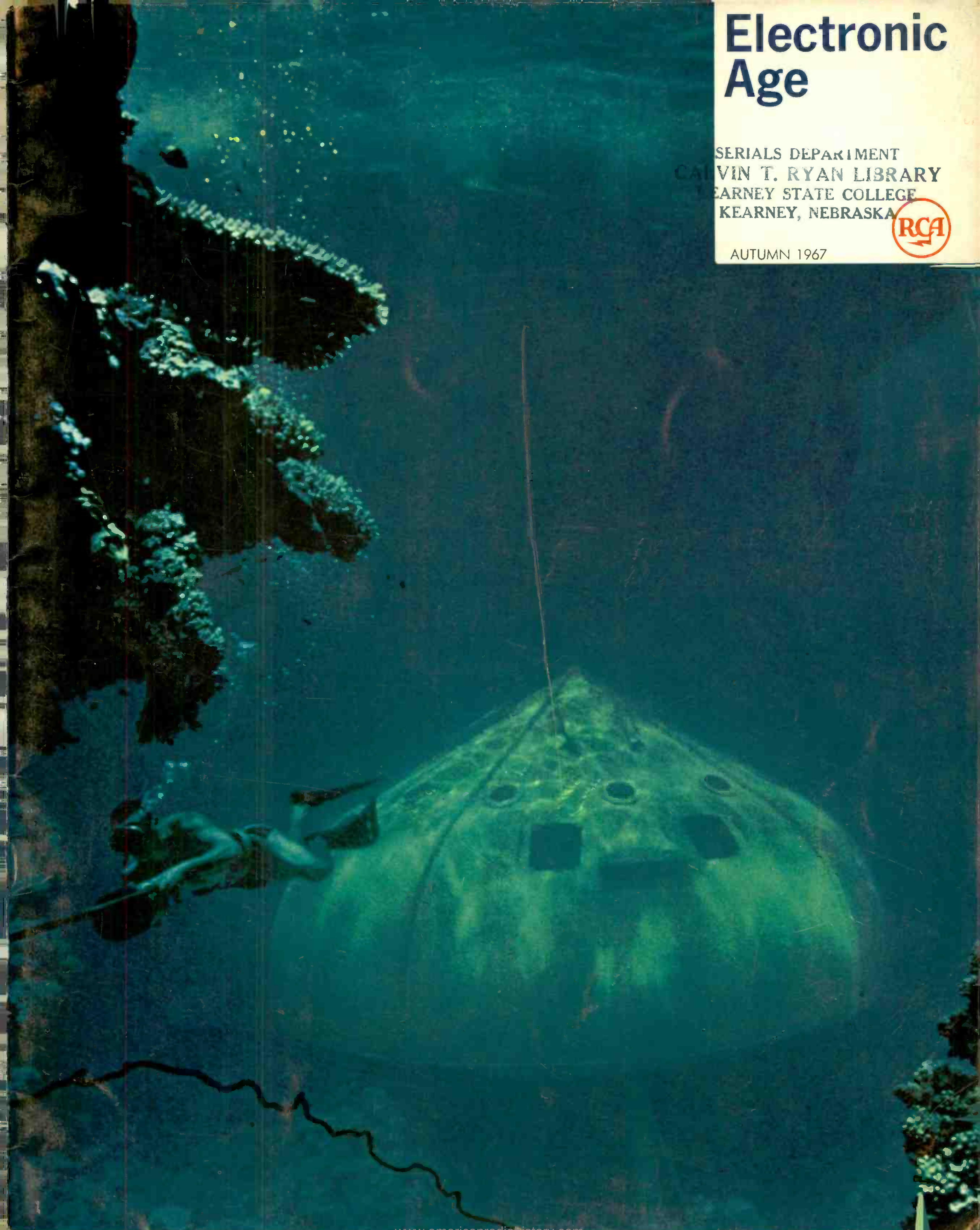

Electronic Age

AUTUMN 1967

A 17th century lunar map. For an article on lunar nomenclature, see page 12.

