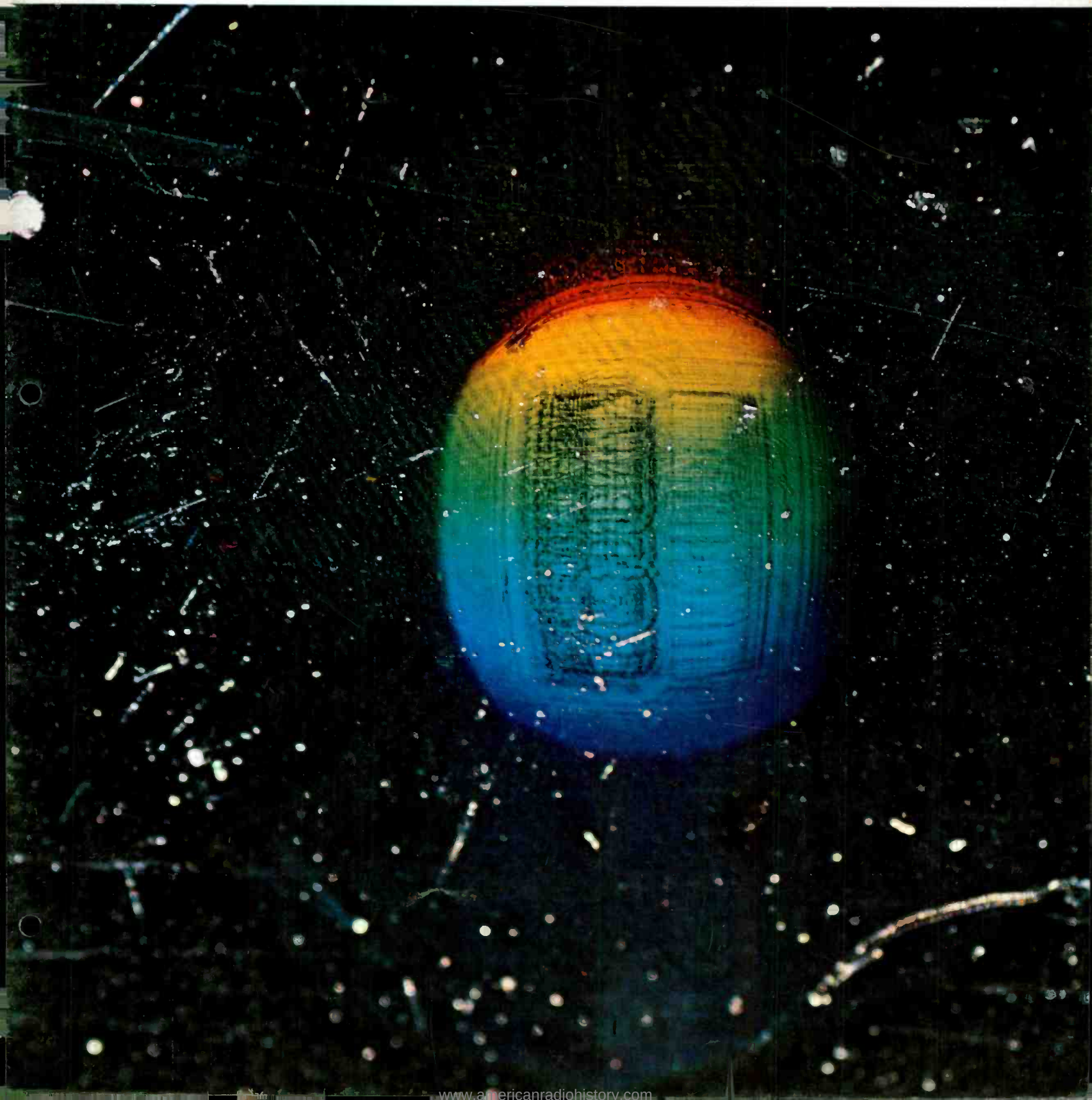
ELECTRONIC AGE

RCA

Autumn 1966

Holography: Recording Light in Three Dimensions.



On September 30, 1966, David Sarnoff, Chairman of the Board of the Radio Corporation of America, marked his 60th anniversary in communications and electronics. In recognition of this event, 1,500 industry leaders, representatives, and guests gathered in New York to pay tribute to a man "whose vision and leadership helped to shape a new age of progress." The three sponsoring organizations—the Electronic Industries Association, the Institute of Electrical and Electronics Engineers, and the National Association of Broadcasters—cited General Sarnoff for his leadership in the creation of new electronics products and services, in the development of radio and television broadcasting, in the application of electronics concepts to the defense of liberty, and in the advancement of electronics as a major economic and social force. From his associates at RCA, General Sarnoff received the above portrait in oils.

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

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Cover: The exciting new technology of three-dimensional photography or holography is represented in this photo. The multicolored blob is a reflection hologram or stored image formed on a photosensitive surface that has been exposed to an object illuminated by a laser. A three-dimensional image of the object, in this case a film slide, is formed when the hologram is exposed again to a laser beam. An article on holography begins on page 6.

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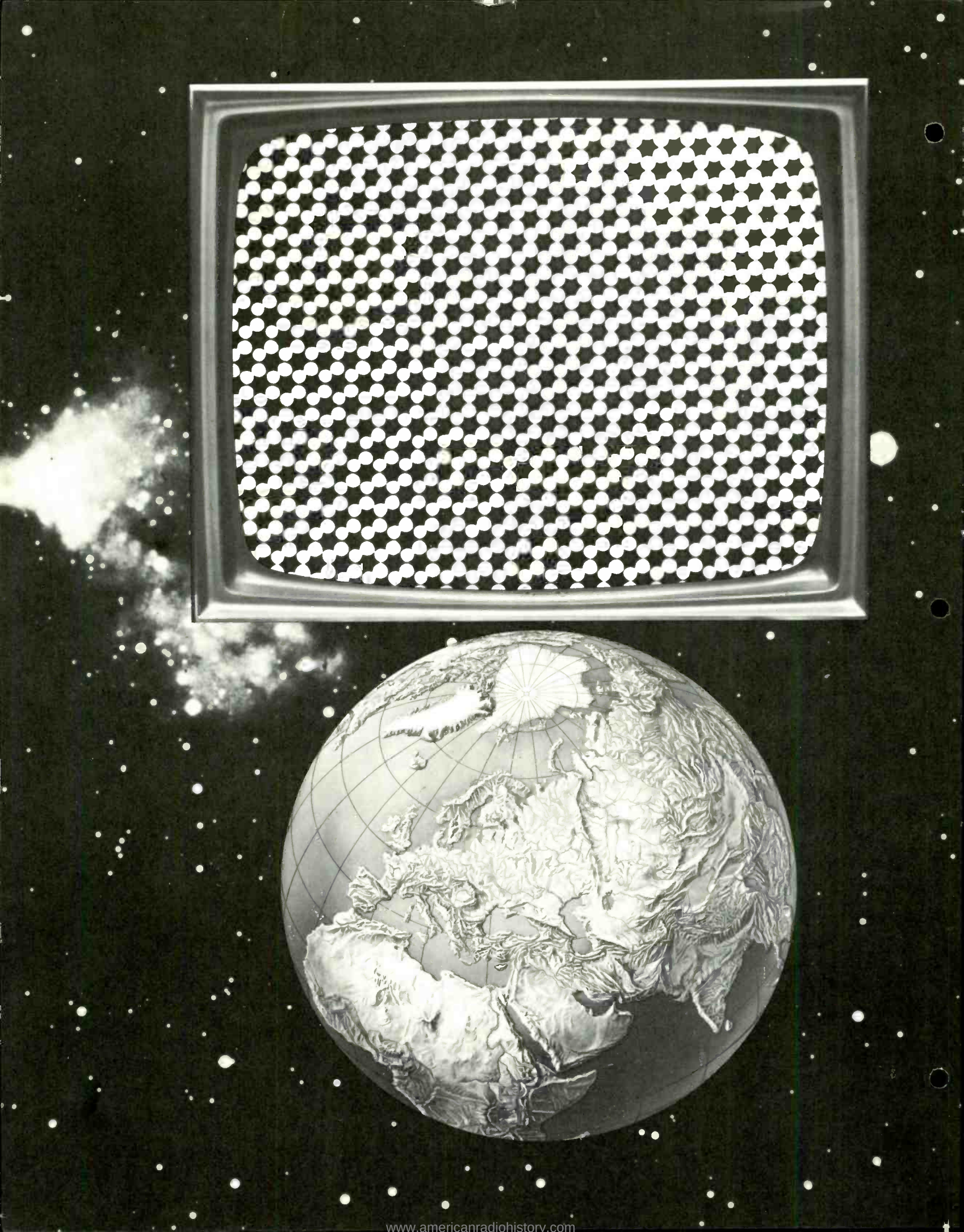


Color TV Around the World

Encouraged by the success of color television in the United States, other nations are planning an early entry into regular color programming.

by David Lachenbruch

That "Wonderful World of Color" has been pretty much of an American world — up to now. But with the success of color in the United States, theoretical discussions in other countries are now beginning to give way to actual plans. The beginning of the decade of the 1960s saw only one country with regular color programming. By the mid-1960s, there were two. At the end of the decade, there may be as many as 20.

For years, color has been on the agenda of international telecommunications conferences, but most nations were far more concerned with building up their black-and-white television services — and the record of color in the United States helped keep the discussions of this new service on a theoretical plane. Even in the most affluent country of the world, the growth of color television from 1954 to 1962 was hardly impressive, and foreign broadcasters — most of them supported solely by public taxation — were determined not to follow the same course.

Since 1962, this gray picture has given way to a rainbow. By the end of this year, approximately 10 million color sets will be in use in this country, after five years of accelerating demand climaxed by sales of about 5 million sets in 1966. All nighttime network programming is now in color, and all of NBC-TV's programs — day and night — are tinted. The majority of stations are equipped to originate local non-network color.

In the United States, color television no longer belongs to the engineer, but to the public. As in the early days of black-and-white, this success has triggered a worldwide race, involving not only mass communications and entertainment but national prestige and international politics.

The world's second color-TV nation joined the United States in colorcasting in 1960, before there was any evidence of a boom. After years of testing, Japan adopted the American NTSC color standards. Facing the same problems as the United States — shortage of programming and high cost of sets — but aggravated by a lower income level and lack of black-and-white saturation, Japan's color era started sluggishly.

DAVID LACHENBRUCH is editorial director of *Television Digest*.

The recent color prosperity in America has had a marked effect on Japan, which now finds its color experience a decided asset in international trade. Unable to meet the domestic demand for color sets, parts, and tubes, American manufacturers and merchandisers turned to Japan to supplement their supply. In the first seven months of this year, Japan has exported 86,000 color sets to the United States. Although this does not equal even one week's production by U.S. manufacturers, it represents the beginning of an international market in color TV receivers.

With the end of Japan's recent economic recession, her domestic color television sales appear to be following the American pattern. It is estimated that 200,000 color sets are now in use, approximately 1 per cent of Japan's total of 20 million television receivers. This year, Japan is expected to produce about 450,000 color sets, nearly five times more than last year's output of 97,100. The total could approach 1 million in 1967.

As domestic sales increase, Japan's percentage of exports will decline. While there is still no color "boom" in Japan, sales are showing a definite rise, geared to the increasing availability of color programming. Colorcasting recently expanded out of the Tokyo–Osaka area and is now nationwide on the government-chartered noncommercial NHK network. Of the seven privately operated commercial networks, five now carry color programming covering an estimated 20 per cent of the broadcast day.

In Japan, unlike the United States, the entire color-set market is dominated by one standard screen size, the 19-inch rectangular tube now accounting for approximately 95 per cent of sales. Partly because of a 13 per cent "luxury" tax, Japanese color sets carry heftier price tags than their U.S. counterparts. Until last summer, the lowest priced 19-inch receivers retailed at $550. The introduction of less-de luxe sets — with single speakers and smaller cabinets — has brought starting prices down to almost $500.

Six years after the start of color in Japan, tinted TV made its debut in Canada. Like the United States and Japan, Canada uses the American NTSC color standards.

Although Canadian stations started color programming on September 1, 1966, color TV is nothing new to Cana-

dians who live near the U.S. border. They have been receiving color programs from stations in nearby American cities — such as Buffalo and Detroit — for many years, both by direct transmission and through cable-fed community antenna (CATV) systems. Before the first Canadian color program was transmitted, in fact, there were an estimated 50,000 color sets in Canada, and several Canadian manufacturers were producing color receivers for both the domestic and U.S. markets.

As color started on the road to success in the United States, it became a cause célèbre among Canadian broadcasters and set manufacturers, who campaigned individually and through their trade associations for authorization to bring color to Canada. When the government's Board of Broadcast Governors (BBG) finally gave its approval, there were some who said that the Montreal 1967 World's Fair, Expo 67, proved to be the deciding factor. American TV networks already had announced plans to cover the fair in color, and the thought that Canadians would have to tune to U.S. stations to see their own fair in color was embarrassing.

The "official" starting date for color in Canada remains January 1, 1967, but regular color programming already is on the air. Canadian broadcasters received permission from the BBG to start "experimental" programming on October 1. Off-hour tests last summer were so successful that the date was moved up to September 1 to coincide with the opening of the fall program season.

Canadians have been promised a substantial diet of color fare. Before the year is over, the government-chartered Canadian Broadcasting Corporation plans to be broadcasting 30 to 35 hours of color weekly on its English-language network and about 15 hours on French-language channels. Affiliates of the private CTV network are promising as many as 40 hours weekly.

The CBC has earmarked $15 million for color facilities in 1966. Much of this is now in place, but availability remains a major headache. U.S. manufacturers of broadcasting equipment are heavily backlogged with orders for cameras and other studio equipment, and their Canadian counterparts are equally swamped. One survey of Canadian station equipment sales channels indicates that more than $27 million in color equipment orders are expected within the next three years. In view of recent experience south of the border, this projection could be conservative.

Canada's 10 set manufacturers, all but one of which are affiliated with U.S. companies, estimate that color receiver sales may total as many as 1,330,000 units in the next five years. A recent survey by the Electronic Industries Association of Canada indicates that sales of 30,000 to 65,000 sets are anticipated this year and that this figure will rise steadily to somewhere between 180,000 and 455,000 in 1970.

All Canadian set manufacturers are now producing color sets, principally in 25-inch and 19-inch screen sizes. Largely because of sales and excise taxes totaling 26 per cent, they are priced as much as $200 higher than the equivalent U.S. domestic-market models which they resemble. Receivers imported from the United States and Japan carry comparable prices.

Workers assemble color television chassis at the Tokyo Shibaura Electric Company, the largest manufacturer of color sets in Japan.

The start of color already has brought a new industry to Canada — color picture tubes. RCA's Canadian subsidiary, RCA Victor Company, Ltd., which has been assembling color tubes at its plant in Prescott, Ontario, now is constructing a new $25-million color-tube manufacturing plant in Midland, Ontario, scheduled to begin production early next year. Canadian General Electric is building a color tube facility at Rexdale, Ontario, due to begin operation late this year. General Telephone & Electronics will produce Sylvania color tubes in a new plant in Cornwall, Ontario. Corning Glass Works, Ltd., is building Canada's first completely integrated television picture-tube bulb plant, which will produce glass for color and monochrome tubes, at Bracebridge, Ontario.

The end of 1966 sees Europe on the verge of its own color boom. Unlike the three current "color TV powers" — U.S., Japan, and Canada — European countries will not use the American-developed NTSC color standards. Much has been made of the fact that European nations have chosen the German PAL or the French SECAM system in preference to NTSC for reasons involving national pride and power politics as much as engineering logic. What is not generally understood is that the similarities of these two systems to our method of color broadcasting are far greater than the differences.

In fact, had it not been for the fundamental principles of NTSC, there could be neither PAL nor SECAM. Both European systems use the same color picture tubes and many of the same components and circuits as the American system. Studio equipment for all three systems is identical. The differences are in the method of modulation of the color signal.

American know-how and experience in the production of color equipment — particularly picture tubes — are becoming very important to European nations planning an early entry into color. There is little doubt that the standard American-type shadow-mask color tube also will become the standard in Europe, as it is in Canada and Japan. No other type of color tube, in fact, is in large-scale production anywhere in the world.

Who will be first with color in Europe? A race is shaping up with the United Kingdom and West Germany (using the PAL system) challenging France and the Soviet Union (using SECAM) for the honor of blazing the new color trail in Europe. All four countries have indicated they plan to start colorcasting in 1967. Most TV observers feel that the United Kingdom and Germany will win the race.

Whichever way it goes, Europe is getting ready. In Eindhoven, Netherlands, the big electrical-electronics combine of N.V. Philips Gloeilampenfabrieken already is in pilot production of 25-inch tubes similar to those now built in the United States. Until Europe provides a color-tube market, Philips plans to sell its tubes in the United States and Canada.

RCA's wholly-owned subsidiary, RCA Great Britain Limited, has teamed up with a major British TV set manufacturer and distributor, Radio Rentals Limited, to establish a new producer, RCA Colour Tubes Limited. The firm, two-thirds owned by RCA, will manufacture color tubes in 25- and 19-inch sizes in a new plant in Skelmersdale, Lancashire. Production will start next year for the British market, although some may be shipped to other countries.

At a news conference announcing the new enterprise, RCA President Robert W. Sarnoff forecast color sales in Great Britain and Western Europe at approximately 300,000 sets in 1968, rising to nearly 1 million in 1969 and nearly 2 million in 1972, with annual sales of almost 3.5 million by 1975. At least two other British firms — Thorn–Associated Electrical Industries and Mullard Limited — are also entering color tube production.

British color TV is expected to lift off gradually in the fall of 1967. Programs initially will be confined to the British Broadcasting Corporation's "Second Channel," a UHF broadcasting service. BBC has stated that only about four hours of programming a week will be in color at first, rising gradually to between 12 and 15 hours.

Neither BBC's more popular "First Channel" nor the commercial ITV network will have color soon, because of a technical problem. These two services in the VHF band operate on 405 TV lines, while the Second Channel operates on the standard European 625 lines. Color TV will be a 625-line service, and the two more popular networks will remain all black-and-white until such time as they switch to 625 lines — not in the very near future.

Although British equipment manufacturers such as Marconi, Pye, and EMI have been manufacturing color cameras and other studio gear for several years, availability of this equipment will be scarce — largely because of the backlog of orders by American broadcasters.

Color sets are expected to retail at about $700 in the United Kingdom when they go on sale. J. W. C. Robinson, Board Chairman of Radio Rentals Limited, estimates that about 70 per cent of British viewers now rent their black-and-white sets, and he forecasts that perhaps 80 to 90 per cent will rent their color sets at an estimated 70 cents a day (about $21 per month).

France faces technical problems similar to Britain's and initially will confine color broadcasting to its UHF "Second Network," one of two government-operated chains. The original "First Network" uses an 819-line standard and will not have color until it has switched to the 625-line standard. Elsewhere in Europe, all major broadcasting systems have 625 lines and can easily accommodate the changeover to color.

