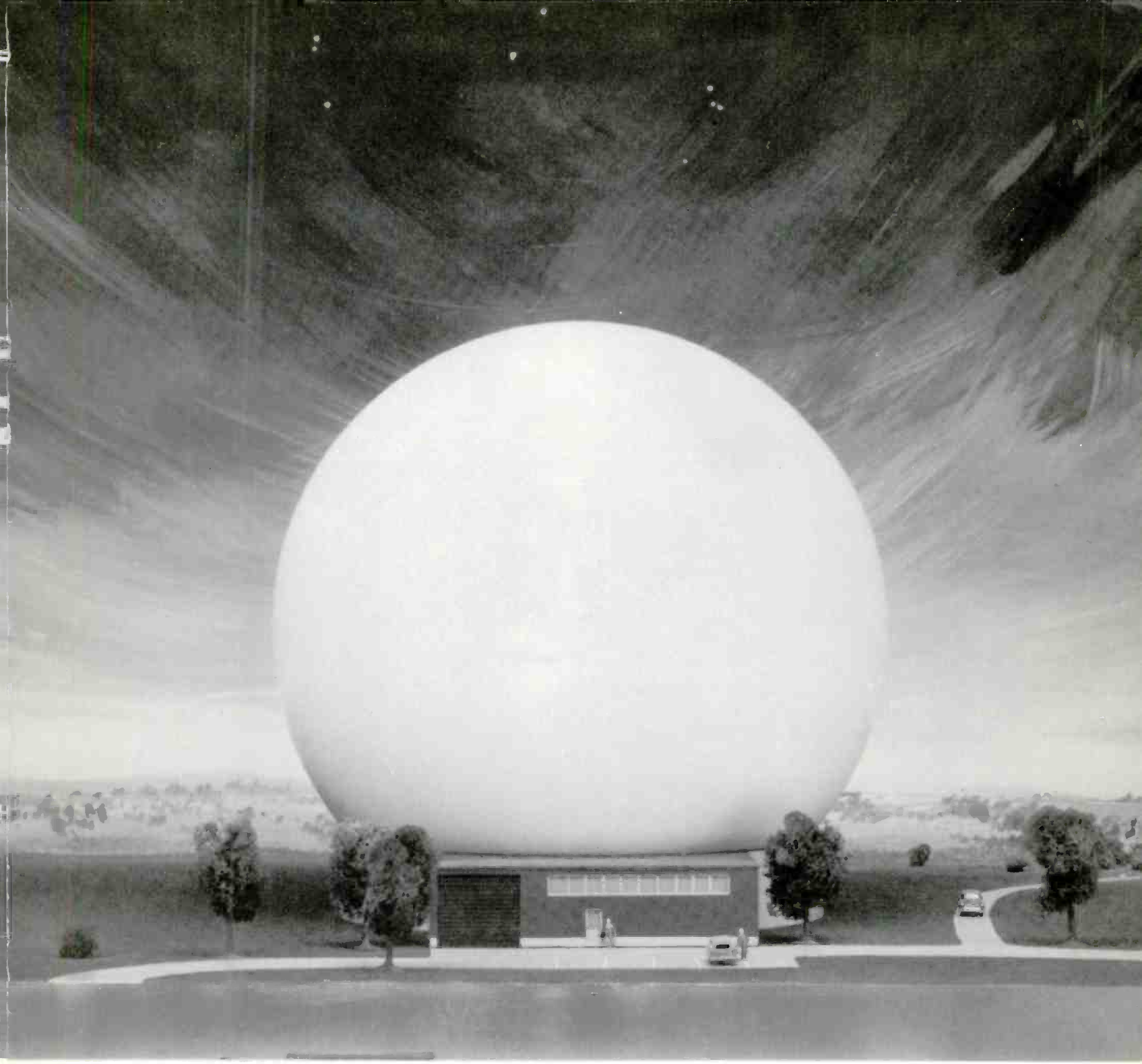
RCA Victor Company, Ltd., of Montreal is the systems integration contractor to the Telecommunications & Electronics Branch of the Department of Transport, Canada, for the new communications satellite ground station. RCA Victor Company, Ltd., a subsidiary of the Radio Corporation of America, is responsible for the design, the supply of equipment, and the installation and check-out of the facility. The Canadian Government will provide site clearance, access roads, buildings, and the microwave links with Canada's national communications network.

Canada's decision to construct a ground station came only a few months after successful testing by the U.S. National Aeronautics and Space Administration of two different types of communications satellite. These are Relay and Telstar, both operating at intermediate altitudes, and Syncom, operating at high (or synchronous) altitude. All are experimental, being intended as research for future development of commercial satellite systems, but their extraordinary success promises rapid advance in this method of communication.

Canada thus has taken a first step toward solving one of the most pressing problems of international telecommunications: the growing demand for expanded facilities and the inherent limitation of conventional cables or radio frequencies. Six other countries already have built or acquired experimental ground stations: Brazil, France, Germany, Great Britain, Italy, and Japan. Many others are expected to construct stations of larger or smaller capacity than Canada's, based on their estimates of future demands.

For heads of state and other public officials responsible for national and international telecommunications, the question of satellites is anything but academic. Already, four continents have been linked experimentally by NASA's famous Relay and Syncom satellites. Moreover, the U.S. Communications Satellite Corporation has announced its intention of inaugurating commercial service to Europe no later than 1965. Many countries, therefore, must decide whether their ever-increasing traffic may effectively make use of satellite communications.

Participation in a satellite system does not imply the need for each country to have its own satellites. It will require only the construction of appropriate ground stations, equipped to trans-



Model of the Canadian experimental ground station, which will be completed in autumn, 1965.

mit to, and receive from, commercially operated satellites in space. The size and complexity of the station, and the number of antennas needed for its operation, depend on the kind of traffic to be handled, and – of equal importance – its volume.

A ground station such as the one being built in Canada must be capable of transmitting and receiving every kind of telecommunications, including teletype, telephone, facsimile, data processing signals, and television. It must be capable, moreover, of communicating via fast-moving intermediate-orbit satellites as well as high-altitude synchronous satellites with relatively fixed positions in relation to the earth. Such a ground station may cost approximately $5 million.

Initially, the station will have a single, 85-foot dish antenna, protected by an all-weather radome. This will suffice for experimental or limited satellite communications. Later, as commercial service is required, this will be expanded to three, and possibly as many as five, antenna installations.