Electronic Age

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

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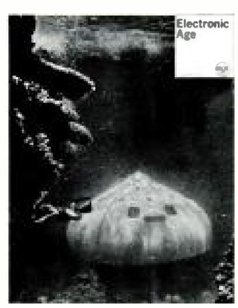
CONTENTS: AUTUMN 1967 Vol. 26/No. 4

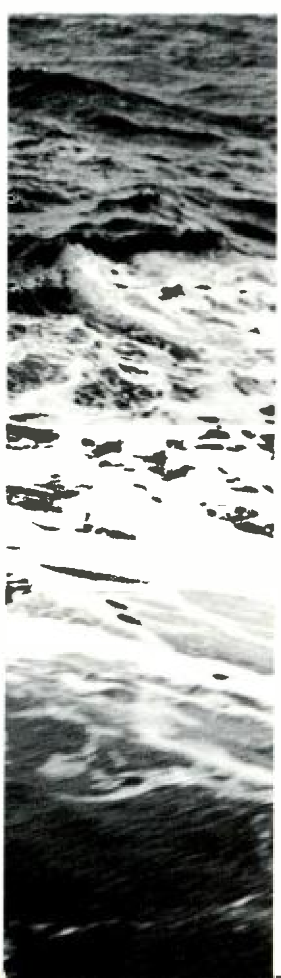


Cover: On a coral ledge 36 feet under the Red Sea rests the Conshelf Two, an oceanographic research structure developed by Capt. Jacques-Yves Cousteau. The structure provided the habitat for five men who were attempting to prove that man could live and work under the sea for extended periods. Man-in-the-sea programs are but one aspect of the developing science of oceanography that is discussed in an article beginning on page 2.

Oceanography: The New Frontier

A concentrated effort to unlock the vast food and mineral resources of the sea may become one of our most important national programs.

by Jan Syrjala



In the next few decades, man will go down, and into, the sea on a scale never before imagined. Investing his time and resources at a level that may, in a few years, match the present investment in space research, he will probe deeply into the ocean, learn to live and work beneath its surface, and begin to harvest its enormous food and mineral resources. Central to this effort will be the tools and technology made possible by modern electronics.

The chief research instrument of oceanography—a broad slice of science and technology that includes the biology, geography, geology, currents, weather, and all the other facts of the surface and subsurface oceanic world—is the oceanographic research vessel. One of the spurs to an intensified program of oceanographic research in this country was the discovery a few years ago that the U.S.S.R. was far better equipped with such vessels than the United States.

In the last few years, a number of large vessels have been built, among them the National Science Foundation's *Anton Bruhn* and the U.S. Bureau of Commercial Fisheries' *Albatross IV*, and the Navy's *Silas Bent.* One of the newest is the Environmental Science Services Administration's (ESSA) *Oceanographer.* A sleek, 303-foot-long vessel equipped with the latest RCA communications and navigation gear, the *Oceanographer* set sail in March on an around-the-world expedition that is expected to add much to man's knowledge of the sea and what lies beneath it.