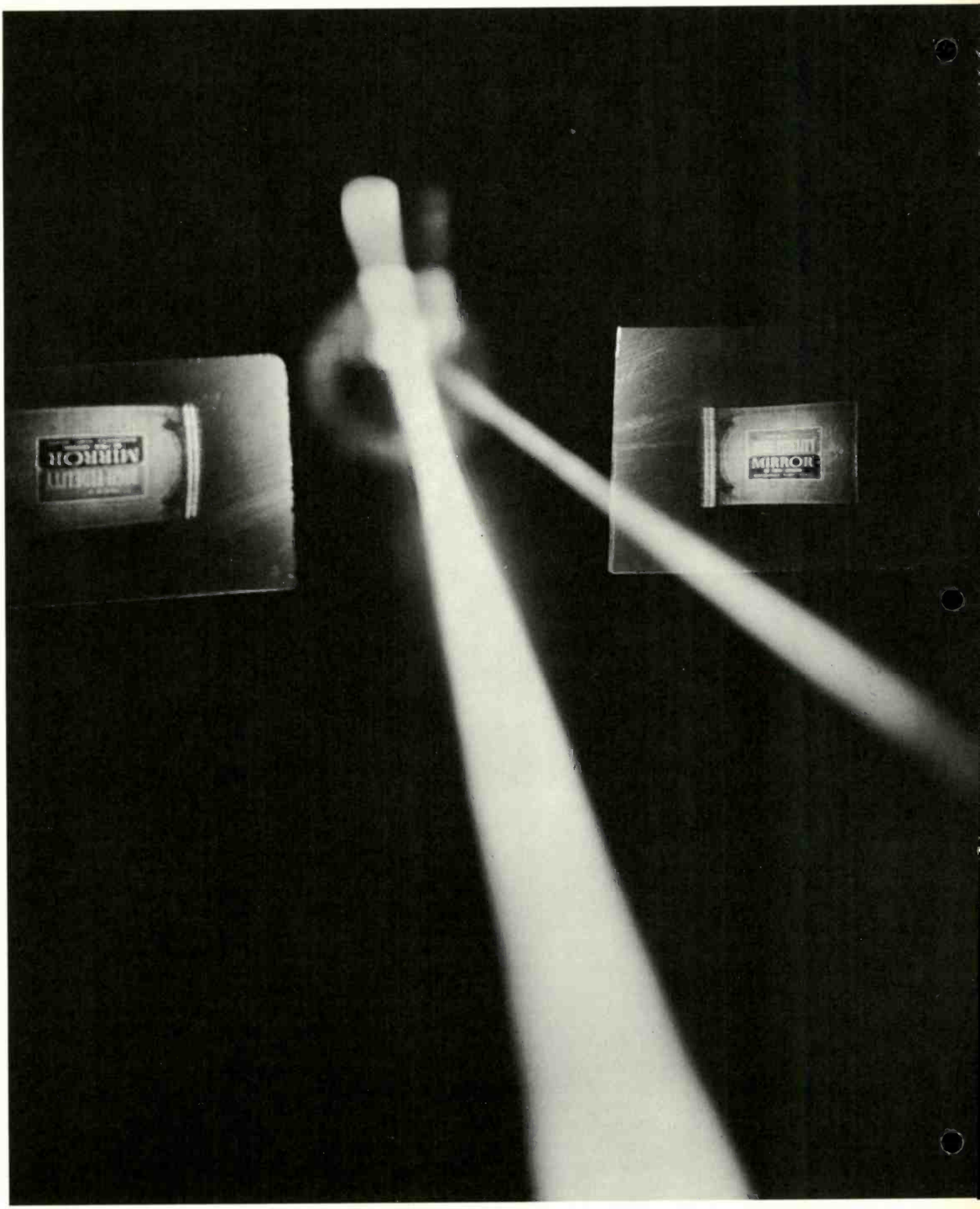
Thanks to American pioneering, other countries may have an easier time getting started in color. Spread over more than 12 years of operating experience have been improvements in every link of the color chain, from studio equipment to picture tubes to camera techniques. There need not even be an initial shortage of color program material, as there was in the United States. America, the world's largest supplier of television programs, has accumulated a huge backlog of color film and tape programs for foreign syndication, and this supply is growing daily.

More than 100 countries throughout the world now enjoy television. The exciting success of color in the United States has served to challenge and encourage the rest of the world to make firm plans to add this final dimension of realism. ■

WORLD COLOR TIMETABLE

(Based on starting dates of color programming and forecasts made by national representatives in an unofficial survey at last summer's meeting of the International Radio Consultative Committee in Oslo.)

Date	*Country*	*System*
December 1953	United States	NTSC
September 1960	Japan	NTSC
September 1966	Canada	NTSC
Fall 1967	France	SECAM
	Monaco	SECAM
	Soviet Union	SECAM
	United Kingdom	PAL
	West Germany	PAL
Possibly 1967	Lebanon	SECAM
	Netherlands	PAL
	Spain	Undecided
1968–69	Brazil	Undecided
	China (Taiwan)	NTSC
	Mexico	Undecided
	Poland	SECAM
	Sweden	PAL
	Yugoslavia	SECAM
About 1970	Belgium	Undecided
	Czechoslovakia	SECAM
	Hungary	SECAM
	Norway	PAL
	Switzerland	PAL



A reflection hologram is read by a blue laser beam. Shown are the real and reverse images of a film slide.

Holography: Recording Light in Three Dimensions

A new use of the laser is enabling scientists to photograph a scene in all its colors and dimensions.

by Bruce Shore

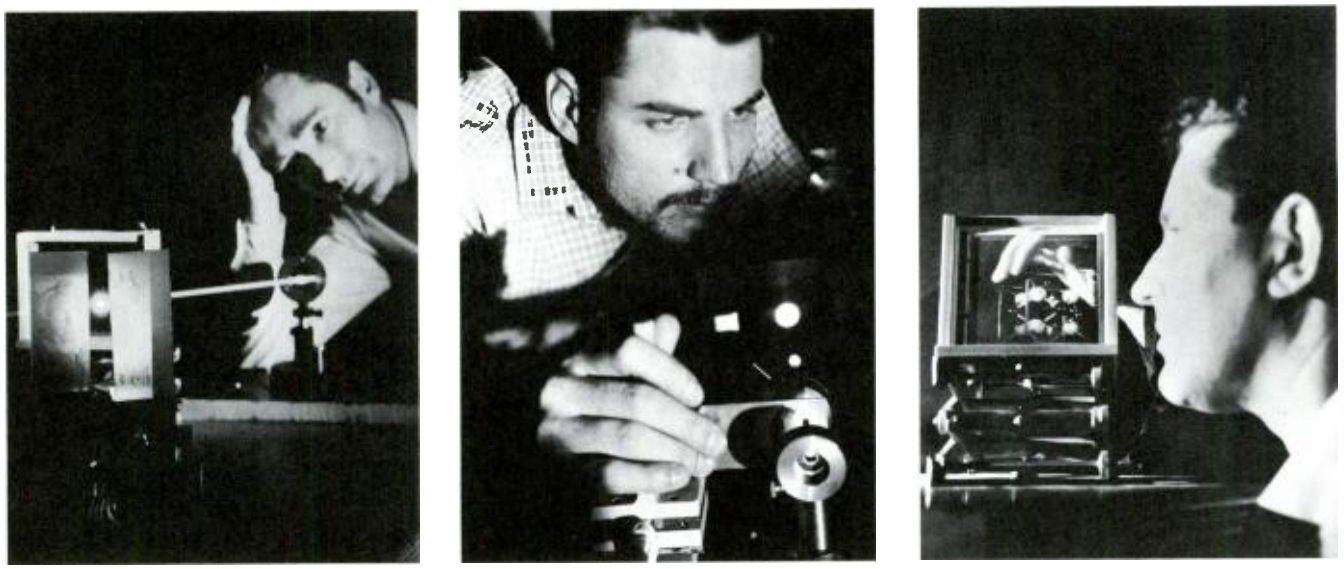
In a feat of cryptography as stunning in its way as the breaking of the Japanese diplomatic code on the eve of World War II, scientists have succeeded in cracking the phase "code" of light. Using the laser as an electromagnetic Rosetta stone, they have developed a new kind of photography that makes it possible to record an object or scene in all its colors and in all three dimensions. Not only that, but the resulting image, when viewed from various angles, undergoes all the optical variations associated with a scene as viewed through a window.

For instance, the background blurs when the eye is focused on the foreground and vice versa; objects behind structures in the foreground pop into sight when the angle of view is changed; the entire scene continues to be visible even when part or most of it is covered, just as it does in a window when the shade is pulled halfway down.

BRUCE SHORE is the staff writer at RCA Laboratories.

Dubbed *holography*, from the Greek meaning "to record everything," this new technology has already led the nation's major research laboratories to assemble small bands of mathematicians, physicists, and specialists in optics to conduct spoiling raids across its frontiers in search of new understanding and new applications of light.

From these forays eventually may come three-dimensional color movies and, possibly, TV, neither of which will require special glasses to be viewed; three-dimensional photographs and paintings that occupy no more space than the two-dimensional versions we now hang; computer memories that store information in the form of light patterns registered not only on the surfaces of certain materials but in their bulk as well; devices that can store ultrasonic sound patterns in such a way that they can be read out with light after they have been used "to photograph" the interior organs of the body; other devices that can record X-rays and be read out with visible light in a magnification process which may make it possible to see atomic structure in three dimensions for the first time; new optical instruments for measur-



RCA Laboratories personnel engage in various types of holographic research. Left: A red laser beam is used to project real images of a Schubert figurine and music sheet. Center: A researcher adjusts a lens to produce a hologram at its focus. Right: A technician appears to hold a model of a crystal behind a window. The window, however, is a transmission hologram, and the model is only a three-dimensional image.

ing air pollution in volume, for performing remarkably accurate analyses of objects under stress, and for doing contour mapping. The list of possible applications of holography grows longer and more fantastic every day.

The product of holography — called a *hologram* — is usually a large glass slide that is either completely transparent or slightly hazy. If hazy, further investigation under a high-powered microscope reveals that one side of the hologram has a peculiar graininess consisting of dark and light ripples scattered through it in ostensibly random fashion.

These curious patterns are actually frozen into a photographic emulsion that has been exposed directly to an object illuminated by a laser without the intervention of a lens. Since even the eye sees nothing but a blur without its natural lens, it is not surprising that the emulsion contains no recognizable image. What it does contain is a record in the form of microscopic particles of precipitated silver (produced via the same chemistry used to make conventional negatives) of where the varying intensities of light reflected from the object fell on it.

Holography depends upon the phenomenon known as optical interference, which was first explained in 1801 by the British physicist Thomas Young. Optical interference is the cause, for example, of the rich color patterns frequently seen on oil slicks and soap bubbles.

At the root of the phenomenon is the fact that light passes through space as a series of electromagnetic waves. Normal light comprises waves of many different frequencies and phases — like waves on the surface of water in a changing wind — and they tend to interfere with one another in random and uncontrolled fashion.

The light of a laser beam, however, is made up of waves of one frequency that are synchronized so that they move in uniform phase. This characteristic gives laser light a precision and coherence that is absent from ordinary light, and it makes possible a control over optical interference that is the basis of holography.

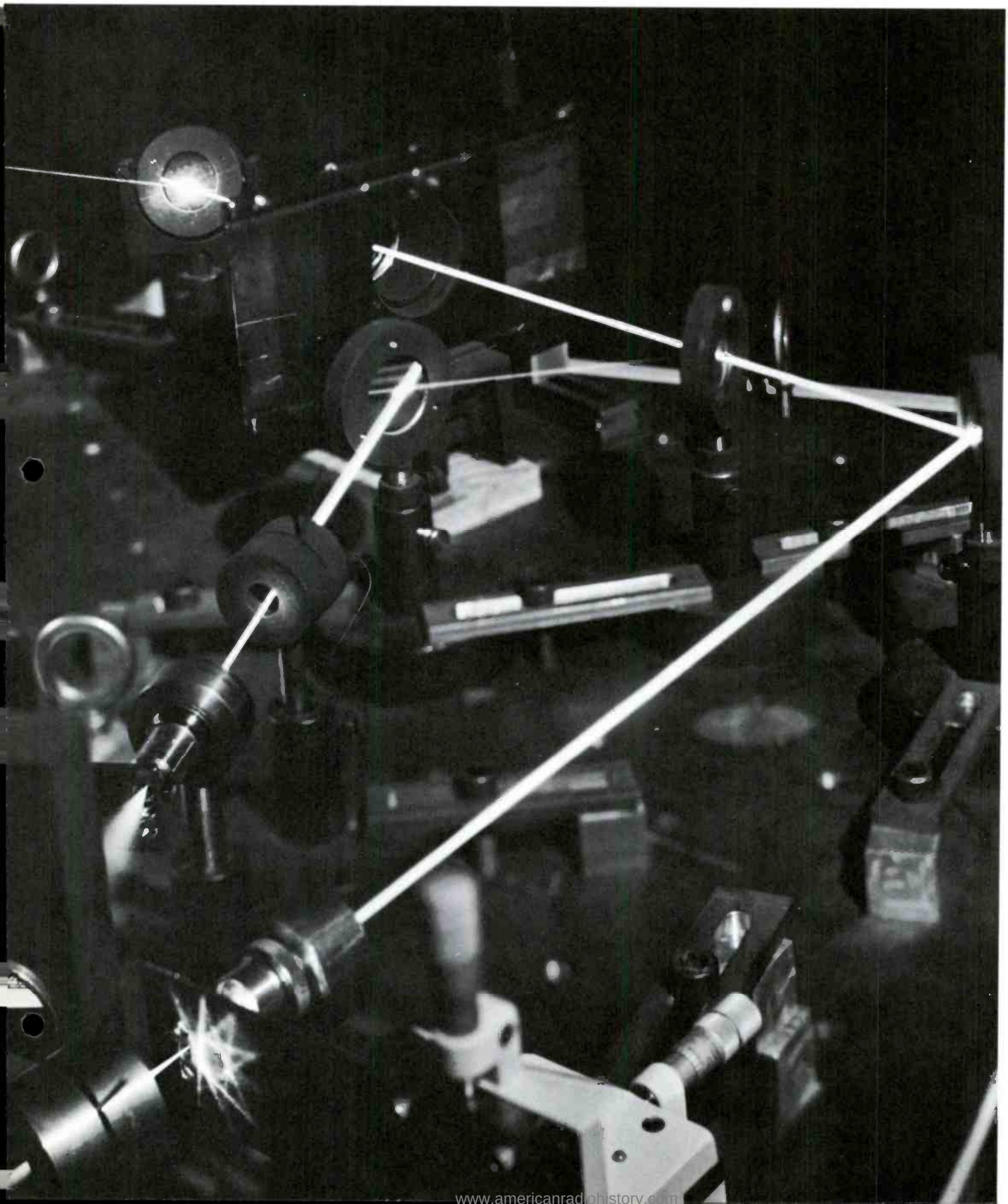
In holography, the laser beam is split in two. One beam is directed at the object to be holographed, while the second, or reference beam, is sent directly to the photographic plate. The first beam, reflected from the object toward the plate, undergoes changes in phase and intensity that do not affect the reference beam on its direct path.

When the two beams meet again in the photographic emulsion, they interfere in such a way as to record not only the average intensity of the light reflected from the object, but also the direction of each wave in the light as revealed by the pattern of interference. The result is a hologram, a three-dimensional image registered in the emulsion in the form of changes in the spacing and density of the silver particles.

When the stored image is exposed again to the coherent light of a laser beam of the same frequency, the effect for the viewer is a reconstruction of the original object, apparently floating in space some distance behind the photographic plate and possessing all of its original dimensions.

Though holograms of complete images are new, holograms of single points of light go back to 1818 when the great French physicist Augustin Fresnel demonstrated

An optical device for producing holographic images. An argon laser beam enters from the top left and is split by a half-silvered mirror. The two beams then follow separate paths—the left one to the object to be holographed (a film slide) and the other (the reference beam) to a point where the beams converge and the hologram is formed on a photographic plate (lower left).



what has since come to be known as the *Fresnel zone plate.* This is a glass plate on which narrowly spaced concentric circles have been scribed in accord with a highly precise formula. As a result, when an ordinary light beam of a single color passes through it, the beam undergoes interference so that a point of light can be seen to hover behind it in space if an observer looks through it toward the light beam. Thus, a modern hologram is really many Fresnel zone plates superimposed so that each produces its own point of light at its own unique focus, and all add together to form an image.

Even the idea of producing images — and vivid colors — by using the phenomenon of light interference is not new. It was first conceived by William Zenker, of Berlin, in 1868, and first demonstrated by the French photographer Gabriel Lippmann in 1891. What Lippmann did was to use a thin, transparent emulsion on a glass slide backed by a shiny surface of mercury. When light waves from an object to be photographed penetrated the emulsion and were reflected back by the mercury, they met and interfered with others just entering the emulsion. (This is exactly how an oil slick on water produces the interference colors we associate with it.) The result was a series of interference patterns trapped in the emulsion. These could be made to reproduce full, two-dimensional color images by the simple expedient of shining a strong white light on them at the proper angle. In fact, Lippmann photographs were the first true color photographs ever made from life.

Once again, in 1934, the principle of light interference set the world abuzz with the development of the phase contrast microscope by Frits Zernike in Holland. For years, the study of biological specimens — human tissue, microbes, and other organic material — had been impeded by the fact that they were almost completely transparent to the eye of the microscope. Zernike found, however, that if the light being used were split so that a portion went through the specimen and another portion went through a transparent piece of mica, the two got out of phase and interfered when they were brought back together. The result was a high-contrast microscope for use in biological research for the first time. In 1953, Zernike won the Nobel Prize for this work.

The next major development in the use of interference phenomena was Dennis Gabor's concept of three-dimensional, holographic imaging propounded while he was working at the Imperial College of Science and Technology in London in 1947. He hoped to use the wave nature of electrons to create electron interference patterns from which he could reconstruct magnified images by optical rather than electronic means. Unfortunately, he could not get the necessary coherence in the electron beam.

There things remained until 1960 and the development of the first laser, a pulsed device made of a ruby crystal impregnated with chromium atoms. This was complemented later by the gas laser — a tube-shaped device that emits coherent light continuously.

Seizing on this development and improving on the concepts of Gabor by introducing the idea of a reference beam to create interference, Emmett Leith and Juris Upatnieks, working with a gas laser at the University of Michigan in 1962, produced the first hologram to give three-dimensional images. The scientific world has not been quite the same since.