By contrast, a country with modest traffic requirements involving only telephone, teletype, and facsimile traffic may be served adequately by a much smaller installation having perhaps a 35-foot or 40-foot antenna. Such a ground station, being smaller and having less critical requirements, may

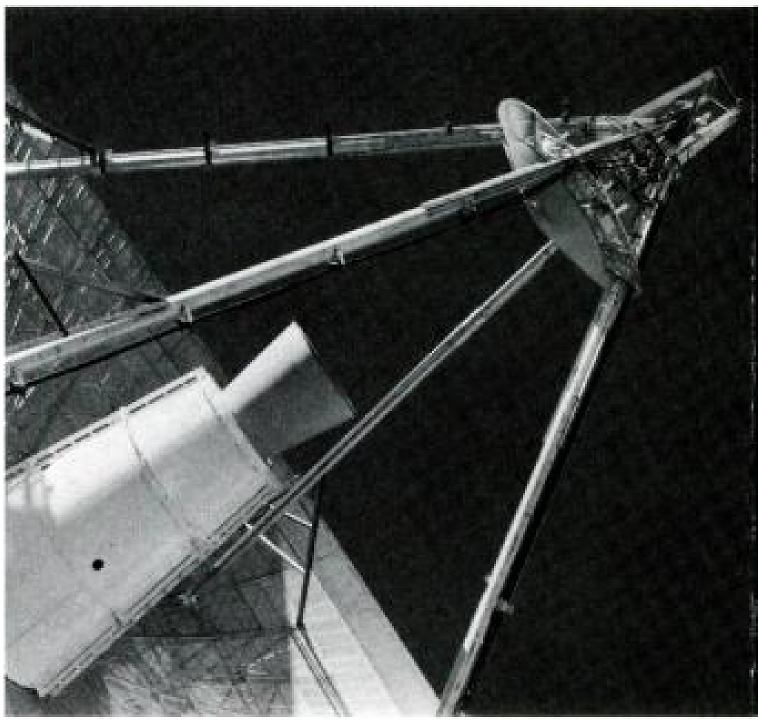
Artist's view of Canada's first communications satellite ground station shows antenna reflector inside its radome.

cost one-tenth as much as a major installation.

A significant decision in favor of satellites was taken recently by the American Telephone and Telegraph Company. It notified the Communications Satellite Corporation that, if suitable satellite circuits became available, it would prefer these to laying new North Atlantic cables. Moreover, it would propose using satellites initially to South America. This preference would continue, A.T.&T. said, until cable and satellite circuits were approximately equal in number. The decision underscored an important change in emphasis, since A.T.&T. previously had announced development of a new, transistorized cable capable of handling 720 voice channels.

It is likely that the first satellites used in commercial service will operate at intermediate altitudes, that is to say, in orbits ranging up to 12,000 statute miles above the earth. The final design still is to be determined, but initially the capabilities of such satellites probably will be equal to that of the experimental Relay and Telstar satellites.

Depending on the prospective traffic require-

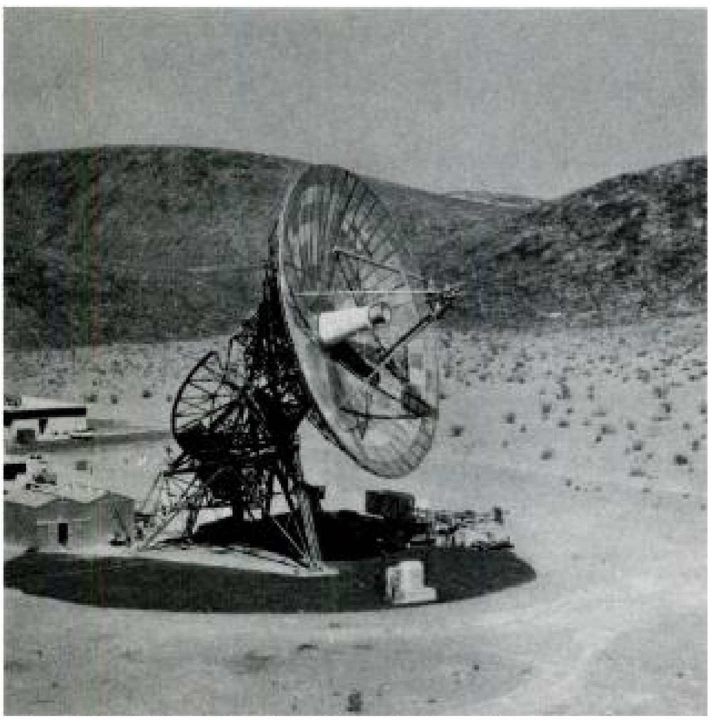


Close-up of RCA-built Cassegrainian feed horn, enhancing capability of NASA deep space network facility.

ments, between 20 to 40 satellites will be required in order to ensure continuous satellite contact between any two ground stations. Later, as research produces more precise answers to many critical questions, it is possible that random-orbit, intermediate-altitude satellites may give way to a system of synchronous orbits, hovering over the earth's equator at an altitude of 22,300 miles. At this height, the speed of the satellite in orbit exactly equals the speed of the earth's rotation making the satellite seem to hang motionless in the sky.

Successful tests of NASA's Syncom satellite suggest that three or possibly four synchronous satellites will be sufficient to give continuous worldwide communications via space.

One critical question remains unanswered, however. That is the prospective operational life of a commercial communications satellite. As of January, 1964, Relay I was in its 13th month of operation and already had established a record for longevity by a communications satellite. This was so in spite of the fact that a timer was supposed to turn it off after one year. Relay II is not equipped



Deep space network facility of U.S. National Aeronautics and Space Administration at Goldstone, Calif.

with a timer specifically to find out how long it will "live" in hazardous space.

Economically, a commercial satellite will have to offer a useful life of at least two years and be so designed that three or four satellites can be launched simultaneously into intermediate-altitude random orbit with a single rocket vehicle.

Satellites operating at intermediate altitude may be expected to circle the earth several times a day. Thus, the time that any one satellite is in common view of two ground stations will be only a fraction of one orbital period, depending on where the stations are located. To use the satellite for communications, both stations must track it during the time it is mutually visible, then wait for its next useful pass. For this reason, one satellite at intermediate altitude cannot provide more than intermittent intervals of use, although other pairs of stations elsewhere in the world can use it whenever it is mutually visible to them.

This is why it will be necessary to have a considerable number of intermediate-altitude satellites, with orbits designed to have at least one satellite passing within range at all times. By switching from one satellite to another as they move through space, it will be possible to achieve continuity of service. To do this, a second antenna (with its associated transmitter and receiver) will be pointed toward the horizon to pick up the next following satellite before contact with the first is lost. Communications thus will be continuous, via succession of satellites, using two sets of equipment at each ground station.

The type of ground station equipment required for satellite telecommunications is not dissimilar from radar tracking equipment which already is widely used by the military and in civilian space research. Parabolic antennas and pedestals built for missile tracking and for deep space probes have many of the same characteristics that will be built into satellite ground stations. The same is true of the microwave transmitters, the ultrasensitive microwave receivers, the selective filters, wave guides, and programming equipment needed to control the antenna beam along a predicted celestial track as the satellite moves in orbit.