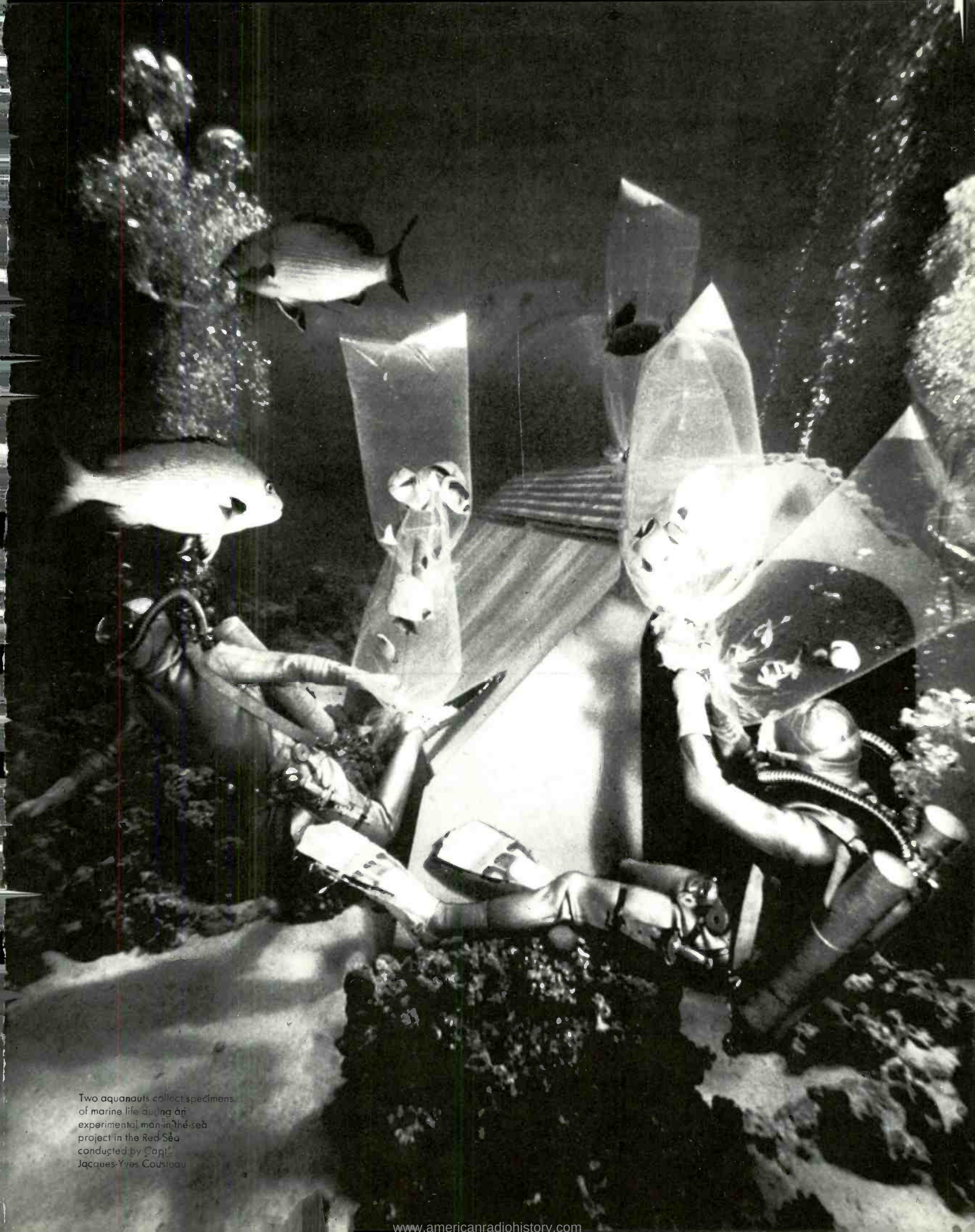
The oceanographic vessel is a floating electronics laboratory that carries a wide variety of sensing instruments to collect data on many characteristics of the surrounding ocean. The bathythermograph, for instance, reads temperature as a function of pressure (or depth) from surface to bottom. The information is sent in electrical form back to the ship via cable. The expendable bathythermograph or XBT utilizes a small expendable wire to transmit the same information and is closely analogous to the expendable radiosonde that radios back air temperatures, pressures, and humidities from a rising balloon.

Electronics is similarly present in a number of other instruments. The salinity of the water is determined by calculating the electrical conductivity of a fixed sample. Turbidity is measured by its light-transmission characteristics; density by the speed with which sound, or sonar pulses, passes through it. The geology of the ocean bottom is given by sensing the tiny alterations in the force of gravity. The water's depth is measured by the time it takes sonar pulses to go from ship to bottom and back to ship.

Getting the information out of the water is just the beginning for electronics. On board the research vessel is an elaborate electronic array that includes recording equipment and specialized computers that have been programmed to suppress electrical noise and emphasize the data signal. These same data-retrieval techniques have been brought to a high level in the space program; without them, the pictures transmitted from the moon would be hopelessly marred.