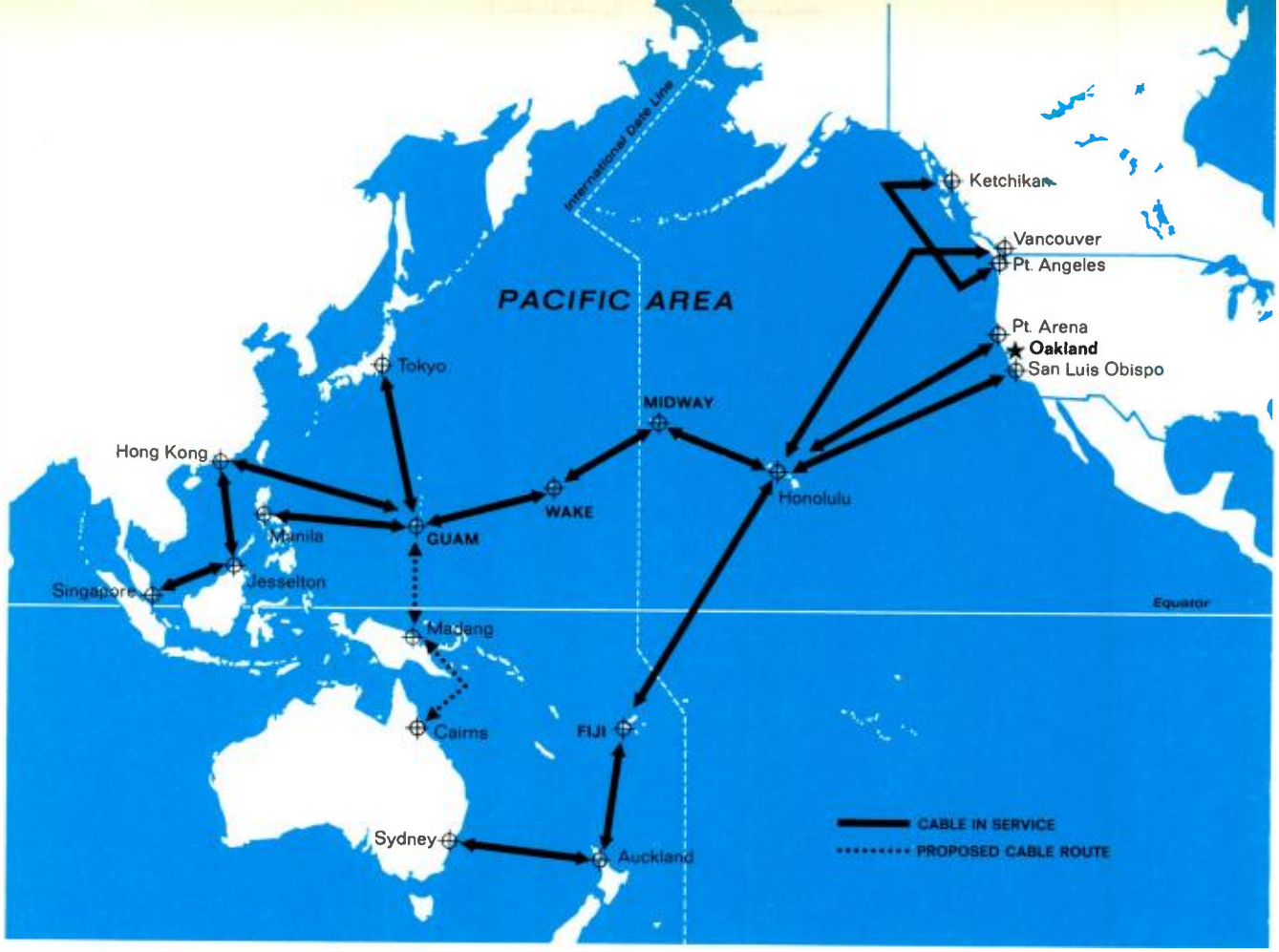
Today, four years later, there is scarcely an electronics research laboratory not investigating the subject. At RCA Laboratories in Princeton, N.J., for example, scientists such as Drs. David Greenaway, Hendrik J. Gerritsen, and Edward G. Ramberg are exploring the feasibility of hologram computer memories that store information in three dimensions, hologram movies, and holograms whose images could be magnified in all three dimensions at the same time to father a whole new type of optical microscopy.

At the moment, however, the major aim of these scientists is to gain new and fundamental insight into the phenomenon of holography itself. In that connection, they have produced several novel forms of holograms: phase holograms that record their three-dimensional information on a mirror surface that is read by reflection, holograms whose images are read out in only two dimensions — like conventional photographs — but with the difference that such "snapshots" are only one-twenty-fifth of an inch on a side, and holograms that store not one but many images. Soon they plan to produce an improved "white-light" hologram — one made in laser light but one that can be read in ordinary daylight . . . a kind of Lippmann photograph in three dimensions.

The ability of holograms to produce standard photographs rests on the fact that they can be made to reconstruct two types of three-dimensional images: one, the so-called *virtual image*, appears only when you look through the hologram in the general direction of the read-out laser beam; the other, called the *real image*, is seen on the other side of the hologram and may be recorded in two dimensions by the simple expedient of inserting a screen or photographic plate in the path of the light.

The ability to produce color holograms in three dimensions visible in ordinary light depends on a surprising technique that employs the thickness of the hologram emulsion itself. Different-colored lasers — red, blue, and green — all illuminate the object to be holographed at the same time. The reference beam of each, instead of hitting the front side where the reflected beam is received, is directed to the back of the hologram. As a consequence, the interference patterns created by each are much finer and lie much closer together. If white light is now shone through the back surface of such a hologram, a full-color reconstruction of the virtual image results. This happens because the hologram acts as a color filter — it allows through only those frequencies composing the white light that are close to the ones used to record the image in the first place. So far, such holograms have shown certain drawbacks, however; they are dim and their colors are usually distorted.

With the invention of standard contrast photography by Louis Daguerre in 1839, man found a way to record, chemically, two-thirds of the graphic information encoded in light reflected from an object. Now, with the invention of holography, he has found a way to record the other third. In the process, his ability to investigate and portray the world around him has acquired — both literally and figuratively — a new dimension. ■



Communications Boom in Southeast Asia

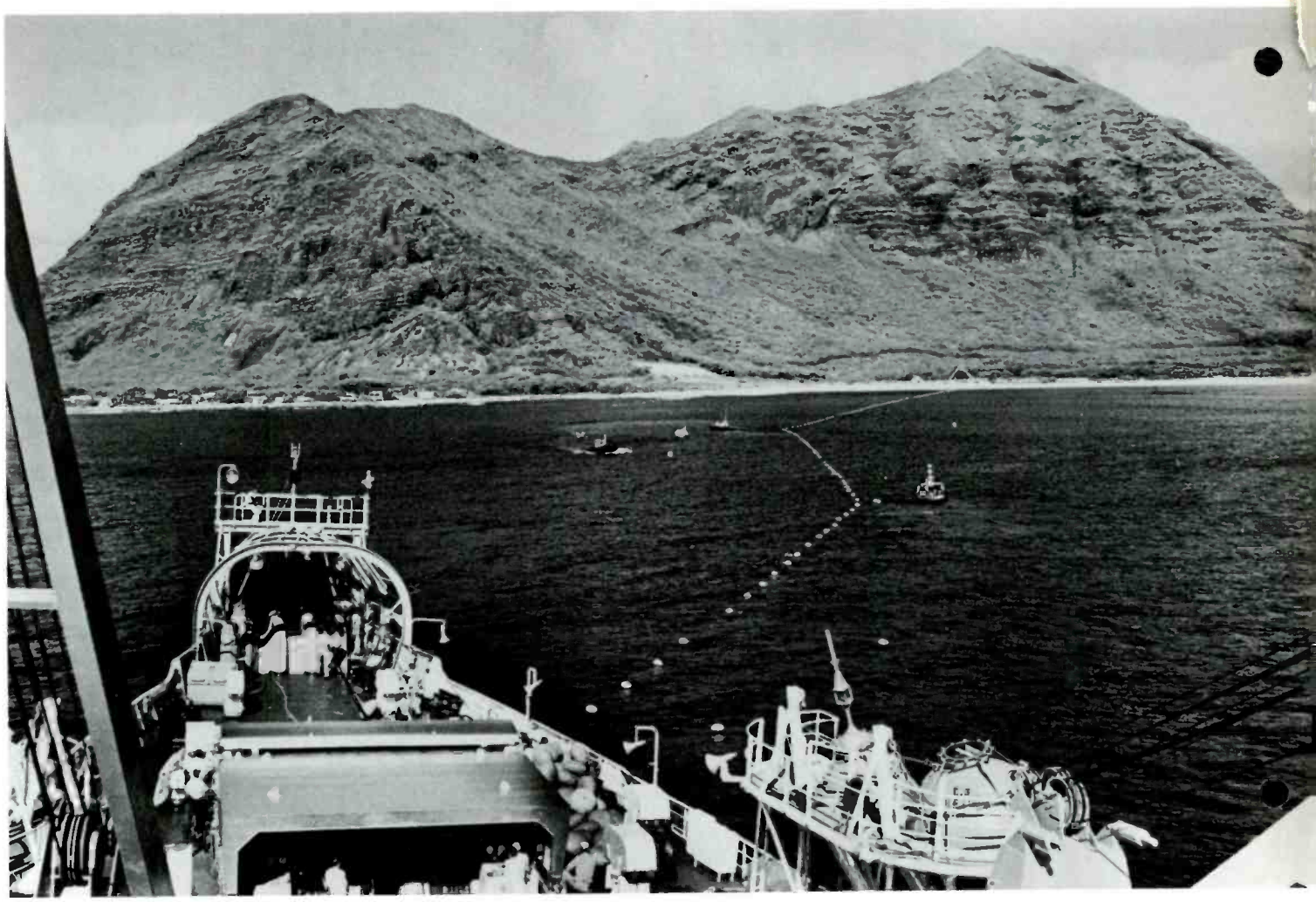
A once-remote region of the world is being linked by an expanding network of radio, cable, and satellite facilities.

by Mitchel Levitas

Last April, two jet-powered boats roared through a 12-mile stretch of dangerous rapids on the border of Laos and Cambodia; the trip, undertaken only rarely in the past, and then only by conventional craft pulled by winches, was another successful link in a long-range United Nations development plan to harness the Mekong River Basin for passenger traffic, irrigation, electric power, and flood control. That same month, in Malaysia, a diplomatic shoal was crossed: the foreign ministers of Thailand, the Philippines, and Malaysia met to revive the languishing Association of Southeast Asia, a five-year-old attempt at regional cooperation which had foundered in international cross-currents. Also in April, top government officials from Japan and six Southeast Asian nations gathered in Tokyo to plan joint economic development policies, principally through the new billion-dollar Asian Development Bank, which has headquarters in Manila.

Overshadowed by the savage war in Vietnam, hopeful signs are emerging that the countries of Southeast Asia are confronting their long-range development problems. There is even talk of a Common Market for the region,

MITCHEL LEVITAS is on the staff of the *New York Times Magazine*.

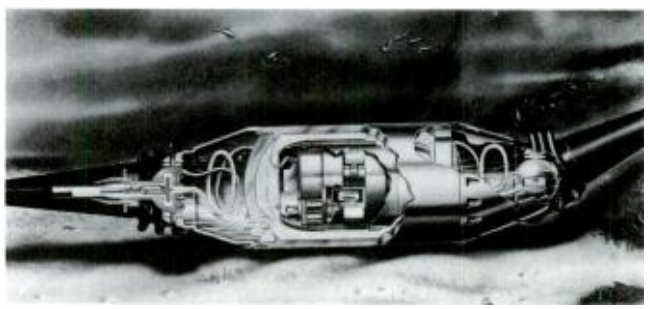


which would give non-Communist states an opportunity to grow and prosper despite the threatening presence of Red China. Some experts, in fact, compare the current status of Southeast Asia to Western Europe just after World War II, drawing a parallel between the promise held out by the Marshall Plan and such programs as the Asian Development Bank to which 32 countries have subscribed or offered funds and the billion-dollar aid-investment offer made by President Lyndon B. Johnson last year.

The parallel runs true in another direction as well: just as Western Europe put a top priority on rebuilding and modernizing its shattered network of communications, Southeast Asia (starting light-years behind) is moving swiftly to hook up its far-flung capitals in a web of new facilities. By radio, coaxial cable, and soon by satellite, the communications system of the area is expanding to match the growing needs of business, industry, defense, and diplomacy. Keeping pace with the demand are the various international communications companies — the American Telephone and Telegraph Company, ITT World Communications, Inc., RCA Communications, Inc., and Western Union International, Inc. RCA, for example, has more than doubled its facilities in the Pacific in the last two years at a cost of $20 million and will spend millions more.

The latest expansion in the area was a new leg for the SEACOM (Southeast Asia Communications) Cable System. Completed August 1, it links Guam, Hong Kong, Singapore, and Malaysia. At Guam, SEACOM connects with RCA's facilities in the Transpacific Cable System — a $120-million project shared by AT&T; Kokusai Denshin Denwa Company, Ltd., of Japan; the Hawaiian Telephone Company; and RCA — thereby providing instant access to the worldwide RCA telecommunications, radio, and cable network. Early next year, another segment of SEACOM will directly connect Guam and Australia, from which point a third cable system, COMPAC (Commonwealth Pacific), already hops to New Zealand, Fiji, Hawaii, and Vancouver.

The new addition to SEACOM will increase substantially the capability to transmit voice and record communications: telephone, telex, leased channels, photo transmission, high-speed data processing that is capable of sending the equivalent of 3,000 words a minute, and, of course, that old standby, the telegram. Initially, RCA will also use eight wide-band circuits for direct public telephone service from the Philippines to Hong Kong, Malaysia, and Singapore. In addition, RCA already has a large network of more than



Left: Transpacific Cable System begins at Oahu, Hawaii, where the Bell System's Cable Ship *Long Lines* started laying the first link of a telephone cable to connect Guam, Tokyo, and Manila.

Upper right: Overseas operator in Oakland, Calif., places a call to Japan by pressing a combination of keys at her right.

Lower right: An amplifying device called a repeater spliced into a cable at 20-mile intervals boosts voice signals about 100,000 times.

60 wide-band circuits in the Transpacific Cable System; each wide-band, three-kilocycle circuit can be used for alternate voice-data transmission or can be subdivided into 22 separate telegraph channels.

Work on the Transpacific Cable System, one of the longest in the world, began in early 1964 when the C.S. *Long Lines*, the Bell System's 17,000-ton cable ship, steamed out of Oahu headed for Guam with 2,000 miles of a new armorless cable. The core consists of steel wires, giving the cable sufficient tensile strength to withstand the tremendous pressure and buffeting on the ocean floor. Around the core are the conductors — two thin layers of copper separated by plastic insulation. Finally, an outer layer of high-density plastic sheathes the cable. As the cable unwound from giant spools, technicians spliced in 500-pound repeaters every 20 miles. Amplifying voice signals 100,000 times, the repeaters ensured against a fading signal over the 4,000-mile distance.

A few months later, the underwater link between Guam and Hawaii (via Wake and Midway islands) was completed, but that was only the first stage of the project. Later that year, two branches of the Transpacific Cable System connected Guam and Tokyo and Guam and Manila, giving those capitals access to a global communications network over 138 channels. It also provided Guam, the chief U.S. Strategic Air Force base in the Pacific, and a major hub of civilian communications, with some of the most sophisticated electronic equipment, particularly switching gear, found anywhere.

The most intensive communications buildup in Southeast Asia has been in Vietnam, of course. RCA is no stranger to the country, having inaugurated telegraph service to Vietnam 40 years ago, and it is still the only carrier that provides direct service over its own circuits. Lately, vast amounts of communications equipment have been installed to enable the military to keep in constant, instant touch with remote field units, regional headquarters, and the Pentagon.

While the war continues, RCA is the main transmission belt for keeping the American public informed of events via telex connections that transmit tens of thousands of words daily. Two public telex positions at the press center in Saigon are plugged into Manila. In addition, major U.S. magazines, news agencies, and broadcasting networks file over leased channels to their home offices in a matter of minutes. But even the job of helping correspondents to

An antenna reflector is assembled at Paumalu, Hawaii.
When complete, the station will be a key link in a satellite communications system serving the Pacific area.

report the war is not without danger; last year in Saigon two RCA employees from Manila stayed over an extra day to wind up work on six new teleprinter channels, missed their plane connection, and were among 43 persons who died when a terrorist bomb blew up a restaurant at which they were dining with friends.

After the U.S. Defense Department, the next heaviest user of communications facilities in the Pacific is the National Aeronautics and Space Administration. The NASA Communications Network includes two subswitching stations in Honolulu, Hawaii, and Adelaide, Australia, that have performed flawlessly during the Gemini series of manned flights. For the next phase of space exploration — the Apollo moon program — new tracking and data acquisition stations are being built in Honolulu and Canberra. Along with the expanded facilities, NASA is expected to increase the number of teleprinter or alternate voice-data channels provided by RCA, which now number about 30.

The leading commercial clients for leased channels in the Pacific are airlines — principally Pan Am, Northwest Orient, Japan Airlines, and Quantas — for whom the need for quick confirmation of passenger reservations and cargo space is urgent. As business and industry expand, communications facilities expand — and with them the volume of messages. Typical of the communications boom are these sample statistics for traffic handled by RCA to and from the United States:

Hong Kong — During the 10 years from 1955 to 1965, the number of telegrams transmitted increased from 71,000 to 205,000. Telex service was introduced in 1959 and leaped from 2,000 calls the following year to 12,000 last year.

Thailand — Direct telegraph service was started in 1951. Telegram traffic rose from 72,000 in 1960 to 102,000 five years later. Telex service, opened in 1964, last year accounted for 2,000 calls.

Australia — The number of telegrams has almost tripled in the decade from 1955–65, rising from 144,000 to 384,000. Since 1959, the first full year of telex operations, calls have increased almost sixfold, from 5,000 to 28,000 last year.

The experience of AT&T is similarly encouraging. In each case where a new cable has been opened, the number of telephone messages between the United States and the overseas point has tripled within a short time. Between 1963 and 1965, for example, messages carried by AT&T between the United States and Japan jumped from 86,000 to 218,500. For the entire Pacific area, messages to and from the United States totaled 1.2 million in 1964, 1.8 million last year, and are expected to pass the 2-million mark this year.

Probably the longest record of peacetime progress in communications has been written in the Philippines, where facilities have been steadily expanding since 1927, when RCA opened the first direct radio-telegraph circuit to the United States. Before 1927, telegraph service between the two countries was carried over a transpacific cable so rudimentary that it could handle only one circuit at a time, and each telegram had to be copied and retransmitted manually at Guam, Wake, and Honolulu on its slow journey to the mainland. The cost reflected the time and trouble: more than $1 a word.

Today, RCA is installing an automatic telex dialing exchange in Manila, with direct connections to any of 120 countries on the company's global hookup. A businessman in the Philippines will be able to dial, say, 851 (London) followed by 21450 (the subscriber number) and reach his party in seconds. The cost is less than five cents a word.

With the location of the Asian Development Bank in Manila, drawing financial, business, and government leaders from all over Southeast Asia, the need for better communications will become more urgent than ever. "We expect it to be a tremendous boost," says Cornelio Balmaceda, who as Secretary of Commerce and Industry led the effort to bring the bank to Manila. "It also gives us a great responsibility to provide good facilities."