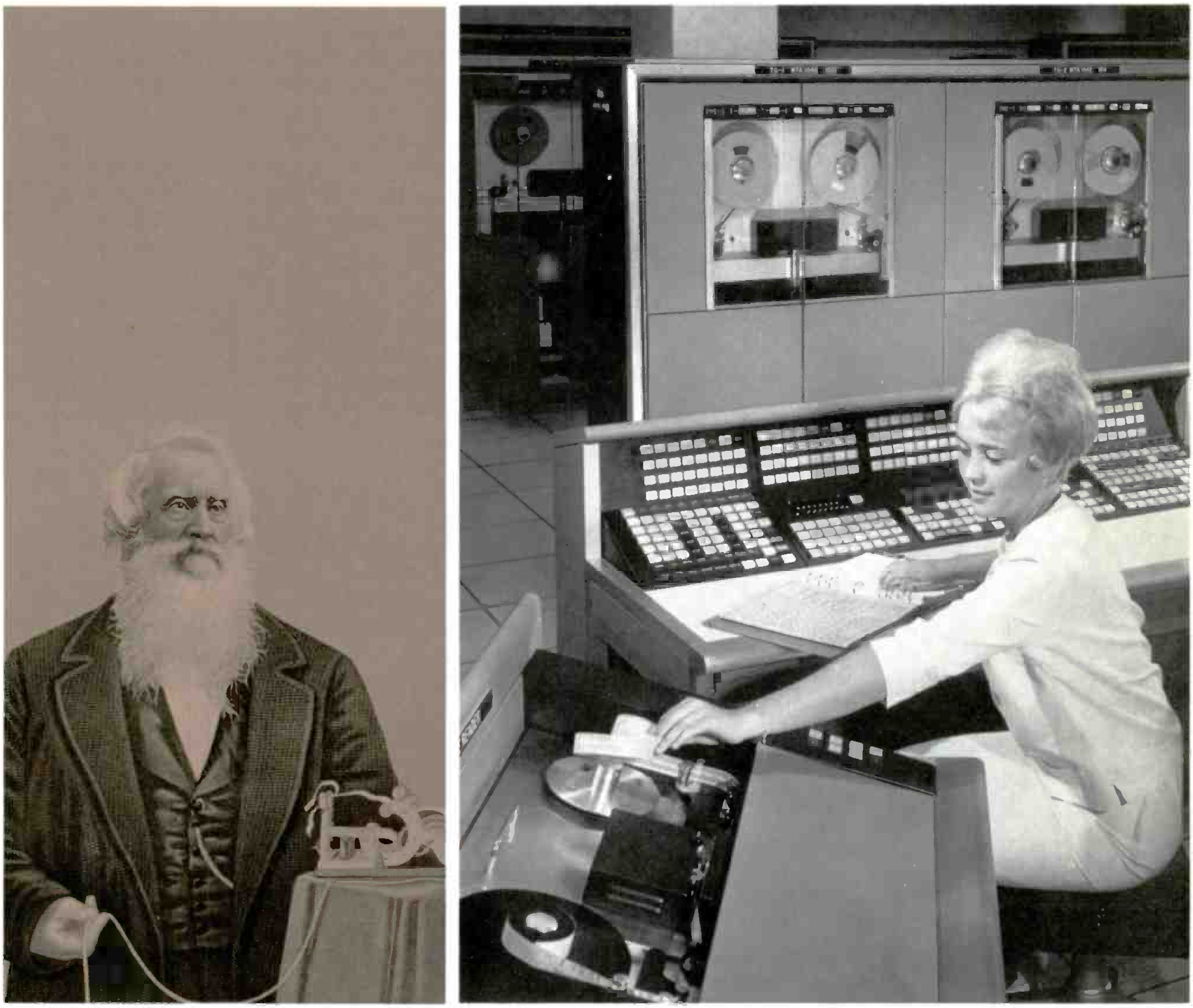
A striking innovation to eliminate or reduce prohibitive costs of building a conventional microwave network is the possible use of satellites for domestic telecommunications between widely separated cities in large countries like Brazil or India. Groups of countries in developing areas of the world, such as Africa, Asia, and Latin America, also may find satellite telecommunications a relatively inexpensive way of establishing a reliable network of communications with one another.

Ground stations will become, in truth, the keys by which nations throughout the world will be enabled to meet the demands of ever-expanding traffic by utilizing commercial satellite communications services that will become available in the next few years. ■

Communications by Computer

by Desmond Smith

In a room the size of a squash court, a new computer-controlled telegraph system for automatic message handling represents a technological breakthrough in telegraphic communications.



The Bettmann Archive

From Morse to ETS . . . a century of telegraphic evolution.

Early in 1964, RCA Communications, Inc., will become the first telegraph company in the competitive communications industry to change over from manual operations to a computer-controlled message switching system. The big change (planning began as long ago as 1957) will be the first significant advance in public message handling technique since the introduction of the five-unit torn tape relay system immediately after World War II. The telegraph industry has long recognized the need for greater accuracy and speed in message handling. The continued growth in international message traffic in recent years (last year RCA Communications alone handled more than 254 million words) has posed a challenge to the telegraph communications industry.

Message handling is a delicate transaction, dealing as it does with other people's business. The customer's message should reach its destination promptly and should be delivered exactly as written. The present torn tape system requires manual handling, including reception, sorting, routing, distribution, message sequence protection, and transmission. This chain of events builds in a human error factor. Moreover, the time lag involved in the cross-office movement of traffic has increased with a rising volume of messages.

The use of radio and cable to send public messages got a start well over a hundred years ago when Samuel Morse invented the telegraph and developed the code bearing his name. (The first public message by telegraph was in 1844.) During the greater part of the 19th century, it was a steadily expanding (if unspectacular) industry, mainly occupied with government and private business messages. But important changes began to take place as the century drew to a close. During the Spanish-American War, the telegraph was used as the principal means of reporting the action. The two World Wars again brought the telegraph into public prominence — especially in its widespread use for sending personal family messages overseas. The tremendous demand on the part of business for means of delivering fast, accurate commercial information overseas all through the postwar years has shown no signs of flagging yet. But the development of jet aviation, the growing practicability of satellite communications, and the surge in electronic data processing have all had a noticeable impact on the international telegraph communications industry.

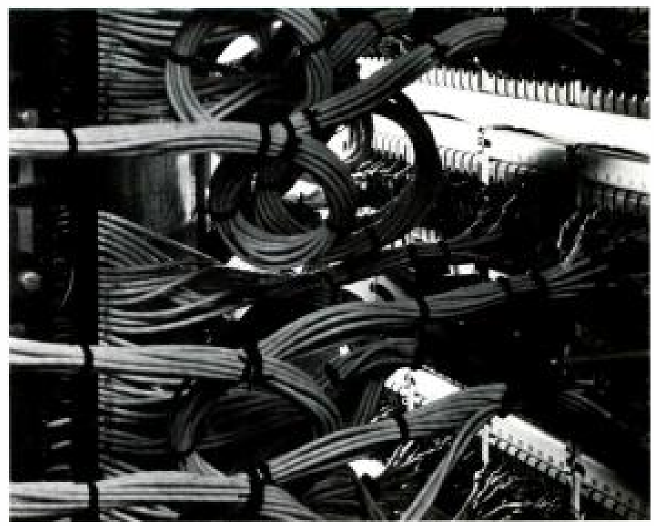
Ten years ago, it was already clear to industry leaders that the existing manual handling system was reaching the limit of efficiency if speed of service and economy of international transmission facilities were to be preserved. In 1956, RCA Communications studied the possibilities of fully automating the international public message service. It seemed for a time as though the problems presented were insurmountable. Yet, a year later — in 1957 — RCA Communications, working closely with RCA Electronic Data Processing, Camden, N.J., began planning an Electronic Telegraph System (ETS). It is true that commercial computers have been adapted for a surprising diversity of tasks; but it proved a far more sophisticated problem to adapt existing RCA computers to on-line communications requirements. RCA Communications faced a clear choice. Either they drop out of computer-controlled message switching and shut their eyes to what, despite the obvious problems, was going to be one of the most exciting fields of telegraphic development, or they had to give the GO signal for the construction of an entirely new method of message handling. They decided to authorize construction of a new system. Nothing smaller than the present RCA Electronic Telegraph System complex seemed likely to be practical; nothing like it had been built in the U.S. before. Considering the obstacles, the design went smoothly. The ETS has been completed and soon will be operating. The men who developed the Electronic Telegraph System have good reason to feel proud.