The ship also carries chemical and biological laboratories for the study of animal and plant life from the sea. Fish nets, dredges, spears, and hook and line are used to gather samples. Boring or deep-dredging equipment takes solid samples from the bottom. Weather sensing instruments, including weather radar, correlate winds, air temperatures, and clouds with ocean conditions. Finally, as on any ocean-

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



Two aquanauts collect specimens of marine life during an experimental man-in-the-sea project in the Red Sea conducted by Capt. Jacques-Yves Cousteau.

going vessel, navigation and communication depend on electronics in radio, radar, loran, and related fixed-shore-station electronic navigation systems.

The government's oceanographic program is directed principally through the National Council of Marine Resources and Engineering Development, an interagency group headed by Vice President Hubert H. Humphrey. As yet, there is no move for a single superagency or a "wet" NASA to assume control of government oceanography. But the Council has real power; it is not just a device for juggling existing agency programs. It is forming some grand battlelines for the attack on the oceans.

One of the most important involves the search for new sources of protein, the life-giving substance that promises to be in ever-short supply as the world's population soars. The ocean is the greatest untapped storehouse of this vital compound. Oceanographers believe, for instance, that our take of fish could be increased as much as 10 times without endangering the world's future supply.

The main problem is to find the fish. Deep-ocean fish tend to concentrate in schools that occupy infinitesimal fractions of the ocean territory. Even those species with habitual locations, such as cod on the Newfoundland Banks or the albacore and blue-fin tuna off the Pacific coast, leave their "stands" periodically, causing drastic fluctuations in the economics of the fishing industry.

Marine biologists now believe that each species likes a particular mix of ocean conditions—temperature, salinity, turbidity, and so on—and that the migrations reflect alterations in these conditions. The first problem is, then, one of research. Those ocean conditions that each of the important species prefers must be identified. Next, a vast monitoring system is needed that will tell where these conditions are prevailing.

Electronics is at work on both problems. For instance, the *Albatross IV*, which is a highly mechanized trawler as well as an electronics laboratory, is taking fish in many areas and correlating the species with the ocean conditions where they are caught. Other vessels of several other institutions have vessels doing similar work. The Bureau of Commercial Fisheries and several of the academic institutes are doing extensive wet-laboratory work on the problem. The U.S. Fish and Wildlife Service, together with the American Museum of Natural History, for several years has been improving the technique of planting small sonar transmitters on fish so that their movements can be followed.

As information accumulates from this research effort, the need for a comprehensive monitoring system will become more urgent. Dr. Oscar Sette of the Bureau of Commercial Fisheries recently envisioned a system in which the following elements would be present: an expanded complement of weather ships anchored on station and equipped not only with weather instrumentation but with ocean-sensing instruments; "ships of opportunity" (commercial ships passing through areas where coverage is needed) equipped with expendable bathythermographs and other ocean-sensing equipment; an army of automatic, deep-anchored buoys with sensors and telemetering equipment for transmitting data to central points; an enlarged complement of tide stations around the world for keeping track of currents; aircraft with infrared sensors for close coverage of surface temperatures;

The ocean's mineral resources are extracted by sea-going oil drilling rigs, such as this one operated by the Standard Oil Co. (N. J.).

and worldwide weather information from weather satellites and other sources.

This great network would, in fact, be a vast electronic instrument in which huge quantities of information would be gathered, communicated, and processed electronically. It would be of utmost value not only to the world's fishermen but to its meteorologists, physical oceanographers, the military, commercial shipping, and many other groups. Greatly improved data for weather prediction might alone justify the large investment.