Yet even the existing "good facilities" are not sufficient to meet the expected demand for stepped-up communications. For, despite the completion of the Transpacific Cable System only two years ago, and despite the further extension of SEACOM from Guam to Australia (via New Guinea) early next year, the communications network in Southeast Asia is already overloaded. Moreover, even the scheduled launching this fall of Intelsat II, the Pacific counterpart of the Early Bird satellite, will not provide sufficient new capacity. At a recent international conference in Sydney to discuss the channel requirements for Intelsat II, the need for more than 400 additional channels was indicated, although the satellite will make only 240 new channels available.

More communications satellites are sure to be launched over Southeast Asia. Comsat is already planning for a second Pacific satellite to be placed in orbit sometime in 1967. For 1968, there are plans for an even bigger satellite with a capacity for 1,200 two-way telephone circuits or four television channels — five times the capacity of Intelsat II and a lifetime that is two years longer. Nor is that all. Specifications have already been drawn by Comsat for an even more versatile, higher-capacity communications satellite that could accommodate 6,000 to 8,000 two-way telephone circuits, 12 to 20 television circuits, or perhaps a dozen circuits for communication between flying aircraft and ground stations. Even this huge, excess capacity over current needs is not expected to be too great, considering the future communications requirements of the area.

Plans for ground stations in Hong Kong, Hawaii, Japan, Thailand, and the Philippines surely will be expanded to include other nations in the region. Nor will it be long before a global system of record communications becomes a reality, since it is technically feasible to bounce signals from ground stations and satellites in the Western Hemisphere to ground stations and satellites in the Pacific. For more than a year, RCA has been operating commercial telegraph and telex service via Early Bird; high-speed overseas computer-to-computer transmissions and both color and black-and-white intercontinental television have also been sent via Early Bird. The next inevitable step is global television, shrinking the world to the size of a picture tube even as it expands our vision to encompass such once-remote areas as Southeast Asia. ■

The Computer: Management Tool

by Robert E. Tolles

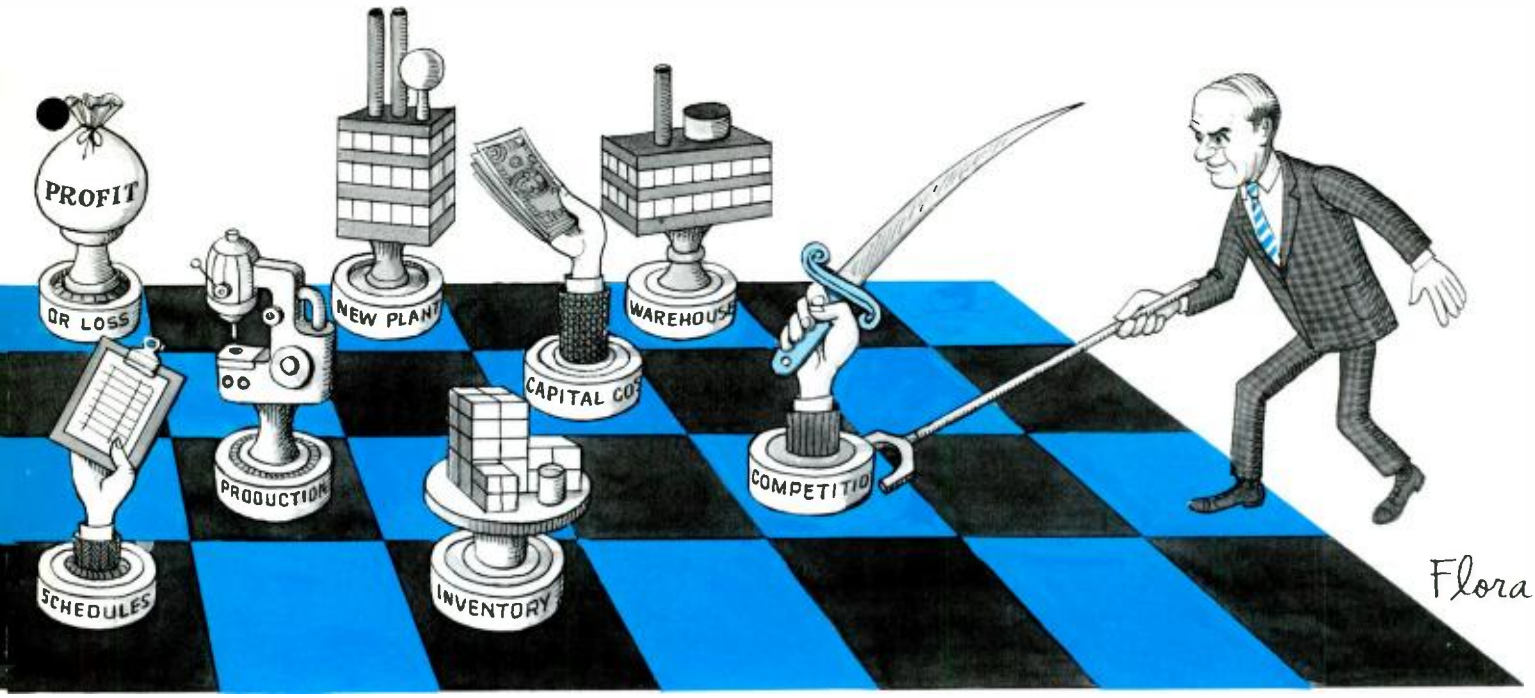
Some of the computer's early visionaries, when asked to describe the business world of tomorrow, were apt to paint a picture somewhat like the following. The management of most large enterprises will be concentrated in one physical location, at the apex of a communications and data processing network that is linked with field installations scattered about the world. Information will flow into this central headquarters, will be processed by batteries of computers, and will be made available to the managers of the enterprise almost as quickly as the described events occur. Managerial decisions will be made in almost as fast a time, and orders will flow from central headquarters to the second-line managers in the field. The staple of today's business environment — the business trip — will have become obsolete, since the information that the headquarters manager needs will be as close as the television screen on his desk and the high-speed printers of the computers on the floor below. Society will be managed in a clean, orderly environment far removed from its production centers, and people, hopefully, will spend the majority of their lives in the pursuit of leisure rather than of material gain.

Today's management systems experts are likely to shudder at such a vision, not only because much of it is overdrawn but because it throws out of perspective what they consider is the computer's proper role in business management. Properly conceived, the computer can be an extremely effective *tool* of management, but never its replacement. It can sharpen managerial insight, but it cannot and probably never will synthesize all the elements that make up this insight.

Given these limitations, however, the computer is having a profound effect on the way business is managed, as profound in its way as Henry Ford's introduction of the assembly line had on the methods of production. Virtually no area of business management has been unaffected by this data processing revolution. In its origins, the computer was thought of as an ultrafast calculator for engineers or a processor of paper for business. By combining this calculative and processing power, the computer is now enabling management to exercise greater control over production and distribution, to obtain greater insight into the relative advantages of various capital investments, and to forecast with considerable accuracy what its business environment may be like two, five, and 10 years in the future.

A more recent use of computers has been in business simulation in which all the operating variables of the business environment that can be defined — price, production, sales, consumer demand, capital costs, and so forth — are

ROBERT E. TOLLES is on the RCA Public Affairs staff.



Business procedures are changing rapidly under the impact of new data processing and analytical techniques.

quantified and processed to simulate the results of alternative courses of action. Just as an airplane is "flown" through simulation before its plans are off the drawing board, so the new business of tomorrow (although without the same degree of approximation) may be shown to be profitable or unprofitable before the first dollar of capital is invested.

A number of factors have been identified as responsible for these changes in business methodology. Rising costs and increasing competition in the postwar era have intensified the profit squeeze in many industries and have encouraged corporate officers to seek improved management methods. Accelerated technical change and more efficient transportation have resulted in a trend to multiplant and multiproduct firms which in turn has intensified the need for improved control. The process of management itself has also been undergoing a change. New analytical techniques have been developed by economists and systems specialists to aid in the solution of complex business problems. The final, and perhaps the most important, factor has been the development of the electronic computer with its unique capability for processing and analyzing vast quantities of information with phenomenal speed and accuracy.

A number of large corporations, among them General Electric, Westinghouse, Lockheed, RCA, and IBM, are devoting increased resources to programs of improved management. These programs generally go by the name of Management Information Systems (MIS) and have as their objective more effective and profitable operation through improved systems of management information and control.

One of the difficulties in instituting such programs has been the attitude of management itself. Managers traditionally have relied on their intuition and experience in making decisions, and they are reluctant to abandon these traditional guides. Yet while intuition and experience will always be needed for effective management, they provide inadequate guidance in themselves for operating in today's increasingly complex business environment. The new analytical tools can provide a much greater degree of accuracy in decision-making, and businessmen know they can ill afford not to use them.

What, then, are management information systems? One expert says that MIS describes the emergent role of the computer in integrating the dynamic functions of a business. Thus, MIS differs from a simple accounting system, which describes merely the financial operations of the company, in that it is intimately involved with the interaction of all the functional areas of the enterprise, such as production, marketing, personnel, and finance. The measure of its worth lies in its ability to process all the relevant information for a business and yet give management only that information needed in a particular decision process.

In a typical manufacturing division, an integrated MIS system will cover the entire range of divisional activity, from planning and control to production and distribution. Attainment of a fully integrated system, however, is still several years in the future. Most of the early effort, rather, has gone into adapting the computer to the production and distribution processes, with the current objective being the installation of real-time (no time lag between event and computer response) systems that log the flow of material through the plant into finished product and eventually to final sale.

For instance, at the RCA Victor Home Instruments Division, considerable progress has been made in implementing a system that controls the production and distribution of television sets, phonographs, radios, and recorders. Production at three plant locations in Indiana is monitored by a computer system that daily updates the availability of thousands of components and materials that are used in the manufacture of these home electronic systems. Production scheduling, reordering of purchased materials, and inventory records have or soon will be placed on the computer. Recently installed was the first computer-to-computer linkup tieing two large plants many miles from the home office to a central data processing complex which performs the heavy calculating load to provide daily production information. These innovations have enabled the Division to eliminate much of the manual preparation of paperwork, reduce inventories, and avoid costly delays in the production process.

At Westinghouse, one of the earliest and largest centralized computer systems is processing 90 per cent of all the company's industrial orders and is updating inventory records on a real-time basis, according to a recent article in *Business Week*. When it is not engaged with these activities, the system keeps a running balance on corporate cash, audits each operating division's closing monthly balance, issues payroll and dividend checks, and handles a portion of the company's invoicing and accounts receivable.

Still, the computer has not operated at the limit of its capacities. Many of the newer and more sophisticated data processing techniques are being applied in the area of market forecasting and analysis. For instance, RCA Victor has recently instituted a system for analyzing the results of RCA Record Club sales through advertisements placed in various national publications and through direct-mail solicitation. The information necessary for this analysis was derived from a data bank into which has been placed the names, addresses, and ordering and payments history of all Club members. The system has enabled the Club to arrive at some tentative conclusions on the relative effectiveness of the advertising media and the various types of record offers.

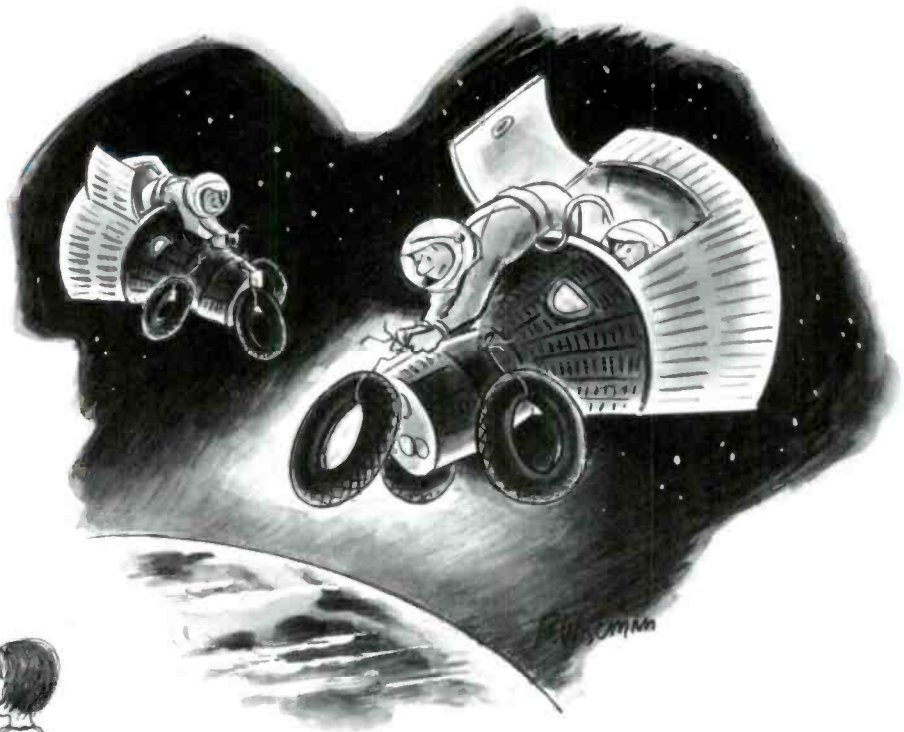
Borrowing from the political pollsters, the market forecasters have been seeking out bellwether counties whose buying habits are predictive of the economy as a whole. RCA's Home Instruments Division, for example, has selected a group of 14 counties in which, it feels, the measurement of consumer demand, as reflected in sales to dealers, provides a yardstick for gauging national trends for two months in the future. Even this rather limited lead-time for anticipating consumer wants can make a difference in profits in such a burgeoning market as color television.

Still more advanced uses of the computer are being made through the construction of business models that simulate in mathematical terms all the operating factors of a business. The Operations Research Group at RCA Laboratories in Princeton, N.J., has completed such a model for the company's new Graphic Systems Division, which was formed in 1965 to develop and market electronic systems for handling printed information. Consisting of some 80 pages of algebraic equations, the model simulates the entire range of factors that will affect the future profitability of the Division.

In manipulating the model, the basic question asked by its operators is "What would happen if . . ." the market were to expand by 15 per cent, for example, or costs were to increase by 5 per cent, or if the selling price of a particular piece of equipment were reduced by 10 per cent. The effect of any of these assumptions on the other operating variables of the business is then predicted by the computer. Herein lies the usefulness of such models. Management can gain considerable insight into the probabilities of reward or risk stemming from specific management decisions or changes in the marketing environment. The model also provides a check on whether the planning assumptions made by the various operating departments, such as marketing, engineering, or administration, are valid. As time goes on, the model becomes an even more powerful tool, since with operating experience the various business interrelationships can be stated with greater precision.

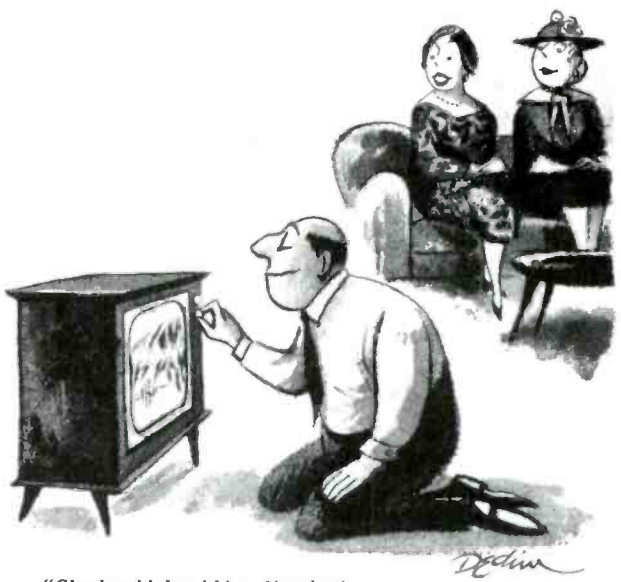
On a corporate level, the MIS concept can help management allocate corporate resources and evaluate the operating performance of the divisions. In a changing business environment, one of management's most difficult decisions is how best to allocate its limited capital resources in response to the competing requests of the divisions. Traditional manual methods of evaluating these demands are often inconsistent or do not take into account the changing value of money over a period of time. New techniques now being developed with the computer avoid both drawbacks and permit a more precise analysis of the cost-benefit ratios of various investments. Similarly, computer processing of the ebb and flow of corporate cash balances can help financial officers improve profit opportunities through more closely scheduled short-term investments.

Where will this revolution in business management eventually lead? A precise answer is difficult, but one conclusion can be ventured. Under the pressure of the bright young graduates with their probability tables and computer lingo, managers have been forced to re-examine traditional ways of doing things and to be less dogmatic in their adherence to old methods. Many of them have gone back to school for quick courses in computer technology and model-building if only so they can understand what these fervent young men are talking about. Gradually, business methods have changed as managers have gained assurance in handling their new tools. But the change that has been introduced is only a small fraction of that which will have taken place by the time these young men become the managers of tomorrow. ■



"Good morning, teaching machine."

THIS ELECTRONIC AGE...



"Charles thinks of himself as having the sure yet sensitive hands of a great surgeon."

Coming: A Natural Resources Satellite

A versatile new space observatory promises to help man gain greater understanding and control over his environment.

by Louis F. Slee

Spacecraft that produce immediate, tangible benefits are a fact of life. Weather satellites continually track weather over the entire earth, and communications satellites relay messages and pictures between continents. Soon there will be a third type of practical spacecraft, another tool to help man understand and control his environment — the natural resources satellite. In terms of its effect on the billions of persons who inhabit this planet, it may be the most important space program yet undertaken.

The natural resources satellite basically is a platform in space, a unique vantage point that allows man to examine the earth. From a satellite he can see infinitely more than from the ground or from a high-flying aircraft. Geographically remote regions as well as urban sprawls can be viewed. Small or large areas can be selected for study as the space platform circles the earth in orbit. Whatever can be seen from the satellite can be analyzed and converted into knowledge. The "seeing" can be performed by man himself, but much more detailed information can be obtained through electronic and optical sensors.