How all this worked out is best demonstrated at RCA Communications headquarters in the center of New York's financial district. A visitor who expects to be visibly impressed will be disappointed. The racks of electronic equipment, housed in steel-blue cabinets, fill an area slightly smaller than a squash court. Deceptively little appears to be happening. Technicians move with deliberate speed. The atmosphere, like the temperature, is decidedly cool. This is the regimen of the electronic impulse and its kind. In fact, a great deal will soon be happening. Messages to and from countries around the world, coursing through millions of route miles of radio and cable links, will flow continuously through the electronic complex. Manual operations will be completed within thousandths of a second. At the heart of the complex is a Communications Data Processor (CDP) — an advanced mutation of computer — operating in tandem fashion with a twin model. The entire traffic load is carried by the primary CDP; the secondary CDP acts as backup. Maintenance, furthermore, need not interfere with operations. Since even seconds are vital, should something occur to the primary CDP, the secondary CDP stands by to take over automatically.

The CDP performs its operations at the incredible rate of 400,000 words per second. To bring traffic coming from low-speed teleprinters up to the high internal speed of the CDP (see drawing), messages first enter the system through input buffer storage units that perform the necessary speed change. Messages are then examined for destination and priority and switched to the overseas channel for transmission. If all channels to the point of destination are occupied, messages are queued up in the intermediate drum storage to await their proper turn. As rapidly as each outgoing circuit becomes idle, the CDP automatically selects, in chronological order, the highest priority message within the system for transmission. Output buffer units reconvert the high internal speed of the CDP to the relatively low speed of the overseas transmitting equipment, and a monitor copy of each message is recorded on magnetic tape for future reference.

The job of the CDP is decision-making — a limited range to be sure — but, nevertheless, decision-making. The gist of its function is to scan an incoming message, locate and identify the start of the message, check the "pilot line" (i.e., the second line on every message contains a four-letter destination code, two-letter priority and class of service code, origin code, and number of paid words in the message), ignore the rest of the message, act on the pilot line, and look for the end of the message. Normally, there is a tendency when thinking about automated processes such as these to forget the human element. Remarkable though the Electronic Telegraph System is, it has taken RCA engineers nearly three years to design the elaborate "road map" that makes sure every individual message entering the system gets to the right place in the correct order and at the proper time.

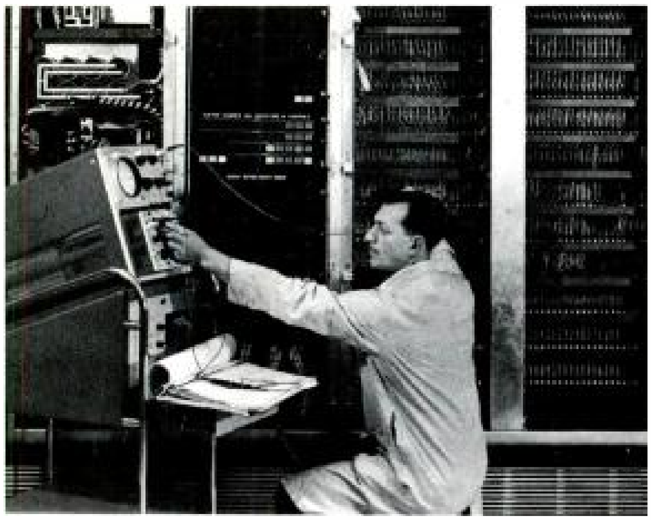
The computer . . .



its maze of signal cables . . .

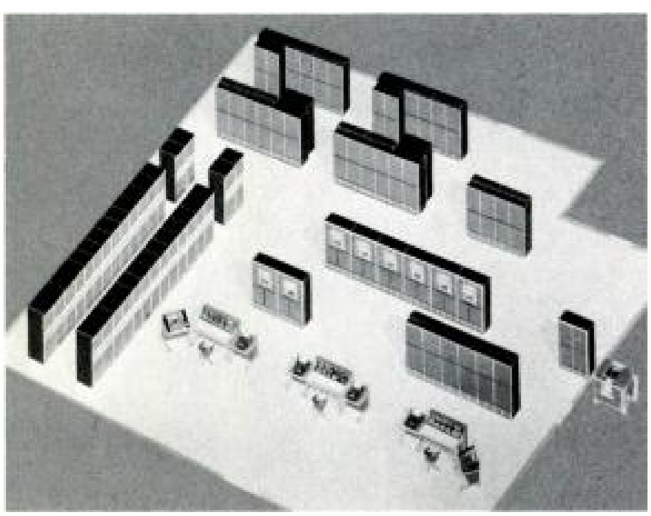
programmers at the Traffic Facility Control position . . .

is decision-making...



testing of the line buffer/scanner . . .

use of a high speed printer . . .



all contribute to the Electronic Telegraph System.

Programming the CDP actually began while the machine (and its twin) were in production at RCA's Camden, N.J., plant. Consider the routing drum (one of four magnetic storage drums), a key stage in the telegraphic process. Within it are stored more than 7,000 names of cities, states, and countries in three languages and 12,000 registered addresses. Should the CDP fail to locate a place name or address, the message is automatically switched to a manual routing circuit where an operator can check the message. Finally, the CDP can handle the prodigious number of 2.5 million characters per second. Since the total incoming and outgoing load of all channels – operating at 3,000 characters per second – uses only a fraction of the available CDP time, the remaining time is used for a variety of purposes. Among them are the processing of information necessary for automatic customer billing and the settling of international traffic accounts. This information is automatically edited and extracted from each message.

RCA Communications' new multi-million-dollar computer-controlled switching system will enable the company to maintain its leading position in the international telegraph industry. The comparison between RCA's Electronic Telegraph System and older manually operated methods is not entirely representative because of the current absence of other automatic message handling systems. RCA's electronic complex will not, for some time, be able to use its full potential (already there is considerable work in hand toward improving new communications facilities). Yet it is obvious that the change-over to an automatic message handling system represents a technological breakthrough of major proportions.

Meanwhile, the future for telegraphic communications never looked better. The Electronic Telegraph System is just one aspect of a total advance that includes developments ranging from trans-oceanic data processing systems to earth-orbiting radio repeaters designed to boost the capacity of the radio spectrum. Samuel Finley Breese Morse once cabled, on a now famous occasion, "What hath God wrought!" As anyone at RCA Communications can tell you, the only thing wrong with that message was the inventor's choice of tense. ■

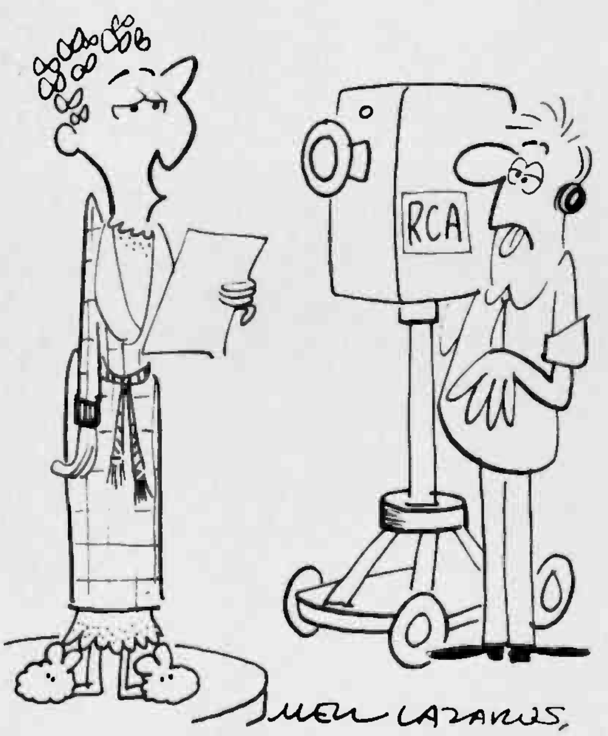
Cartoonists View The New York World's Fair

Lost children will be televised in full "Living Color."

RCA will operate the Official World's Fair Color Television Communications Center at the New York World's Fair, 1964-65. Included will be the world's largest closed-circuit color network, reaching more than 200 receivers spotted throughout the Fair grounds. The Center will be "on the air" twelve hours a day, seven days a week, throughout both years of the Fair.

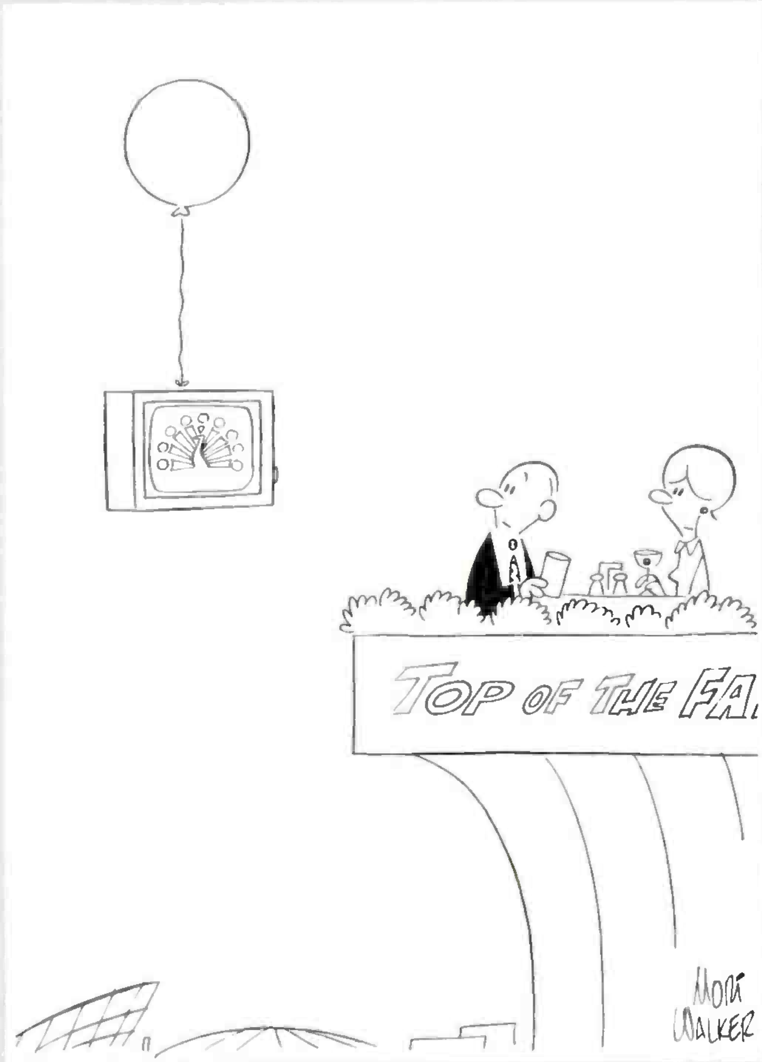
One of the highlights of the programming will be regularly scheduled live appearances of many of the nation's leading cartoonists, sponsored by the Newspaper Comics Council, Inc. Here are scattered scenes of the Fair as seen by cartoonists Mel Casson (Angel), Mell Lazarus (Miss Peach), Mort Walker (Beetle Bailey, Hi and Lois), Dick Cavalli (Morty Meekle), Johnny Hart (B. C.), Allan Jaffee (Tall Tales), and Irving Phillips (Strange World of Mr. Mum).

Videotapes of the cartoonists in action will be preserved for use by future artists.



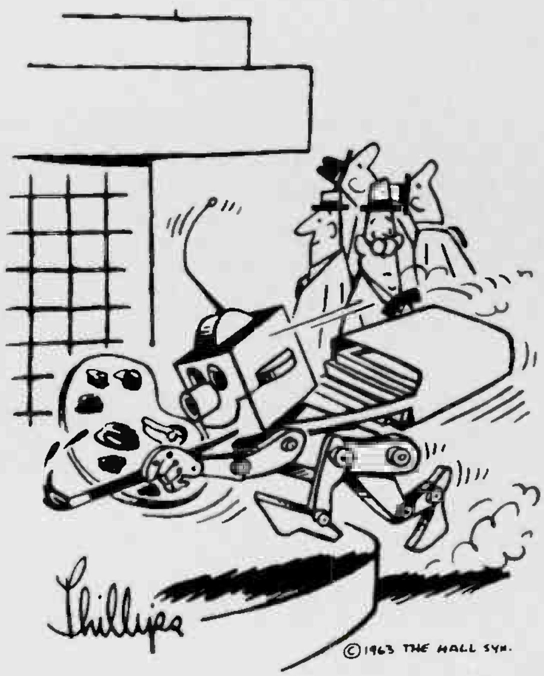
Visiting dignitaries will appear before the color cameras in make-up or not, as they choose.

Every Fair visitor can appear before the color cameras — and then see himself played back: an electronic magic mirror.



More than 200 color receivers will be spotted throughout the Fair — almost anywhere.