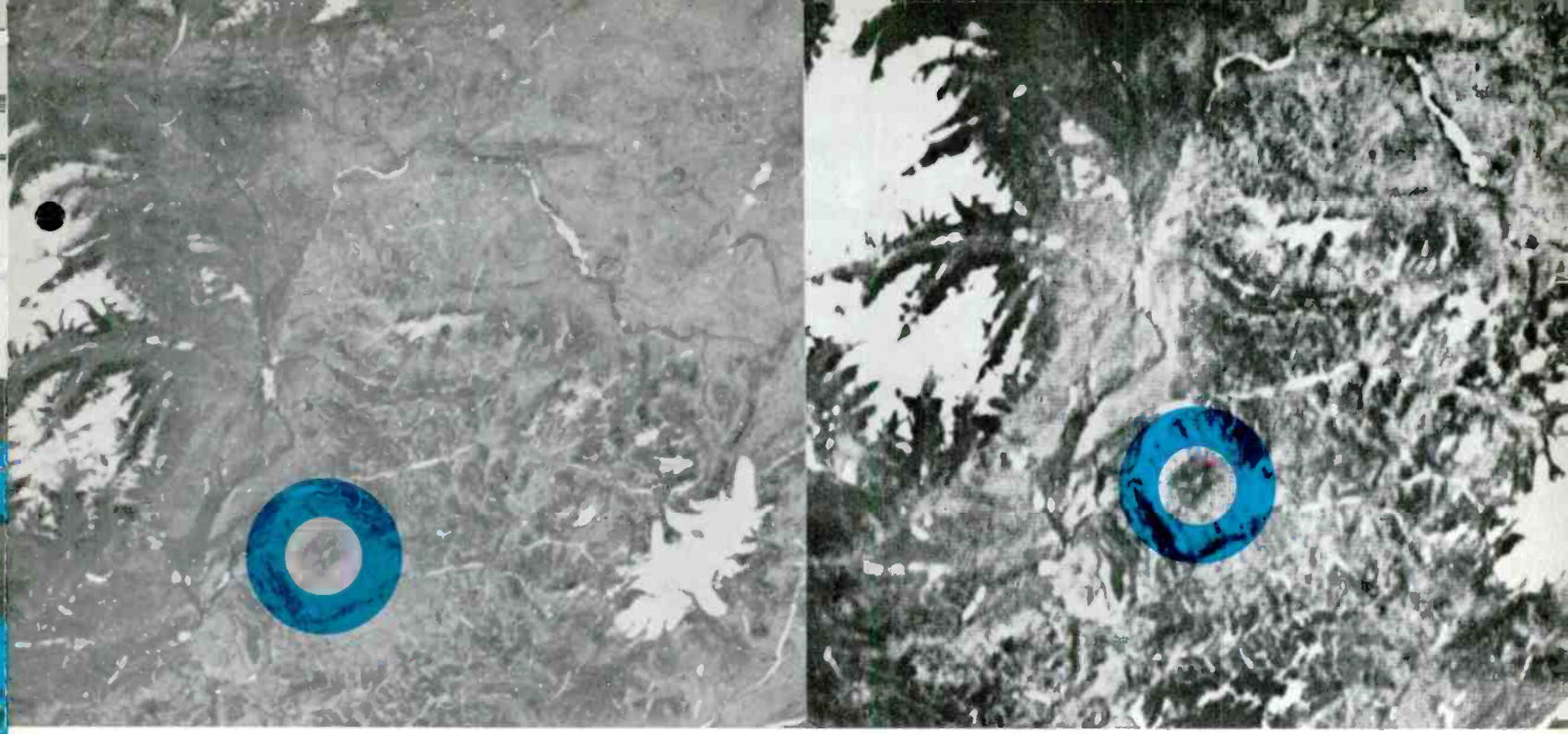
The information produced by the satellite will open new doors for the earth sciences of agriculture, forestry, geology, oceanography, hydrology, and geography. Agricultural productivity throughout the world can be increased to meet the demand for food. In this application, the satellite will be a tool for crop and soil identification, detection of plant disease, prediction of crop yield, analysis of soil moisture content, and many other factors that affect farming productivity. An economist recently pointed out that farmers in the United States currently earn more than $35 billion from 79 leading crops and forms of livestock they produce. If the satellite helped to increase this food production by just 3 per cent, it would add $1 billion to farm income.

In the field of forestry, the satellite can be used to take inventory of forest land with respect to species of trees, their location and volume. As in agriculture, it can implement insect and disease control. Suppression of timber losses due to fire, wind, and erosion is still another application.

Geologists will be able to make maps more rapidly. This will aid in the location and assessment of new mineral resources such as iron and oil. The satellite can also provide geological maps of the earth's surface that would lead to better understanding of its crustal structure, morphology, and composition. Recently, magnetic surveys taken from the air of the Pea Ridge area in Missouri have uncovered iron ore valued at $2 billion 1,300 feet below the earth's surface. The satellite might uncover deeper deposits in other areas of the United States and the world.

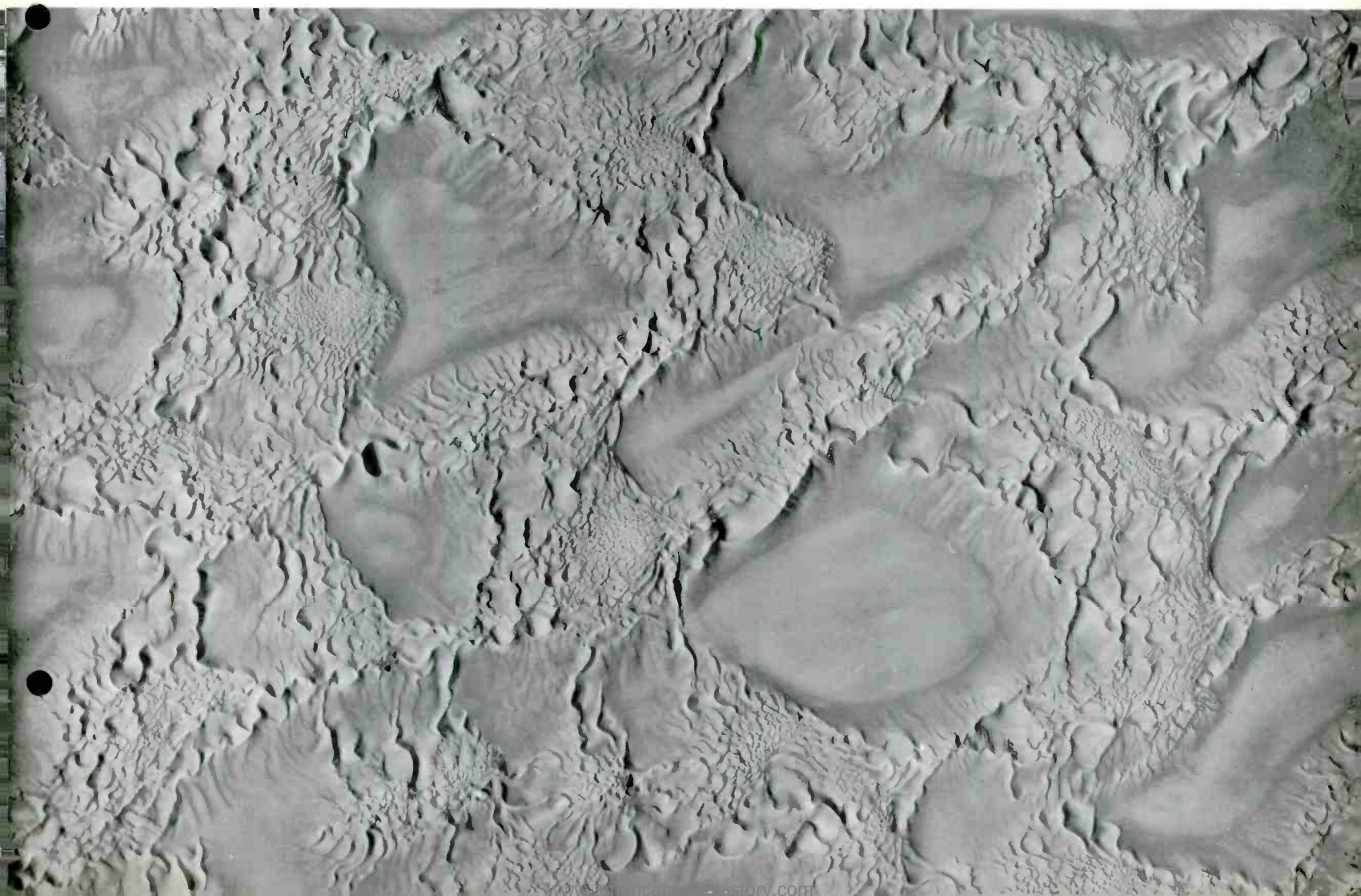
The natural processes affecting the sea will be unveiled in a new dimension by the satellite. Ocean currents can be accurately mapped, and waves and sea-state conditions observed on a regular basis. The effect of seasonal and climatic changes on the distribution and vigor of marine life can be studied. Coastline and shallow sea-floor variations can be mapped and the movement of sea ice followed. Substantial economic benefits can be anticipated. For example, U.S. ship-carried imports and exports amount to $50 million a year and are expected to rise 48 per cent by 1970.

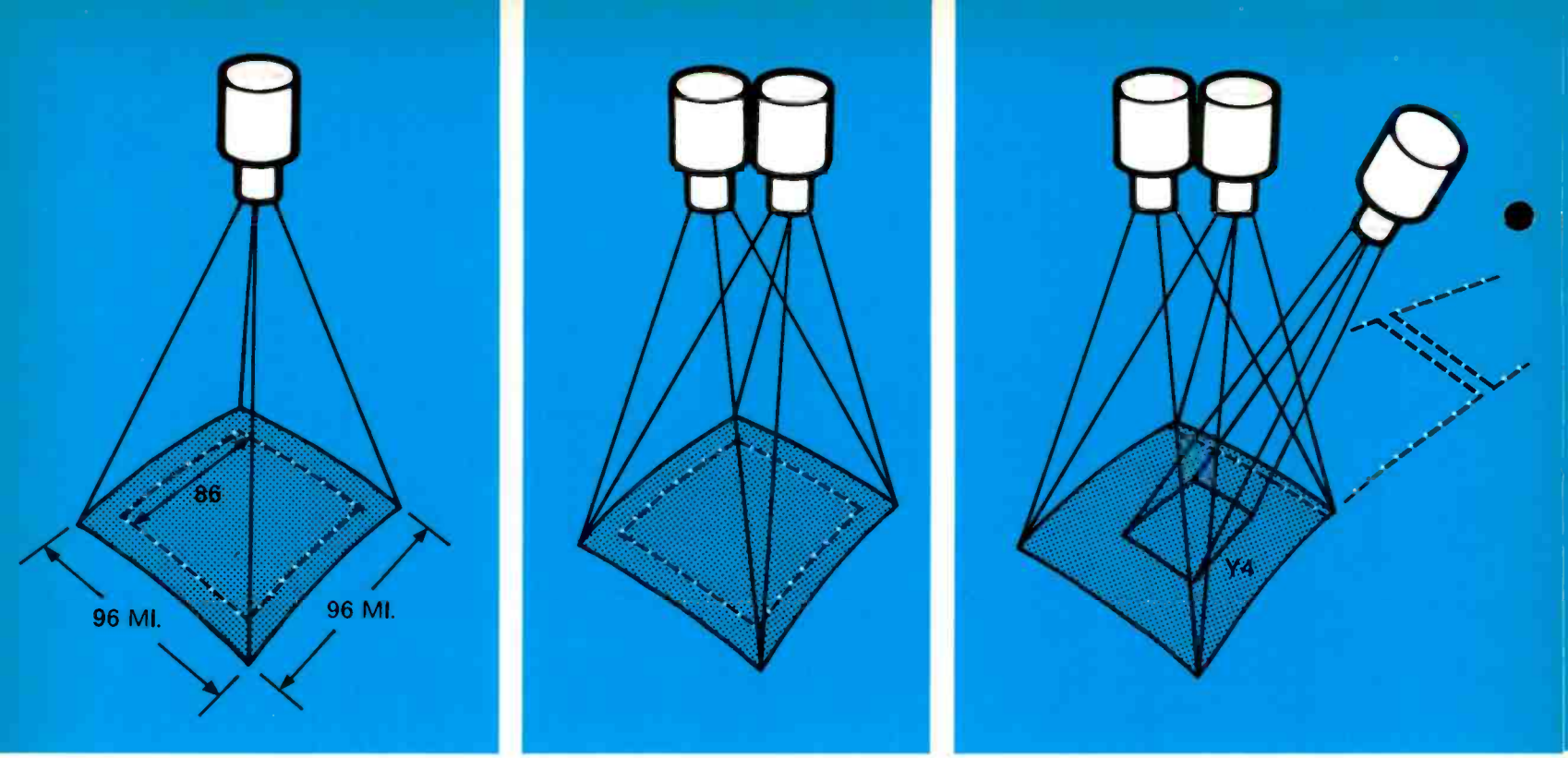
LOUIS F. SLEE is on the staff of RCA's Astro-Electronics Division.



A view of the Tibetan mountains as seen from a Mercury space flight. On the left is the film photograph taken by the Mercury astronaut and, on the right, the same photograph as reproduced by television. The encircled spot is an oil dome, a geological formation that indicates the presence of subsurface oil.

An aerial view of the Libyan Desert. Features of the terrain have been sharpened by a television technique that could be useful for mapping studies conducted by means of a natural resources satellite.





By 1975, the annual cost to ship these goods will be $5 billion. Even a small improvement in ship-routing, made possible through satellite-derived information, could contribute significant dollar savings. Another target is fishing. Last year, the United States imported enough fish to cause a $500 million deficit in its balance of payments. Planners foresee the satellite providing information that will permit improvement of near-shore yields of fish to the point where domestic production could double in the next 10 to 15 years.

The satellite could provide hydrologists with a tool for measuring water pollution, for investigating water use, and determining irrigation potential. It will provide data to help develop techniques for control of flood and drought damage, as well as development of water power. It can observe the distribution of snow and ice and of water volume in streams and lakes. The economic benefits in this application could be far-reaching. For example, a single, medium-sized Canadian hydroelectric plant saves $1 million for each 1 per cent increase in the accuracy of predicting water flow between April and August. The satellite could provide this precise observation of water flow.

For the geographer, the satellite will transmit pictures that will help him to draw more accurate maps, study land use, determine population distribution, and provide for better transportation routes and facilities. Savings in the cost of mapping already are under study. It has been estimated that more than $1 billion is spent yearly to make maps by means of aerial surveys. To date, only a small part of the earth has been adequately mapped. Experts believe that satellites can perform many mapping tasks more cheaply than can be done by other methods.

Electronic and other sensors on the satellite will operate in select regions of the electromagnetic spectrum, from the visible to microwave frequencies, to gather information that the eye alone cannot detect. This is possible because the sun radiates electromagnetic energy that is reflected by the earth. Each object on the earth reflects, absorbs, and re-emits this energy in a manner characteristic of the object's physical and molecular structure. Objects thus have their own spectral "signature" which, when picked up by the sensors, permits their identification.

Among the many sensors that could be flown on a natural resources satellite are film cameras, television cameras, infrared radiometers, laser altimeters, and radar devices. These sensors will have to be modified or "tailored" for space flight and to meet information requirements of earth scientists who are the principal users of data from a natural resources satellite. In terms of the speed and economy with which pictorial information can be transmitted and in light of past space-flight experience, television bids fair to be an important feature on a natural resources satellite.

In meteorological satellites, the television camera has provided more than 750,000 photographs of cloud cover, storms, and hurricanes since 1960. Although designed to perform a weather-watching mission, TV systems aboard TIROS 2 sent back pictures of ice conditions in the Gulf of St. Lawrence as early as 1961. TIROS 4, orbited in February, 1962, was used in an ice reconnaissance project, a joint program of Canada and the United States. Subsequent TIROS satellites, with TV systems optimized for daily weather photography, have spotted a dust storm in the Middle East, a forest fire in California, and water pollution in the United States.

Television for the natural resources satellite will require higher resolution than previous satellite systems as well as multispectral sensing capability to provide useful informa-

A multiple-camera television system proposed by RCA's Astro-Electronics Division for a natural resources satellite system. The first camera provides visual coverage of an area of 96 nautical square miles. A second camera covers the same area but is sensitive to radiation near the infrared region. The third camera covers a smaller area and can be used to focus on features of interest.

tion on a regular and continuous basis. Currently under development is a new space television camera that has shown a resolution capability of more than 5,000 TV lines in laboratory tests. A standard broadcast television camera has a resolution capacity of 525 lines. For earth resources observation, a pair of these cameras would provide multispectral sensing capability. A trio of the new cameras could provide color photography of the earth. Work on ultrahigh-resolution television for resource observation is being brought forward by companies such as RCA, while investigation of other sensors is being carried on by universities and the National Aeronautics and Space Administration.

At NASA, the focal point for the natural resources satellite is the Earth Resources Program Office in Washington, D.C., headed by Dr. Peter C. Badgley, a young scientist who earned his doctorate in geology at Princeton University. Dr. Badgley and his staff are studying more than two dozen sensors that could be used in manned or unmanned orbiting earth resources observatories. Under NASA direction, some of these sensors have been flown in aircraft to test their effectiveness in probing for geologic earth resource information. In addition, NASA has authorized the University of Michigan to carry out extensive sensor studies. Dr. Badgley's office is already studying ways for obtaining earth resources information from manned Apollo flights as well as from large and small unmanned satellites. NASA's Manned Spacecraft Center in Houston, Tex., is an important part of the program and has set up an organization to handle the collection of multi-sensor data obtained by aerial overflight of test sites, and photographs of the earth taken by the Gemini astronauts.

Another scientist participating in the planning for a natural resources satellite is William A. Fischer of the U.S. Geological Survey. Mr. Fischer recently made a presentation on mapping uses of the satellite to Secretary of the Interior Stewart L. Udall. The Department of Interior has since announced plans for a satellite program entitled Project EROS. Similar presentations on an unmanned satellite, viewed as an initial step toward getting the program under way within a short period of time, have been made by RCA to NASA, the National Aeronautics and Space Council, the National Academy of Sciences, and the State Department's Agency for International Development. This concept also was presented to the former President of Colombia, Dr. Alberto Lleras Camargo, when he visited RCA's Space Center in Princeton, N.J. The Organization of American States, of which Colombia is a member, has also expressed interest in the program.

At the U.S. Department of Agriculture, Dr. A. B. Park of the Agriculture Research Service, is the principal liaison between that agency and NASA for the Earth Resources Survey Program. Work at present is aimed at defining and developing experimental space-based systems for collecting data which will be useful in agriculture and forestry. He and other top USDA officials foresee significant practical uses of space-age technology, particularly in helping build food production to meet the rapidly growing world needs.

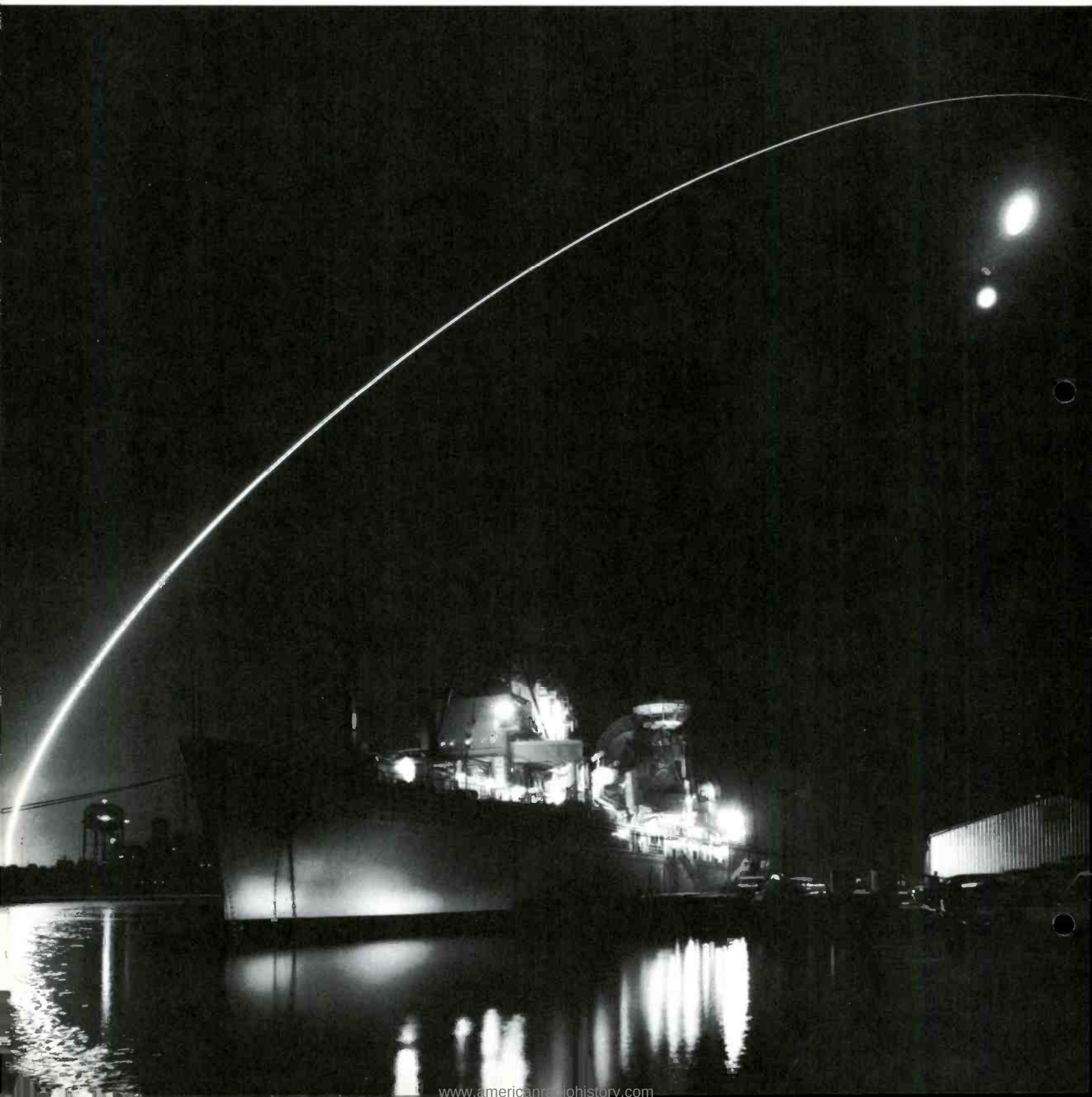
Also participating in the program is the U.S. Navy Oceanographic Office. Arthur G. Alexiou of that office leads a working group that is bringing together the oceanographers' requirements for space-acquired data and is studying promising sensors for oceanographic measurements from space.

Still, there are major problems to be solved with the natural resources satellite. One of these involves data handling. Existing space technology would permit a satellite to be built and flown within two to three years. But, when it starts sending back vast quantities of information, a system will be needed for analyzing the data and disseminating the results so that the new knowledge derived can be put to practical use. Manual methods are not adequate for the handling of large quantities of data with speed and absolute accuracy, especially the kinds and quantity of data that will come from electronic and optical sensors on an orbiting space platform. The job of selecting information of specific value most probably will be performed by specially designed computers, capable of scanning photographs as well as sampling radar profiles of the earth. Through the use of a computer, the earth scientist can be provided with natural resources information in a form that will permit him to make judgments and recommendations. The benefits that would flow from a natural resources satellite will depend a great deal on these judgments and recommendations.

The natural resources satellite perhaps may be of greatest benefit to the underdeveloped world where abject poverty frequently coexists with rich, unexploited resources. The first step in turning these resources into economic benefit is to determine their extent and how they may best be exploited. The natural resources satellite is well suited for this task. The day that the first such satellite is orbited will mark a significant milestone in the continuing effort to make the benefits of space technology available to all mankind. ■

Space-Age Armada

A Minuteman missile rises from Cape Kennedy over the *General Hoyt S. Vandenberg*, an Advanced Range Instrumentation Ship that is part of the Eastern Test Range tracking network.



Sea-going tracking stations are providing vital data acquisition and communications coverage for the nation's space program.

by Tom Elliott

American weapons development and space exploration over the past decade have spawned a new breed of sea-going vessel. Its superstructure bristles with multistoried antennas able to gather data from missiles flying ballistic trajectories and spacecraft operating at vast distances from earth. Packed below its decks is the most sophisticated electronics instrumentation available.

The vessels are the ship stations in the nation's far-flung missile and space vehicle tracking networks. Operating as part of the Air Force's Eastern and Western test ranges and the Navy's Pacific Missile Range, but knowing no geographical limitations, these ships comprise a space-age armada that is playing an important role in the U.S. missile and space program.

For example, as astronaut Gordon Cooper entered the final phases of his first voyage into space, Mercury Mission MA-9, a malfunction in the automatic systems aboard his Faith 7 spacecraft forced a manual retrofire — the braking maneuver that slows the vehicle so that it returns to earth. As Faith 7 sped over the Pacific during its next-to-last revolution, John Glenn, Jr., the first American to orbit the globe and a capsule communicator on Cooper's MA-9 mission, relayed the retrofire checklist spaceward from the USNS *Coastal Sentry*, Pacific Command Ship for the flight. Then, when the craft again approached the *Coastal Sentry* during its final revolution, Glenn beamed the countdown to the orbiting astronaut so that he could initiate the retrofire sequence that was subsequently to bring him down safely within view of the recovery ships.

More recently, the USNS *Rose Knot*, a sister ship to the *Coastal Sentry*, again demonstrated the importance of the tracking vessels when it provided the data, command control, and communications support for the first docking of two vehicles in space. The event was the linkup of Gemini 8, piloted by astronauts Neil Armstrong and David Scott, and its Agena target. After rendezvousing with the Agena, the astronauts purposely delayed the docking until they were within range of the *Rose Knot*.

MA-9 and Gemini 8 are but two in a growing list of Department of Defense and National Aeronautics and Space Administration space spectaculars in which the tracking ships have played key roles. Others include the first recovery of an intercontinental ballistic missile nose cone and the recovery of the first film taken in space from a missile re-entry vehicle.

The fact that the *Coastal Sentry* and *Rose Knot* — and every other ship in the missile-tracking fleet — have been able to lend critical support at dramatic points in mission after mission is not happenstance, according to W. J. Tubell, Manager of Ships Instrumentation for the RCA Service Company's Missile Test Project, which operates the instrumentation systems aboard Air Force Eastern Test Range vessels.

"The ships are placed at strategic points along the flight route so that they can acquire data at vital moments in the missions," Tubell points out. "Their ability to move about gives the mission planners much greater flexibility since it allows them to schedule specific events at the best times, even though the missile or spacecraft at that particular point may be beyond the range of fixed land stations."

This, essentially, has been the role of the ships — to fill the gaps and provide data acquisition and communications coverage where no land stations exist.

As they apply their special capabilities to the nation's space activities, the ships must cope with a number of circumstances not associated with land tracking stations. Not the least of these is the isolation from a source of supply that results from being at sea and sailing from a dozen or so different foreign ports.

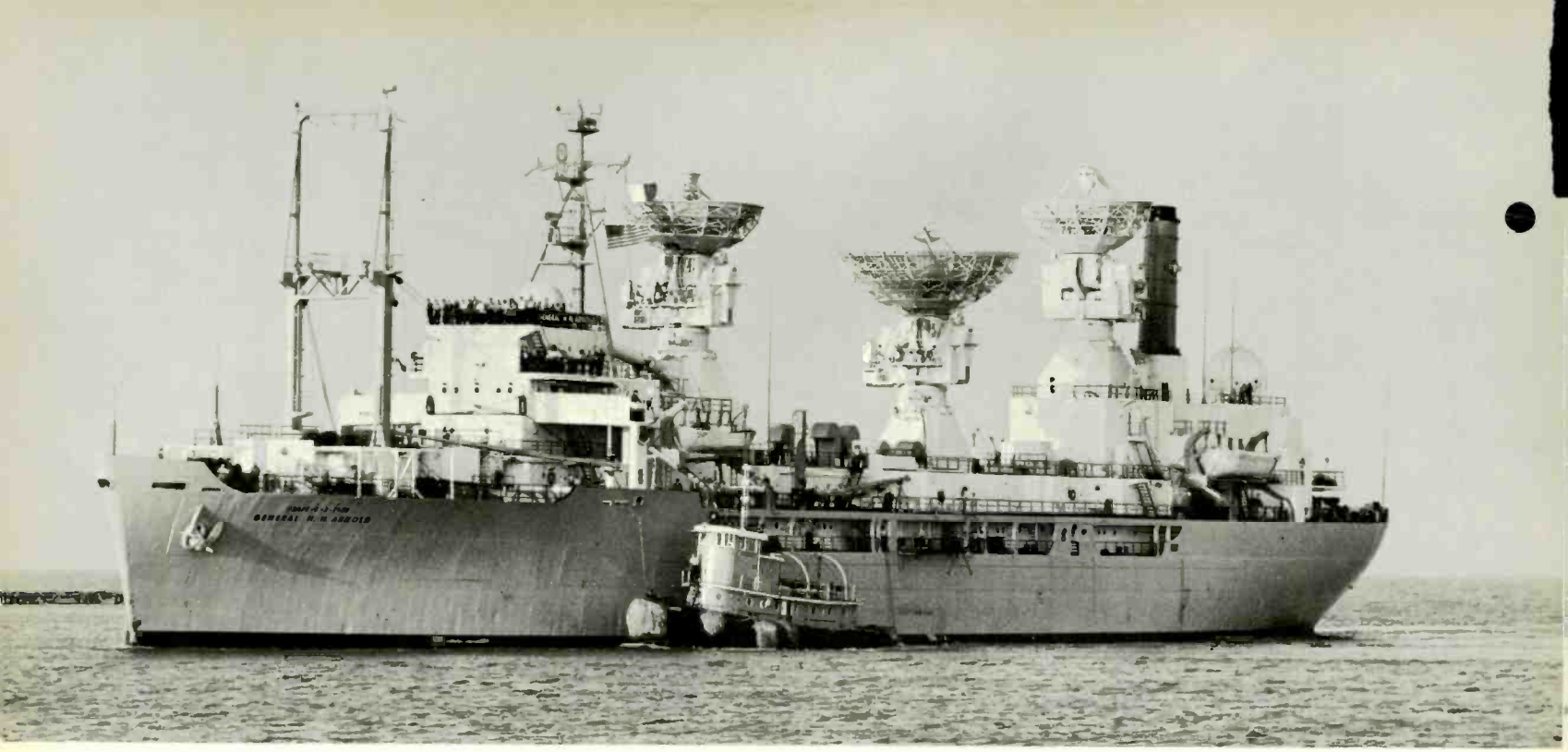
"This leads to quite a bit of ingenuity on the part of our engineers and technicians," Tubell explained. "They sometimes must operate with what is on hand when there is a malfunction and no replacement component is readily available. In this case, their technical knowledge and skill are taxed, but they inevitably come up with a method to substitute a part or to otherwise bypass the problem. So, the isolation, in the sense that it stimulates the development of technical creativity, sometimes works constructively for us. Most of the ships' personnel appreciate this facet of the operation since it means great reliance is placed on their individual knowledge and skill."

The first tracking ships came onto the Eastern Test Range in 1957. Small, and carrying only modest instrumentation and a technical staff of five or six persons, they were strung out in the South Atlantic between Puerto Rico and Ascension Island to gather telemetry data transmitted by air-breathing Snark cruise missiles, which lumbered down range from Cape Kennedy (then Canaveral) at a relatively slow 600 miles per hour.

With the increasing activity in ballistic missile testing, five second-generation telemetry vessels were outfitted in 1958 to replace the original force. Larger and more extensively instrumented, they were referred to as the "Cimavis" — a combination of their letter-number Cl-MAV-1 designation. Like the first ships, they were converted cargo carriers.

The *Coastal Sentry* and *Rose Knot* were both among the first Cimavis. So were the USNS *Sword Knot*, USNS

TOM ELLIOTT is on the staff of the RCA Missile Test Project, Cape Kennedy, Fla.



Three towering radar antennas dominate the superstructure of the *General H. H. Arnold.*

Coastal Crusader, and USNS *Timber Hitch*, all of which continue to function on the Eastern Test Range.

The list of vehicles the ships supported over the next few years reads like a "Who's Who" of American rocketry — Atlas, Polaris, Thor, Titan, Jupiter, Pershing, Minuteman, Redstone. Although they performed a wide variety of tasks on the flights, the ships' specialty was gathering data as the nose cone dived toward the sea. With the vessel sitting within five miles or less of the target, crew members topside often watched the re-entry vehicle, glowing white hot from atmospheric friction, as it streaked to impact.

One of the significant early accomplishments of the ships came in 1958 when the *Rose Knot* tracked a ballistic missile warhead to splashdown and then hoisted the vehicle aboard. It was the first recovery of a nose cone flown at intercontinental ranges.

A few months later, the *Coastal Sentry*, situated in the South Atlantic off Ascension Island, fished from the sea a canister that had been ejected from an Atlas nose cone. In the container was film that provided the first photographs taken in space by an ICBM — valuable cargo indeed.

"We didn't even wait until returning to port to develop it," recalls W. S. Stewart, RCA leader aboard the *Coastal Sentry* at the time and now a ships coordinator for RCA at Cape Kennedy. "We turned one of the staterooms into a darkroom so the film could be processed right away. The Air Force had decided that this would be done to guard against fogging of the undeveloped film."

Their importance to the space program already clearly established, the tracking ships in 1960 underwent further sophistication. Perhaps the most striking development was the creation of a precision radar tracking ship.

The ship selected was the USNS *Twin Falls*, a converted World War II Victory vessel. The radar was the RCA AN/FPS-16, which was in worldwide use on land stations for missile tracking.

The *Twin Falls*' initial operational assignment was on the Army's Pershing, a small, mobile missile with a range of only a few hundred miles. The vessel's importance to the Pershing tests was vital since the range of the missile was such that no land station was available to provide terminal trajectory data, as Antigua and Ascension islands did for IRBMs and ICBMs.

The *Twin Falls* has gone on to support some of the nation's most ambitious programs, including the Mariner Venus shots and the Ranger moon-photographing flights, and continues presently as an important unit on the Eastern Test Range.

The year the *Twin Falls* was being developed, 1960, was also significant for the *Coastal Sentry* and the *Rose Knot*. With manned space flight just over the horizon, both entered the shipyards for instrument modifications and additions to support the Mercury program. In 1963, the two were back in the yards for more work, this time for Gemini.

The next ship milestone for the Eastern Test Range came in 1963 with the completion of the most heavily instrumented and technically advanced vessels yet conceived. These were the USNS *General H. H. Arnold* and the USNS *General Hoyt S. Vandenberg*, designated ARIS for Advanced Range Instrumentation Ships.

The ARIS differ from the other tracking ships in both design and the specialized nature of their mission, according to A. W. Wren, Manager of RCA's Signature Operations organization, which is responsible for the instrumentation operation, maintenance, and related data acquisition functions on the vessels.

The prime mission of the ARIS is to conduct basic scientific research in signature re-entry measurements,

although they also serve importantly on space flights as a secondary function. The vessels' instrumentation is unique in that it can gather both radar signature information, which is concerned with the physical characteristics of the object being tracked, and radar metric data, which reveal factors such as position and speed.

Easily distinguishable by the three towering antennas that dominate their superstructures, the ARIS carry three types of radar plus extensive and highly developed telemetry, communications, and navigation equipment. Each ship has a technical crew of 75 engineers and technicians.

The groundwork laid during Mercury and Gemini by the *Coastal Sentry* and the *Rose Knot* is now leading to the newest and most extensive addition to the country's marine tracking force — the Apollo ships. Five Apollo vessels, which will be assigned to the Western Test Range, are currently being constructed to serve primarily, as their name indicates, on NASA's Apollo manned lunar landing program. However, the ships will also render valuable support on many other NASA and Department of Defense projects.

Converted T-2 tankers, the Apollo ships will be the largest vessels ever used for tracking purposes. The major instrumentation aboard each will include an RCA AN/FPS-16 radar similar to the one originally installed aboard the *Twin Falls*.

The specific task of the new ships will be to provide command control, communications, tracking, and telemetry for the Apollo spacecraft during the critical phases of insertion into earth orbit and then during injection into translunar trajectory as the craft blasts away toward placing American astronauts on the surface of the moon.

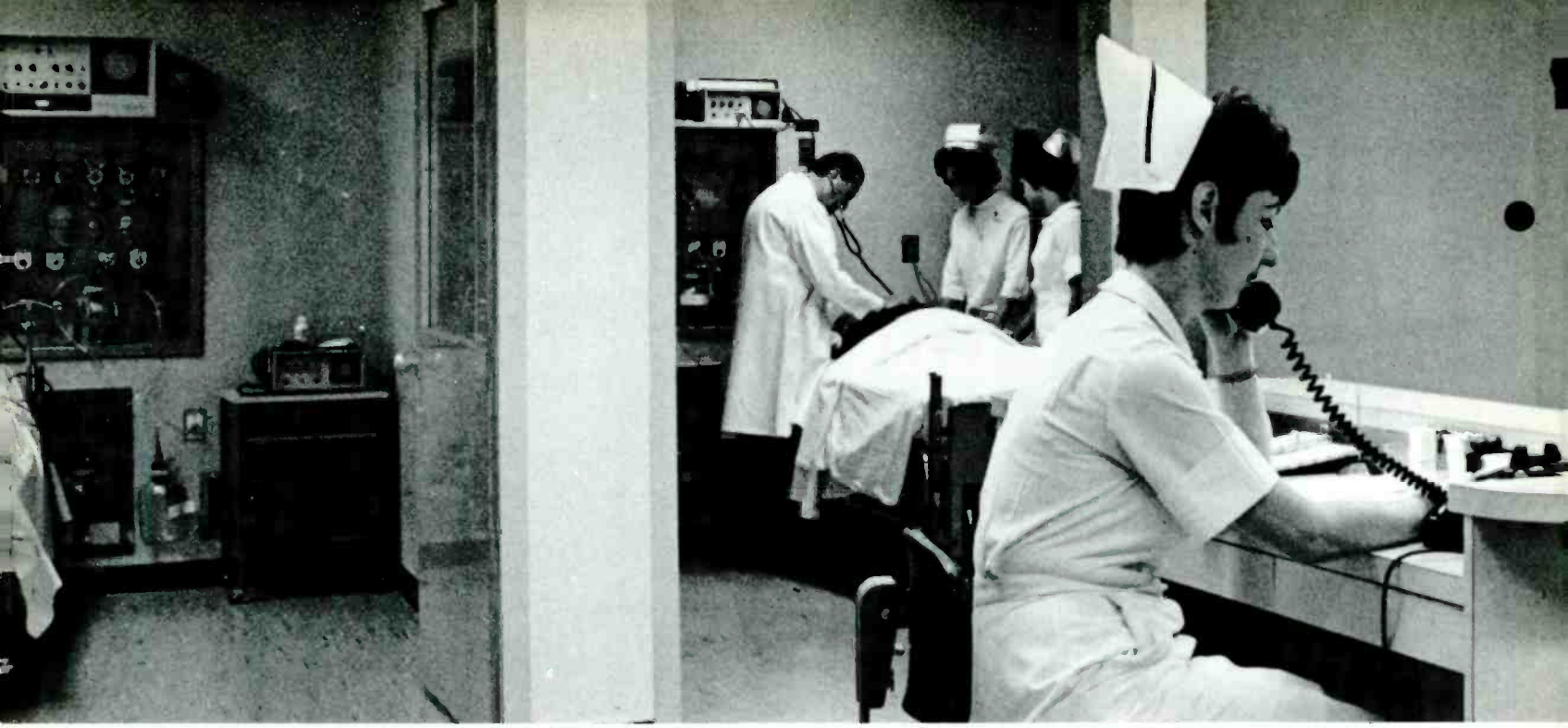
Just as the manned flights have influenced the evolution of the ships, the increasing complexity of unmanned projects — particularly the deep space probes — has given impetus to the further development and improvement of their tracking capabilities. Two of the original Eastern Test Range Cimavis, the *Coastal Crusader* and the *Sword Knot*, recently gained new state-of-the-art telemetry and communications systems. They are now providing valuable data coverage on the Pioneer solar orbiting flights, the Lunar Orbiter moon-photographing missions, and the Surveyor lunar soft-landing shots.