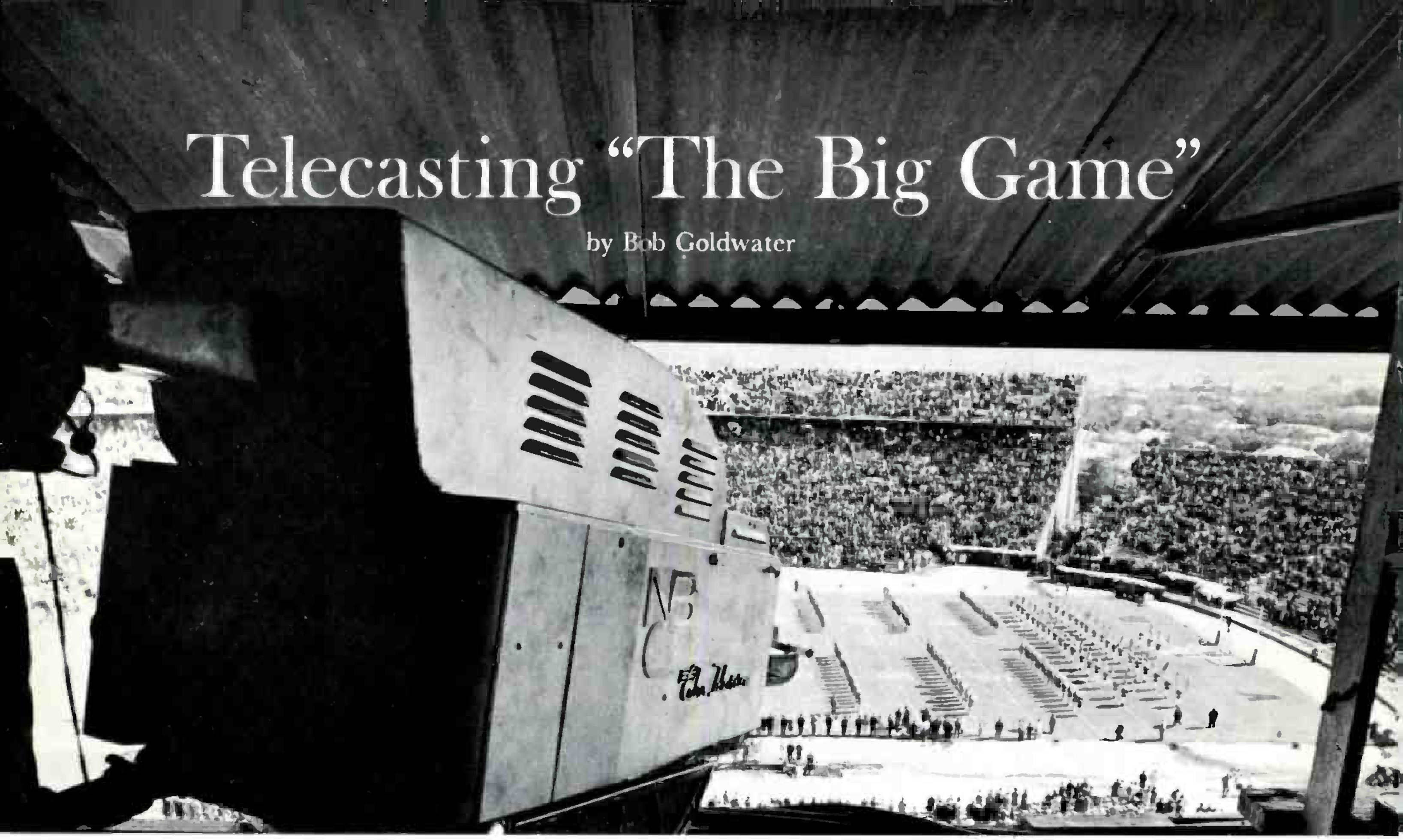
The site of the 1964-65 Fair, and the 1939 Fair before it, originally was part of the Corona Dumps.



A mobile color unit will be ready to cover spot news wherever it occurs on the Fair grounds.

Telecasting "The Big Game"

by Bob Goldwater



On December 29 of last year, an estimated audience of 40 million people watched the telecast of the National Football League championship game between the New York Giants and Chicago Bears. The size of the audience and the price paid for the rights to televise the game ($926,000, the largest price ever paid for a single event) were testimony to the affection Americans have for professional football – an affection that has been engendered by the precision and skill with which the professionals attend to their business on the field.

While the Giants and Bears held the center of the stage that day, a third team – unsung and unknown – was playing a vital part in the presentation of the game to the public. This team was the unit from NBC-TV that handled the telecast of the game, and an error of commission or omission on its part would be as noticeable and costly as a mistake by a player on the field.

Top college and professional football games will be on NBC-TV's sports schedule in the coming years. NBC has the TV rights to the National Collegiate Athletic Association football schedule during the 1964 and 1965 seasons, and to the games of the American Football League for five years, starting in 1965.

As with the Bears and Giants, this team had a Game Plan that called for perfect execution of assignments, split-second timing, attention to detail, and careful selection of plays.

The NBC team for televising the Big Game – be it World Series or Rose Bowl or the National Football League championship game – is headed by producer Perry Smith and director Harry Coyle. Others on the 30- to 35-man team include two commentators, two assistant directors, one technical supervisor, eight cameramen, and some 20 other technicians.

When a game is being presented in color, a color mobile unit and remote crew are sent from New York City or Los Angeles.

Several days before the game, the mobile unit – the TV control room on wheels – is parked outside the stadium, and engineers toil at turning the stadium into an electronic outpost. Their first job is to set up the complex installation of cameras,

Precise planning,
modern television techniques,
and on-the-spot decisions
combine to bring close-up,
comprehensive coverage of sports
into the viewer's living room.

cables, and microphones. Nine different communication circuits – two video lines, two audio lines, two production lines, and three business phones – are brought into the stadium. Five separate and widely scattered cameras are focused on the play and players.