"These deep space programs rely heavily on the ships," observed Tubell. "On ballistic and earth orbital flights, the launch trajectories vary some, but they are still fairly uniform and standard. However, when you begin going for solar orbits and the deep space targets, the trajectories become much more variable, and this, of course, emphasizes the importance of the ships since they can be moved about to match the trajectories."

Not only can the ships now acquire more and higher quality data but they can also transmit data with amazing speed. On a deep space shot, for example, a scientist in California can monitor a spacecraft function the instant it occurs — or in "real time" — from data gathered by a ship in the Indian Ocean, then radioed to Cape Kennedy for transmission across the country — all in a fraction of a second.

This speed in assembling and transmitting data, coupled with the inherent mobility of the ships and the skill of their crews, has enabled the space-age armada to more than fulfill its supporting role in America's space program. ■

A NASA instrumentation aircraft checks out the *Vanguard*, one of the five tracking ships outfitted for the Apollo program.



An electronic cardiac monitor at Saint Barnabas Medical Center, Livingston, N.J., enables hospital personnel to maintain constant surveillance of critically-ill heart patients.

Electronics in the Hospital

by Jan Syrjala

Advancing electronics and medical science, coupled with new social legislation, are creating a new kind of hospital. This new medical institution is vastly more complex, with a bewildering variety of skills represented among its personnel, and increasingly reliant upon electronics for communications and data processing and for assistance in diagnosis and therapy.

Hospital electronics is still in its very early stages, with maturity probably 10 to 20 years away. But it is already a big business. One informed guess is that it totals between $300 and $350 million a year, not including X-ray equipment which has been standard for many years.

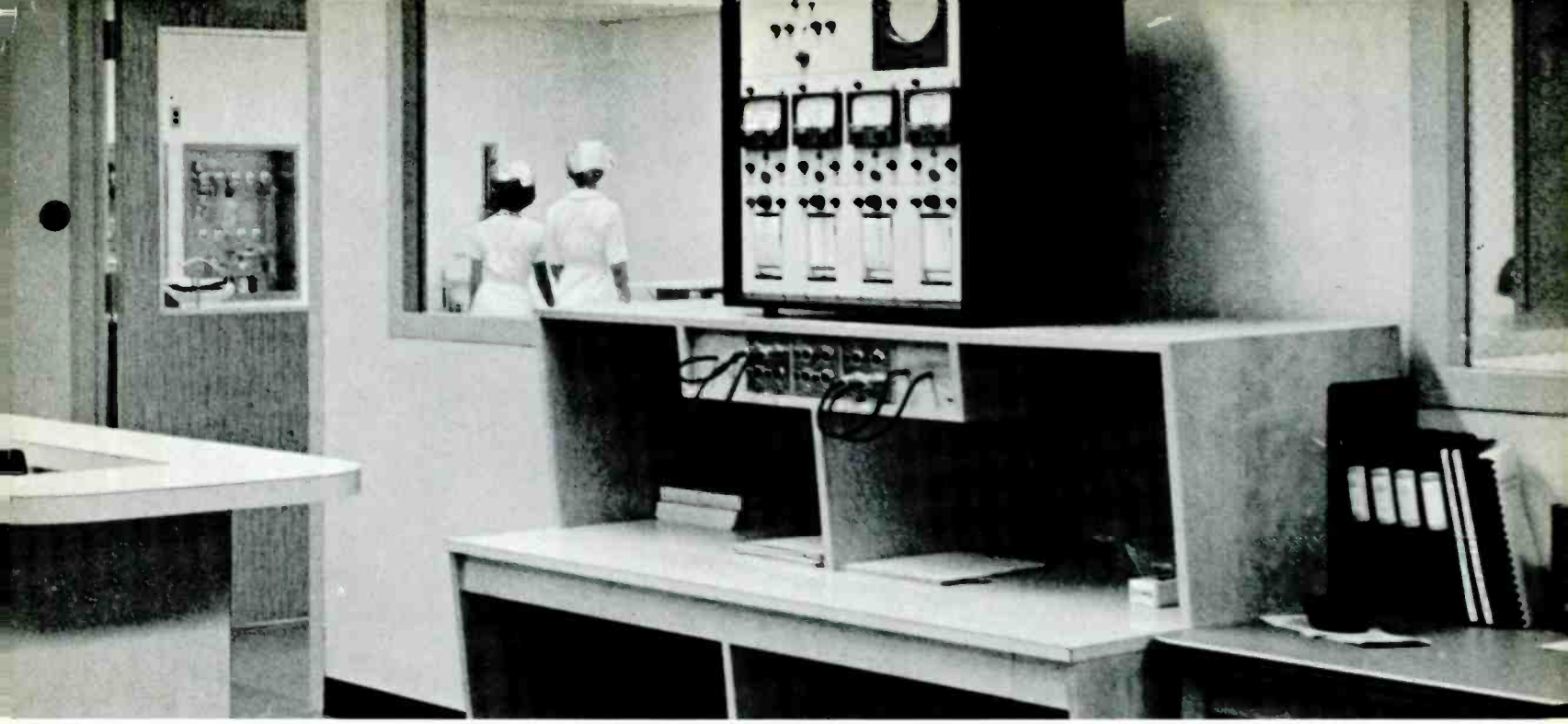
The electronic advances are coming mainly from two directions: from the space program with its enormous skill in telemetering or reading quantities at a distance; and from computer technology. Government-sponsored research is also helping to bring a greater variety of new devices and skills to the treatment of the ill. New social legislation, and particularly Medicare, promises a vast expansion of hospital service. The bookkeeping chore required for the various insurance methods of paying for medical care, whether private or governmental, in itself has become a staggering task.

While much has been reported on the development of electronic techniques and devices for therapy, perhaps the most sweeping transformation in hospital procedures now is occurring in the application of electronics to new systems of communication, measurement, and information handling.

For the patient, the basic communications link is the line to the nurse on duty. For decades this was, and still is, in many hospitals no more than a doorbell with a button, a battery (or a connection to the house power), and a light or buzzer. It is an extremely simple device, but it works — the nurse gets the message that she is wanted at a certain bed.

However, this is the only message the system will carry, and it works in one direction only. In newer electronic nurse-call systems manufactured by RCA and a small number of other firms, the patient pushes a button to call the nurse and can then converse with her through a microphone-loudspeaker behind a grille next to his bed. Electronic amplification makes this mike-speaker so sensitive that even a feeble patient can make himself heard without raising his head from the pillow. The system is much more efficient

JAN SYRJALA is an engineer who has written frequently on electronics for the *New York Times* and other publications.



In diagnosis and therapy, in nurse-call systems and record-keeping, electronics technology is helping create a more efficient medical institution.

because the nurse never has to make two trips, one simply to find out the nature of the call. And the response to urgent needs can be immediate.

The nurse-call system can be integrated with remotely controlled television. The small, spade-shaped bedside unit not only holds the call button and nike-speaker for nurse communication but also the major controls for a television set mounted on the wall of the room. The patient tunes the set himself and listens through the small speaker, disturbing no one.

Television in the hospital is more than mere entertainment. Hospitals that use it say that familiar television programs can alleviate or eliminate the boredom and irritability that afflict many convalescing patients, and thus contribute to recovery.

Closed-circuit television, added to this system, gives a hospital an avenue of information and entertainment of its own. One interesting use, for instance (at Saint Barnabas Medical Center, in Livingston, N.J.), is a camera permanently trained on the main lobby which allows a patient to see a visiting friend the instant he comes in.

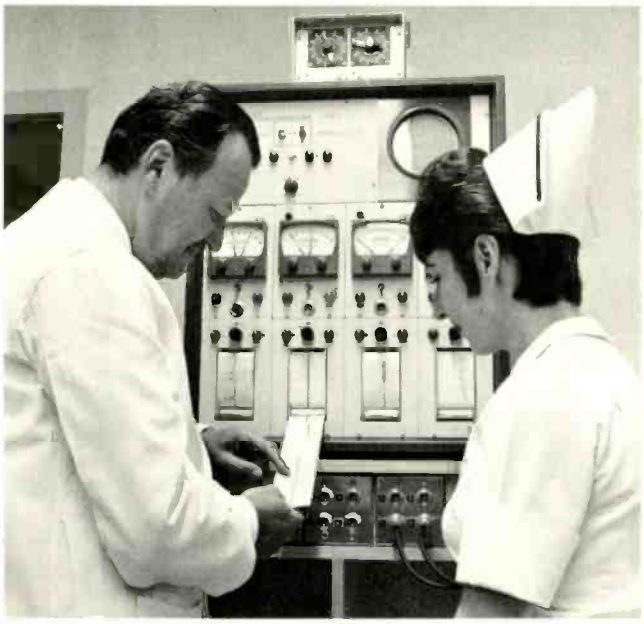
Another whole class of electronic communications systems comes under the heading of "patient monitoring." The information handled is the state of some aspect of the patient's condition. The unique contribution of electronics is to make it easy to know immediately and continuously, for instance, a patient's blood pressure, or heart rate, or any of a score of other significant physiological factors. And this information can be read, not just beside the patient, but at any convenient point where the "receiving" instrument is set up.

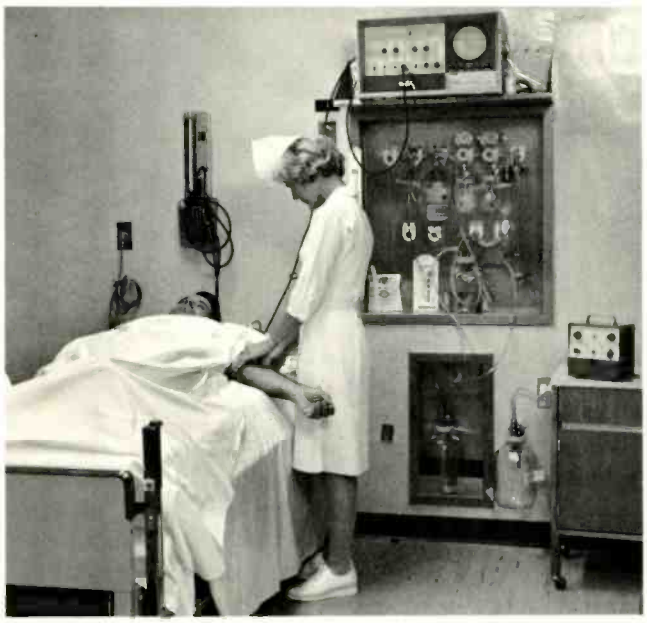
A good example of these systems is the cardiac monitor which, in one form or another, is used in a number of hospitals across the country. About half the persons who have had a severe heart attack will suffer a second attack, an arrhythmia, or irregular heart action, a few days after the first. At one time, about 80 per cent of these secondary attacks were fatal, partly because the beginning of an arrhythmia is hard to detect.

A coronary patient is wired up to the monitor, which displays and records both heart rate and blood pressure for constant surveillance by a trained rescue team at a central point. Built into the monitor is a "counting" circuit which will "recognize" any of the 24 typical arrhythmias. If one is received from any of the patients being monitored, the monitor rings an alarm bell, and the rescue team can be with the patient within seconds.

Another quite spectacular use of electronic monitoring

The master control of the cardiac monitor at Saint Barnabas Medical Center records both heart action and blood pressure.





The patient is wired directly to the monitor. Alarm bell rings when an irregular heart action is detected.

is the tiny capsule-size transmitter, which is swallowed or otherwise inserted into the body to send out via radio a continuous account of some internal condition, such as the pH, or acidity, of the stomach. The range of electronic monitoring is extremely wide, provided the condition to be monitored can be reached, and read, by the "transducer," the tiny instrument that converts the changing body state into electrical signals. And the monitor can be constructed to give an alarm at the occurrence of any selected level or combination of conditions.

The electronic computer brings into the hospital another battery of communications skills that promises, over the next decade, to transform medical care thoroughly. Not the least important of these is the computer's extreme efficiency of record-keeping. A person's whole medical insurance history may some day be carried on a small card that could be read by a computer. The new information developed by the use of hospital services can be added to the card by the computer. Or, in another form, the patient's insurance history can be stored by the computer itself, which instantaneously makes all necessary revisions as new information is fed in. Whenever it is queried, the computer furnishes in readable form the patient's up-to-the-minute status. The exact forms that these systems will take is now more a matter of cost and convenience than of technology because the basic technology is already well developed.

But insurance data processing is just the beginning of what the computer can do for the hospital. With a "memory" stocked with medical information, a computer could speed diagnosis dramatically. The doctor feeds in a set of symptoms, the computer instantly comes back with its suggestions as to what they mean, perhaps indicating additional tests that should be made. The patient's medical history also could be stored and made available on inquiry.

It is even conceivable to have the patient wired directly to the computer, so that no hospital personnel need "read" the symptoms and then tell the computer what they are. But this might not be always suitable for treatment. Medical scientists are currently engaged in experimenting with the virtually infinite resources of electronic communication in order to develop those that will help them and to dispose of those that might tend to get in their way or not be worth the cost of continued research and development. Many proven systems have gone into wide use, such as the cardiac monitor. But experimentation and evaluation are going to continue for a long time.

The problem of how best to use the computer is sometimes solved through the following method. A general-purpose machine, which tends to be a rather large and expensive one, is installed. At first, it may be used for accounting, but the addition of various kinds of "input" equipment, as needs are proved, gradually enlarges its scope until the computer handles many kinds of information for the hospital — medical histories, diagnoses, the results of laboratory tests, doctors' orders, the carrying out of those orders, and so forth. It becomes a Hospital Information Service with information defined in the broadest possible way. In such services, electronic communication promises to raise the efficiency of medical care in hospitals far above its general level today. ■

American TV adventure series are popular overseas, particularly in Africa.

American Television Abroad

Expanding broadcast schedules and audience popularity have created an unprecedented foreign demand for U.S. television programs.

by Al Husted

Television shows have become one of the most sought-after United States products for foreign consumption.

Today, 60 per cent of the estimated 181 million television sets in use in the world are owned by people in other countries. Approximately 1,600 stations are broadcasting daily on 4,800 channels in more than 100 foreign countries. Not unlike their American counterparts, these foreign stations have an insatiable appetite for television programming to fill their expanding broadcast schedule. Most of the television stations in the world have increased their telecasting schedules from three to five hours a day to an average of more than seven hours a day. International television specialists estimate that the total number of broadcasting hours will increase by more than 100 per cent within the next five years.

While the explosion in the number of broadcast hours overwhelms foreign television film producers, another explosion is upon the world: color television. Today, color is broadcast regularly in the United States, Canada, and Japan, and the leading nations of Europe and Latin America are preparing to advance soon from pilot programming to regular color broadcast service. But at this time, only U.S. television film distributors, and primarily NBC International, have a large number of color television programs available for purchase.

Demand and technology are two of the reasons why television programs produced in the United States are seen in other countries. Another important reason is their popularity. Although other countries do not generally have rating services as we know them, reports of a program's audience are recorded in popularity polls.

The most popular U.S.-produced program abroad is "Bonanza." The best estimate of that program's weekly audience is 350 million persons in more than 70 countries. It is possible that no other television series has ever had — nor will have in the immediate future — such a large following. In second place in audience popularity is "Dr. Kildare," which is seen in more than 60 countries. "Get Smart" is running third on the NBC books and is seen in

AL HUSTED is with the NBC Press Department.

Japanese television audiences can comfortably separate reality from fantasy.

43 countries. After an audience popularity check, one television station in Europe renewed its contract with NBC for additional programs of the latter series even before the first group of programs had been shown.

U.S. television producers are thoroughly aware of foreign markets. *Broadcasting Magazine* estimated the international sale of U.S. television properties would reach a record high of $80 million this year. According to that publication, this is a 6 per cent increase over the estimated sales volume in 1965 of $76 million. Canada leads all other foreign nations in the buying of U.S. television properties with an estimated 1966 expenditure of $20 million. The estimated expenditures for other countries are: Australia, $16 million; Japan, $12 million; Latin America and the Caribbean countries, $11 million; Western Europe, $7.5 million; United Kingdom, $7 million; Far East (excluding Japan and Australia), $3.5 million; and the Near East and African countries, $3 million.

With all this money to spend, who decides what is to be purchased for overseas broadcast? In some cases, the viewers, more often the broadcasters, and sometimes the local government.

Popular or selective viewing decides the success of some U.S. television shows. For example, families in Latin American countries usually are dominated by a strong father or strong husband image. Only those U.S. television programs in which the father meets this standard are popular.

However, it is the overseas broadcasters who ultimately determine which United States shows are seen in their countries. The foreign television station, often government-controlled, selects the show believed to hold the greatest interest for that country's audience. The decision to show "Laramie" and "The Lawless Years" to the British public would be made by the British Broadcasting Corporation or the Independent Television Authority — not the U.S. producer. And it is also the decision of the foreign broadcaster to televise an NBC White Paper or a "CBS Reports."

Documentaries are particularly well received by most foreign audiences. According to popularity polls, NBC documentary and educational programs, such as "Continental Classroom," "Watch Mr. Wizard," NBC News Specials, White Papers, and the "Wisdom" series are popular abroad. "Profiles in Courage" was an immediate success overseas.

Television production centers in other countries have not developed news organizations to compare with those of the three major networks of the United States. Therefore, the international sales wings of the U.S. networks, and in the main NBC International, supply the majority of news and documentary programs broadcast around the world.

There are some restrictions that prevent many U.S. television productions from appearing overseas. Many foreign governments have placed quotas upon the number of television programs their stations may purchase from other countries. Consequently, the most appealing U.S. television products are selected by the programming staffs of the foreign stations. Even some outstanding U.S. television shows are not made available to the foreign audience because contracts for international distribution cannot always be obtained from guest stars on some variety programs and dramatic shows.

Because their shows are sold abroad, U.S. television producers are becoming increasingly mindful of the foreign climate. Plans for on-location television production in 1967 and 1968 include an increasing number of United States programs with background material filmed abroad. "I Spy"

already uses many Hong Kong, Italian, and Japanese backgrounds. Even "Bonanza" executive producer David Dortort is considering overseas production.

Although shows that are slightly "de-Americanized" by including foreign locations are very popular overseas, the same shows frequently are not bought by stations in the countries in which they were filmed. Programs with a Japanese background are not always popular in that country. Japanese broadcasters apparently feel that American interpretation of the Japanese way of life will not appeal to their people.

U.S. television producers must keep foreign social customs in mind when planning to distribute a series abroad. Sex, comedy, music, and action-adventure tailored for Americans are particular problems in shows sold to overseas broadcasters.

Although dramas dealing with illegitimate children and social indiscretions often receive mixed acceptance in the United States and Australia, they are considered quite acceptable in the Scandinavian countries.

Subtle American humor sometimes gets lost in translation in programs broadcast in other countries. Even in Canada, however, American humor does not always make sense. Around the world, our political and satirical humor goes over about as big as a copy of *Punch* in a burlesque house. But, slapstick is universally understood and liked. A pie in the face is worth more to the foreign producer than a half-hour of classic Bob Hope one-liners on contemporary Americana.

As in comedy, action is the key to success in foreign acceptance of dramas and adventure series. The sales records of hard-riding Westerns, action-packed war stories, slug-'em-out detective shows, and sword-slashing adventure programs prove to U.S. producers that story lines must develop fast and characters should be muscular.

Music is not always the universal language. At least, American music does not always have the charm to soothe television audiences overseas. Although most Mexicans love "Hullabaloo" as much as do Americans, older people from many other countries are not as interested. But, teen-agers and the young-thinking set would not miss "Hullabaloo," whatever their birthplace.

Perry Como's smooth, effortless style is enjoyed by hundreds of thousands of people. But, in Italy, where the popular singers have gusto and force, his relaxed style has limited appeal.

Germans enjoy both series and documentaries. For example, programs sold in Germany include such series as "Bonanza" and "Hullabaloo"; and such documentaries as "Who Shall Live?" about life-saving kidney machines, and "California the Most," about life in the fast-growing, sun-fun state. In West Germany, there are two television networks, ARD and ZDF. Buying U.S. programs has become a specialized profession at ARD. One man buys the action-adventures, another buys the comedies.

Far Eastern and African countries prefer entertainment programs to documentaries. Thousands of fan letters each month come from African countries to the stars of "Bonanza." In Nigeria, some of the other popular programs are "The Deputy," "Hennesey," "Kentucky Jones," and "Get Smart." In Ethiopia, "Dr. Kildare" is in its third season. "Dr. Kildare" is also liked by the Japanese. Other shows seen in Japan include "Panic," "I Spy," "Victory at Sea," "Michael Shayne," and "Blue Angels."

Britons and other Commonwealth citizens will not accept the rough physical action that is seen in some U.S. shows. On the other hand, Australians like high-powered action and physical conflict. Outright brutality is not accepted by any foreign country, just as it is not accepted in the United States. Lately, some British television film producers have integrated rougher action in their series to attract U.S. program buyers.

"Hullabaloo" is universally liked by teen-agers and the young-thinking set abroad.

A sequence of "I Spy" is filmed in Italy. American television producers are increasingly using foreign locales to stimulate overseas sales.

The different international attitudes toward action and violence in children's programs were pointed out when NBC Enterprises co-produced an animated series with Mushi Productions in Japan. It seems the Japanese can comfortably separate reality from fantasy and do not object to a children's program in which death is presented. In one of the co-produced "Astro-Boy" episodes, the story included a highway accident in which a hot-rod driver kills a pedestrian. For syndication in the United States, the plot of the program was softened by skilled translators. Instead of being killed by a hot-rod driver, the pedestrian was slightly hurt in an unavoidable accident. The audience could then identify with the young driver of the automobile and sympathize with both the driver and pedestrian.

Although many NBC documentaries are broadcast in Japan, the English-speaking countries are the biggest buyers of this type of program. United Kingdom television stations buy many documentary programs that treat history from an American point of view. Some actualities sold in England include "American Landmark: Lexington and Concord," "America the Beautiful," and "Vietnam: It's a Mad War." "Meet the Press" has also been seen in England.

Around the world, every type of television program produced in the United States has had some exposure. An American traveling from country to country will see evidence of the popularity of U.S. programs. But he may miss some of the more subtle results these shows have on the local society.

In a Middle Eastern country, for example, it was a violation of social and religious mores to use a drawing of a whole person for any purpose. Even pedestrian-crossing signs along the busy streets showed only the torso of a man crossing a street. After television came to the country, people became used to seeing a person from head to toe on the screen. Now, the old pedestrian crossing signs are being replaced with a new drawing of a complete person.

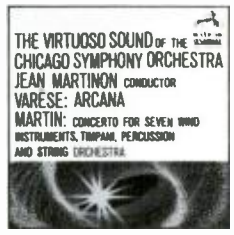
A traveler from the United States may feel bombarded with U.S. programming as he gallivants in other countries. Restaurants are named Bonanza, hotel doctors talk about Dr. Kildare, children play Laramie, and everyone is eager to talk about the "American" television show he saw the night before.

Along one street in a Far Eastern country, dozens of small restaurants line the shore of a river. Each of the open-air establishments has a television set that is always tuned to whatever U.S. television program is being broadcast. It is possible for the traveler from the United States to walk for miles along this beautiful river — viewing magnificent mountains on one side, seeing sampans floating on the river below — and have as his constant companion one or another of the television programs from back home. ■

"LEONTYNE PRICE — PRIMA DONNA": *Francesco Molinari-Pradelli conducting the RCA Italiana Opera Orchestra (RCA Victor LM/LSC 2898).* As one of the world's leading prima donnas, Miss Price was selected to sing at the world première of Barber's "Antony and Cleopatra" on opening night of the new Met at Lincoln Center. For this album, she has recorded nine arias, covering 250 years of operatic history and depicting nine diverse heroines from Purcell's "Dido and Aeneas" to Barber's "Vanessa." All of these arias are from operas that Miss Price has yet to sing on stage in their entirety. This Dynagroove recording was produced in RCA's Rome studios by Richard Mohr.

WAGNER: LOHENGRIN: *Sándor Kónya, Tenor, and Lucine Amara, Soprano, with the Boston Symphony Orchestra, Erich Leinsdorf, Musical Director (RCA Victor LM/LSC 6710).* This first complete American recording of a Wagner opera is also the first complete opera recording by a major American symphony orchestra since the days of Toscanini and the NBC Symphony. It is, in addition, the first complete recording of "Lohengrin" ever made. The cast of carefully hand-picked stars is heard at its best in the resonant Dynagroove sound, and the Boston Symphony Orchestra, supplemented by the Boston Chorus Pro Musica, gives a glowing performance of Wagner's great score.

"SHOW BOAT": *Original cast recording of the Lincoln Center production, starring Barbara Cook, Constance Towers, Stephen Douglass, David Wayne, and William Warfield (RCA Victor LOC/LSO 1126).** Another smash-hit revival by the Music Theater of Lincoln Center, produced by Richard Rodgers, which ran to SRO houses at the New York State Theater last summer. In addition to the great songs of this enduring Broadway musical classic by Jerome Kern and Oscar Hammerstein, 2nd, there is "Bill," with original words by P. G. Wodehouse. The lavish production went on tour after completing its successful run at New York's Lincoln Center for the Performing Arts.



For the Records...

NEWS OF RECENT OUTSTANDING RCA VICTOR RECORDINGS

"OPENING NIGHTS AT THE MET": *Historic Recordings of Metropolitan Opera Stars Re-creating Their Celebrated Opening Night Roles (RCA Victor LM 6171).* An historic Limited Edition, saluting the passing of the old Met and containing arias by 32 great RCA Victor recording artists from 21 operas in which they appeared on 30 glamorous "opening nights at the Met," never before on LP. Each album contains a precious memento of the beloved old building on 39th Street in the form of a swatch from the golden curtain.

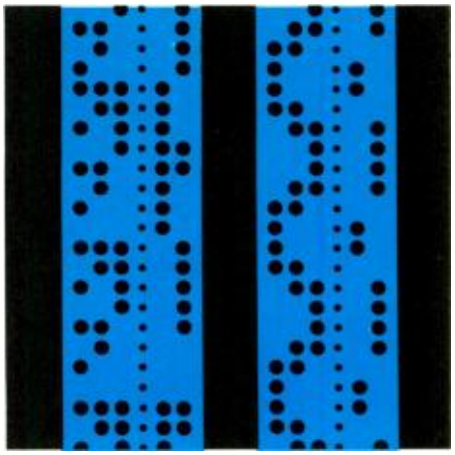
"IN MY QUIET ROOM"—HARRY BELAFONTE *(RCA Victor LPM/LSP 3571).** Belafonte's first solo album in some time of popular songs in English is built around the theme of "my quiet room" and reflects the many moods of this peerless singer and artist. Belafonte has won an audience of millions by his unrivaled ability to create a mood of intense personal intimacy, a mood he sustains throughout the lovely, offbeat ballads in his new album. Among them are "Summertime Love," "Raindrop," and "I'm Just a Country Boy."

"WHAT DID YOU DO IN THE WAR, DADDY?": *Music from the film score composed and conducted by Henry Mancini (RCA Victor LPM/LSP 3648).* The miracle team of Blake Edwards and Henry Mancini has come up with another hilarious, action-fun- and girl-packed musical in the manner of their last year's hit, "The Great Race." Mancini's score deftly heightens the action of this World War II comedy and melodiously serenades the incomparable beauties of Sicily — both the girls and the scenery, as well as the festal setting.

OTHER CURRENT RELEASES

**Also available in 8-track stereo tape.*

Electronically



Speaking...

COMPUTER TRAINING PROGRAM

The Oklahoma State Board for Vocational Education recently initiated a unique program that will help meet the critical need for trained data processing personnel — a need that is expected to exceed 500,000 persons by 1970.

Students at four Oklahoma Area Vocational-Technical schools, three junior colleges, and a technical institute embarked in September on a two-year training program that will include instruction in basic and advanced computer programming, computer operation, and systems analysis. Inquiries have already been received by the Oklahoma board from companies that want to know when the first graduate programmers will be available.

The program will make use of an elaborate data communications network that initially will include nine computers — an RCA Spectra 70/35 and eight RCA 301 systems, as well as peripheral equipment. As students are trained in the fundamentals of programming, they will prepare their own punched-card programs that will be read into the 301 computer at their school. Each student's program then will be transmitted to the Spectra 70 at a data center in Oklahoma City where it will be checked by the advanced computer and returned to the student in printed or punched-card form.

HIGH-SPEED DATA SERVICE

The Social Security Administration has become the first international computer user of a new service that permits the high-speed transmission of data from one overseas point to another. Commercial operation of the new service, called datel by its sponsor, RCA Communications, Inc., was inaugurated when the government agency transmitted data concerning its new Medicare program from San Juan, Puerto Rico, to the Administration's data processing center in Baltimore.

Datel is a high-speed customer-to-customer service similar to telex. It makes available on a time or a demand basis a means by which data on punched paper tape may be transmitted overseas at speeds equivalent of up to 2,100 words a minute. The service is also being used by Social Security to send Medicare information from Hawaii to Baltimore.

ULTRAVIOLET LASER

A tiny, transparent platelet of zinc oxide — the phosphor material with properties similar to those used on the face of a television picture tube to emit light when struck by electrons — has made possible the development of the first solid-state laser to produce ultraviolet light. The discovery is of both scientific and practical importance, since lasers of this kind might be used to produce novel types of TV picture and radar displays as well as high-speed computer print-out devices.

Developed by scientists at the RCA Laboratories, Princeton, N.J., the laser is activated by firing an electron beam at the rate of 2,000 pulses per second at the zinc oxide platelet mounted on a metal support housed in a glass vacuum tube. At first, the material glows green, but when the power of the electron beam reaches a certain critical intensity, the light streaming from it suddenly becomes coherent. At the same time, the light shifts predominantly into the ultraviolet and emerges as a narrow beam of laser light.

NEW TOOL FOR SOCIAL SCIENTISTS

A high-speed computer system that will have for instant recall nearly 400 million answers to questions asked in public-opinion polls since 1936 is to be installed this fall at the Roper Public Opinion Research Center at Williams College.

Donated by RCA to the Research Center, the computer, with its massive file of public-opinion data, is expected to become a valuable tool for social scientists involved in research for education, government, and industry. Committed to the computer's memory will be the results of more than 7,000 studies conducted in the United States and abroad by Roper, Gallup, and 101 other American and foreign polling organizations.

A researcher, for instance, may want to know how the American people view the selective service system. Using the computer, he will be able to learn in a matter of minutes how public attitude toward the draft has changed since 1936. Or an economist may request information on how housewives in Greece spend their money. The computer will be able to compile a statistical breakdown of major consumer expenditures in 28 countries, based on data from its archive.

During 1967, the computer will be linked by telephone line to the University of California at Berkeley, the Massachusetts Institute of Technology at Cambridge, and the University of Michigan at Ann Arbor in a telecommunications experiment sponsored by the National Science Foundation.

"SELF-HEALING" SOLAR CELLS

A "self-healing" solar cell that is expected to be 50 times more resistant to radiation damage than present-type silicon cells has been developed for operation aboard spacecraft in the Van Allen radiation belts and other areas in space.

Most present spacecraft derive at least a portion of their power from cells that convert sunlight to electricity. The new type of cell, developed by RCA's David Sarnoff Research Center under contract to the National Aeronautics and Space Administration, derives its "self-healing" property from the presence of minute quantities of lithium diffused through its structure.

Radiation damage occurs when a high-speed electron, proton, or gamma ray bursts into the orderly rows of silicon atoms and knocks them out of position, leaving a gap. Such gaps act as electron traps and reduce the flow of current from the cell.

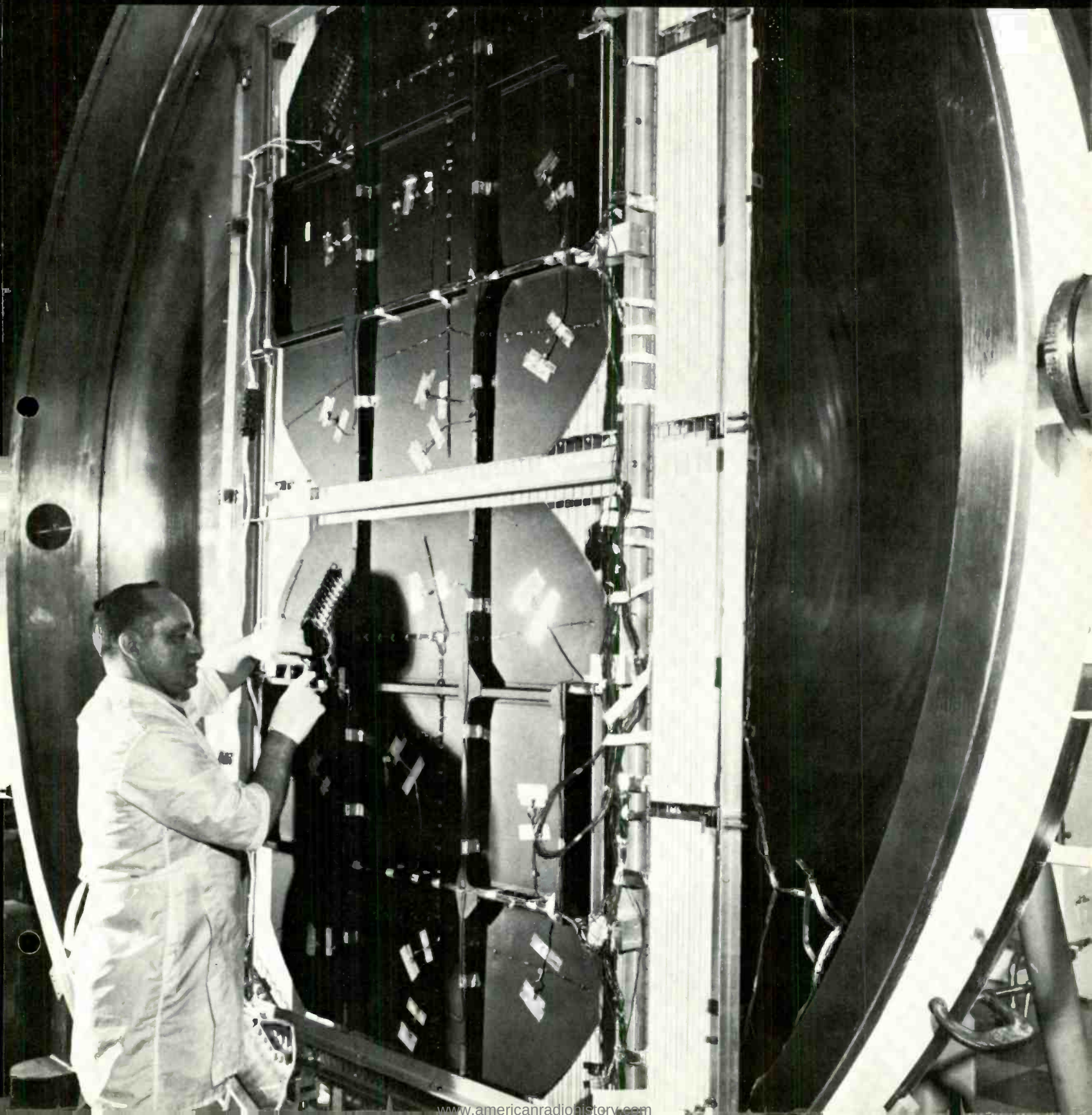
When lithium atoms are present in such cells, they are constantly on the move and ready, whenever a vacancy occurs, to fill or otherwise neutralize it. Thus, there is no degradation in the performance of the cell. In addition, the weight of the solar cell shielding can be reduced by as much as 90 per cent.

NEW SOLID-STATE TECHNOLOGY

Germanium and silicon, the basic materials used in present solid-state electronics, will soon be joined by a third substance — gallium arsenide — in the continuing effort to design and manufacture a wide variety of new high-performance electronic communications and information processing devices.

Development of the first practical technology for the use of gallium arsenide and its alloys is expected to have significant impact on the electronics industry by providing the basis for new equipment that employs light or extremely high frequency radio waves for earth and space communications, for electronic displays and information processing, and for achieving many basic components of radically improved performance. The new technology was perfected by Dr. James J. Tietjen of the RCA Laboratories technical staff in a program sponsored in part by the Department of Defense.

Hot and cold temperature extremes of the lunar environment are simulated in this clamshell-like chamber at the RCA Space Center, Princeton, N.J. Undergoing testing are the solar panels of the Lunar Orbiter spacecraft, the first model of which was launched on August 10 from Cape Kennedy. A few days later, the Orbiter began transmitting pictures of potential sites for a manned landing on the lunar surface. The RCA-built solar panels convert sunlight into electricity to operate the power systems of the spacecraft.



ELECTRONIC AGE

RCA *Autumn 1966*

Holography: Recording Light in Three Dimensions.