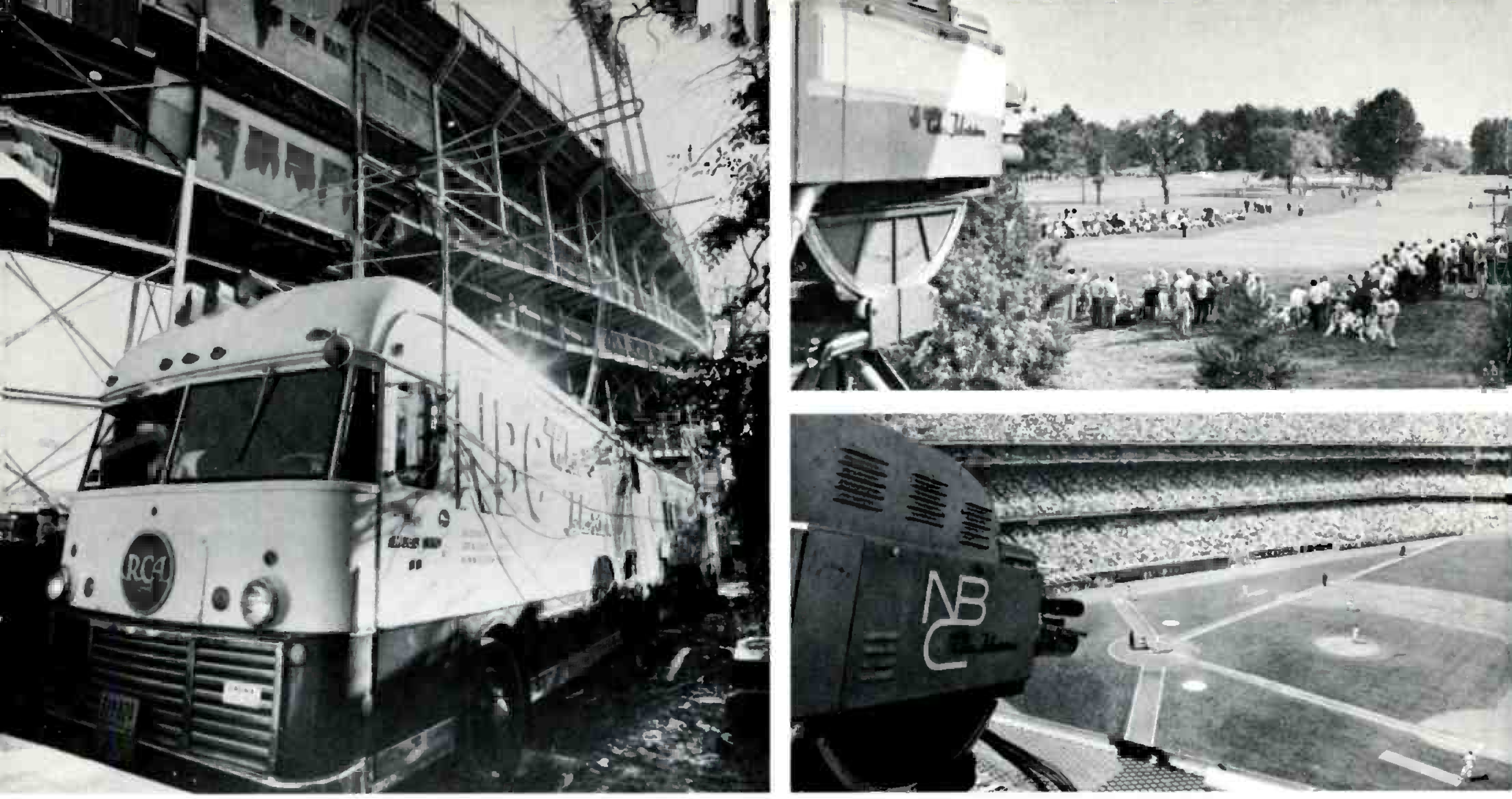
For football, the cameras are set up atop or alongside the press box, facing east away from the sun, between the two 20-yard lines. Spotting the cameras in this way assures total coverage as the play moves up and down the field. Occasionally, one camera is located high in an end-zone area for such special plays as extra-point or field-goal attempts, goal-line stands, and panoramic views of the stadium.

One of the cameras at the mid-field stripe utilizes a 40-inch telephoto lens that obtains extreme close-ups and virtually puts the at-home viewer in the huddle. The others are equipped with Zoomar lenses of such varying intensity that a twist of a dial can bring the action from close-up to panorama.

While the cameras are being installed, other technicians from the network and from A. T. & T. are arranging the telephone-line hookup that will feed the telecast from the stadium to NBC headquarters in either New York, Chicago, or Los Angeles, whichever is closest. From that point, the telecast is transmitted into the coast-to-coast network. An open phone line is installed from the mobile unit control room to the master control point in one of those cities so that film commercials can be integrated without interrupting the telecast of the game itself.

During the day-before-game rehearsal, the entire TV crew works out the Game Plan that pinpoints which camera covers the various plays – kickoffs, punt returns, passes, running plays, conversion attempts, the referee signaling a score. Then the announcers and producer Smith, after learning about each team's style of play by viewing films of the teams in previous games and conferring with the coaches, brief the cameramen on the type of play they may expect in the coming game.

This scouting report pays big dividends by helping the cameramen follow all the action on the field. For instance, in one major game covered by NBC, the TV crew knew in advance that one team would unveil a new deceptive double-wing-T for-



Mobile units provide cameras . . . televising golf (top), baseball (bottom) . . . with on-the-spot production facilities.

. . . and it was the TV fan who saw the play unfold best of all.

mation. It came as a surprise to the opponents, and to the TV and stadium viewers — and it was the TV fan who saw the play unfold best of all.

On the day of the Big Game, the TV crew comes to the stadium about eight hours before the kickoff hour. At that time, five crack color cameramen and five equally adept video engineers begin checking out their sensitive cameras. Then the senior videoman, working with each camera-video unit separately, establishes the proper color balance for the five cameras — a lengthy task. Audio circuits are connected and checked, commercial cut-ins are reviewed via private line with the master control point, and at last everything is ready for the kickoff.

Once the color telecast takes the air, director Coyle assumes the role of a professional quarterback. Sitting in the color mobile unit, he watches TV monitors showing the pictures each of the five cameras is getting at that moment and must decide almost instantaneously which picture to put on the air. As he snaps "One," meaning Camera Number One, the technical director at his side flips the switch that puts that image on the air.

Coyle's cues on the kickoff might run something like this:

"Three, get on the kicker . . . stay with him."

"Two, take the safety men . . . get both of them."

"One, stay wide on both teams . . . that's it . . . good shot."

As one camera shows a player catching a long pass and scampering into the end zone for a touchdown, Coyle commands, "Super," and the player's name is superimposed along the bottom of the TV screen.

As the teams get set for the conversion attempt, Coyle might call:

"One, go wide on both teams."

"Take one."

"Take three."

"Two, you stay on the ref."

"Four, your shot is the scoreboard."

"Take two."

In the announcers' booth in the press box, facing a monitor that shows them what is going on the air, the commentators know they have a responsibility to the audience in the truck as well as in the living rooms. "This is a kicking down," one

This directional microphone allows the viewer to hear the play of the game.

of them will comment as a team faces fourth down with yards to go. In the truck, the director will act on the clue and make sure one camera is on the kicker and another on the safety men.

"We used to have the camera follow the ball in flight on punts, but we found this disoriented the audience," explains Coyle. "Now we show the kicker, the commentator tells what kind of a kick it is – high, short, squib, or shotgun – and the camera follows the kicking team down field to the receiver."

One of the chief differences between television and radio can be seen by comparing the commentator's job on both media. "On TV, the audio must supplement the video, but not overpower it," producer Smith says. "He should try to keep out of the way as much as possible. It's a funny thing, but audience preference in sportscasting breaks down regionally. In the East, they don't want you to talk at all – just shut up and let them see. In the Midwest, they want you to talk your head off. They get nervous if they can't hear you chattering. Other sections fall in-between, but all agree in wanting to know accurately the basic facts: Who carried the ball? How far did he go? Who stopped him?"

The actual telecast of the game requires split-second coordination of widely scattered activities. The announcers' booth, the camera crews, the control room in the color mobile unit, plus the master control point at the NBC studios, are in constant touch by open phone lines. Producer Smith supervises the entire operation, including the integration of commercials into the telecast, from the mobile unit.

When the final whistle blows, the TV crew still has hours of work – dismantling installations, coiling three miles of cable, loading the trucks.

Except for different camera locations, televising such other major sports events as the World Series, the National Open Golf Championship, or National Singles Tennis Championships, is similar to covering a big football game. Nor is there much variation in handling a game in color or in black-and-white, except for the differences in equipment.

During the early days of television, an anti-television snob observed that for a year he believed that, if a person turned on his TV set in the winter, all he would see on his screen would be a picture of a deserted baseball park.

Though none of the sports fans who depend on television for a major share of their entertainment is as out-of-the-picture as that gentleman, few know how much is involved in the telecasting of their favorite games.

The fact that they don't is a high compliment to the skill of the team doing the job. ■

Electronically Speaking

News of current developments briefly told.

MEMORIES IN MINIATURE

A new process has been developed for making miniature integrated computer memories of thin sheets that are stacked, laminated, and cured in the manner of plywood construction. This process, employing tissue-thin layers of the ferrite material used in present standard core memories, is one of the simplest and potentially most economical approaches yet conceived for manufacturing these complex subsystems.

The new memories developed at the RCA Laboratories demonstrate major gains in achieving either high speed or large capacity in memories of extremely small size and potentially lower-cost construction. For example, one experimental laminated memory unit, suitable for auxiliary or "scratch pad" use in a computer, stores 256 bits of information in a package smaller than an aspirin tablet and processes the information at a rate of 10 million bits per second.

Further development may provide a unit capable of storing more than 10 million bits of information at one time in a space equivalent to that occupied by a package of chewing gum.

"NOW HEAR THIS"—ELECTRONICALLY

Nuclear-powered submarines — both attack and Polaris-armed — will soon be equipped with electronic intercommunications systems with unique features.

Built by RCA's Communications Systems Division, the new systems (designed for maintenance-free operation) will not only integrate amplified voice interior communications requirements in one system but will include an emergency reporting system whereby a report of trouble or damage to the boat may be made instantly and directly from any compartment of the boat to the control room. Also, a portable intercom station is included that may be taken "topside" when the submarine is surfaced.

All alarm sounds, such as the diving alarm and general alarm, are electronically generated by the equipment.

INSTANT WEATHER PICTURES FROM SPACE

A new and ingenious tool for weather forescasting is being tested in space. It is a device designed to provide "instant" local area weather pictures from an orbiting satellite, available on simple and relatively inexpensive receiving equipment.

The device is called APT (for Automatic Picture Transmission), and the first experimental model was carried aloft December 21, 1963, in the TIROS VIII weather satellite. TIROS VIII was the eighth straight successful weather satellite to be launched in this series by the National Aeronautics and Space Administration since April 1, 1960.

Both the TIROS weather satellites and the new APT camera system were designed and built for NASA, under the technical direction of the Goddard Space Flight Center, by the Radio Corporation of America at its Astro-Electronics Division in Princeton, N. J. The eight-for-eight success story of TIROS has earned it the designation of the nation's most successful unmanned space project.

TIROS global weather pictures are recorded on magnetic tape as the satellite sweeps over vast land and sea areas of the world. Then, when the satellite is within range of a central TIROS readout station, the stored pictures, on command, are played back to earth.

Operationally, the picture data are processed by the U.S. Weather Bureau and retransmitted to meteorologists in other countries of the world.

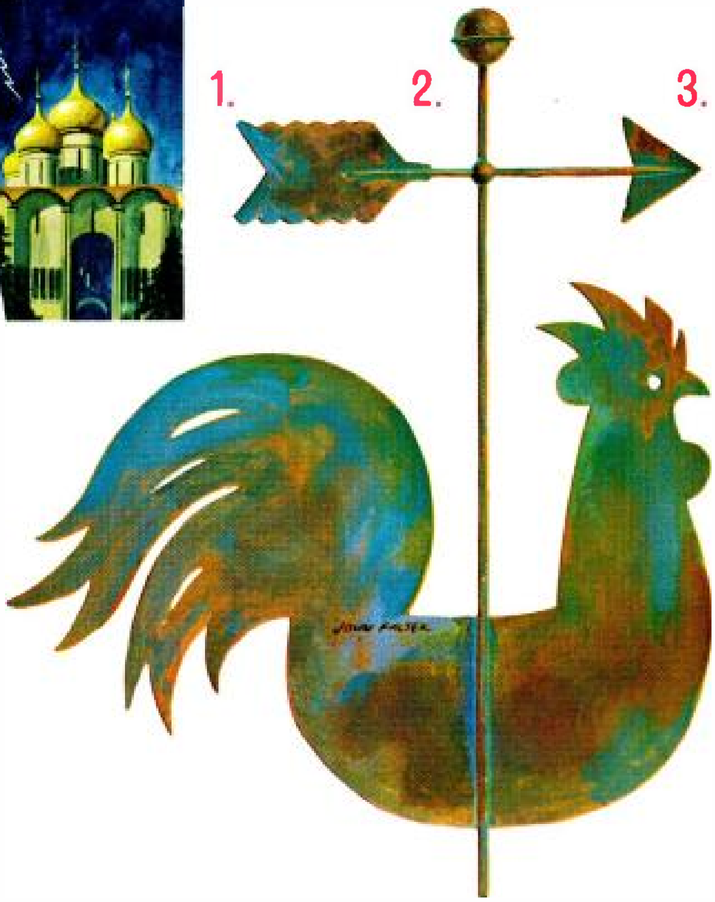
Scientists at NASA's Goddard Space Flight Center and at RCA theorized that weathermen in Africa, Asia, Latin America, and Europe would be directly served if they could have pictures of local weather the satellite was "seeing" as it passed over their own particular areas. APT will make this possible, delivering pictures of local weather conditions in a surrounding area measuring 1,000 miles on each side.

In the near future, when research and development give way to regular operating systems, any country on earth equipped with a simple ground station may be able to receive APT reports as the satellite passes overhead. APT then will have become part of the second-generation Nimbus weather satellites, for which it was designed.

As pages in these volumes hold facts, so data are held on magnetic cards in this new RCA computer memory system, shown here with one of its magazines displayed by Arnold K. Weber, Vice President and General Manager, RCA Electronic Data Processing. Each magazine holds 256 cards, with eight magazines to each complete memory unit (background). All the characters printed in the volumes—1,260,000,000 —could be contained in four of these immensely high-capacity units, and any of the characters could be extracted in a fraction of a second.

IF YOU COUNT ON THE "HOT LINE"... WORRY ABOUT WEATHER... OR WATCH COLOR TV

1. 2. 3.



...RCA IS PART OF YOUR LIFE

1. If you count on the "Hot Line": The radio "Hot Line" between Washington, D. C. and Moscow was entrusted to RCA Communications, Inc. It cuts chances of an unthinkable accident by giving the heads of state full-time radio contact.

2. Worry about weather: NASA's TIROS weather satellites were built by RCA. Working with RCA, the U. S. Weather Bureau reports on satellite findings, helps make weather predictions more accurate.

3. Watch color TV: Today's all-electronic TV is based on the picture and camera tubes developed by RCA scientists. Today's color TV is also the product of continuing RCA research and development.

SEE WALT DISNEY'S "WONDERFUL WORLD OF COLOR," SUNDAYS, NBC-TV NETWORK.

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