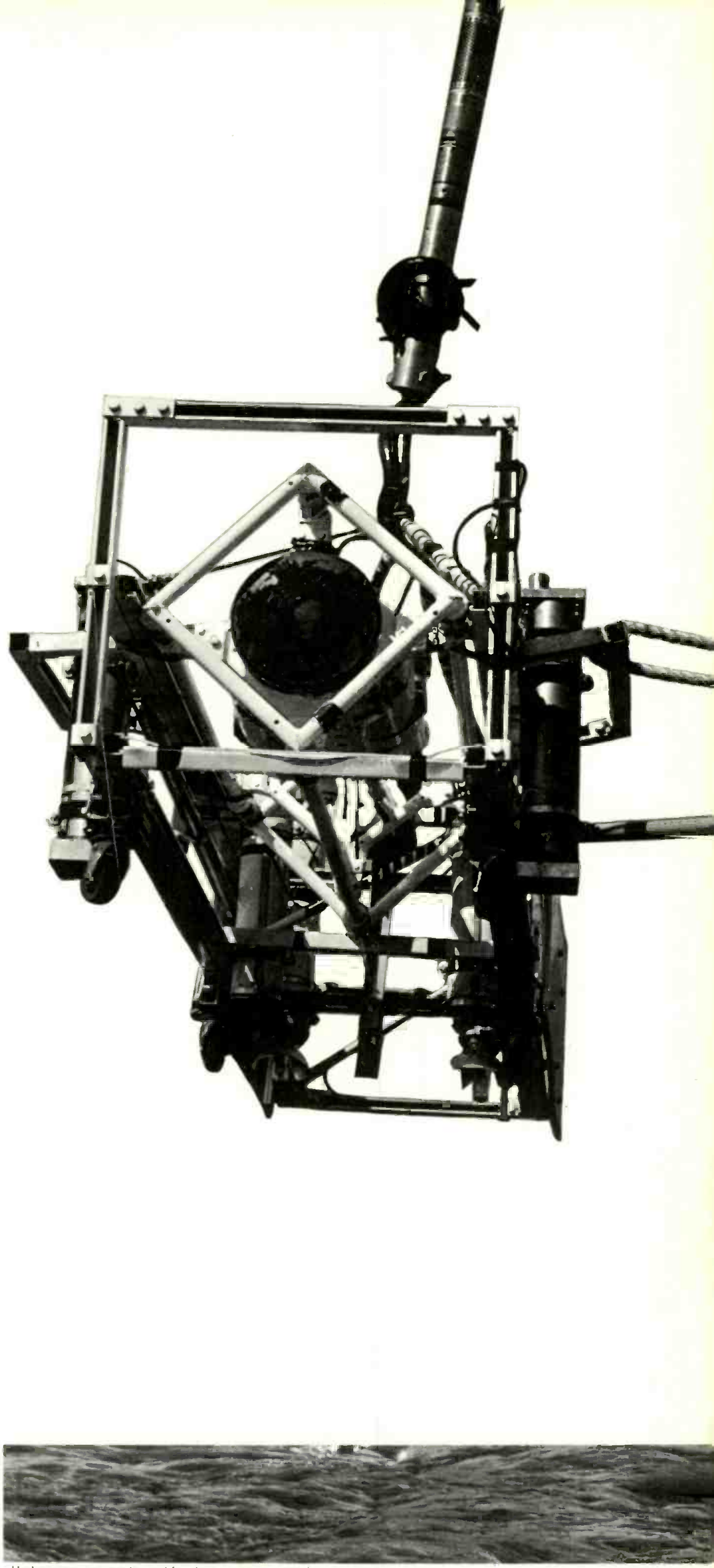
Another important division of oceanography consists of the "man-in-the-sea" and bottom-exploration programs. These programs, involving the Navy and a number of private firms, are focused on the minerals and fuels to be found on and below the ocean floor. The Navy's search-and-rescue, or "Deep Submergence," project, stimulated in large part by the loss of the atomic submarine *Thresher* in 1963, is directed toward finding objects at great depths and developing the ability of men to work far below present diving levels. The successful search for the *Thresher* itself brought forth a number of new techniques. Two of the most fruitful were a high-resolution, side-looking sonar transmitter, towed just above the bottom, which allows the shapes of objects on the ocean floor to be "seen" on the surface; and an unmanned deep-submergence research vessel, equipped with a television camera, that gives an even more detailed picture of a narrow area of the bottom.

Another Navy program, entitled "Deep Ocean Technology," is concerned with extending the operating range of the submarine to great depths. For these and other projects of oceanographic research, the Navy recently proposed that its annual funding, now at about $300 million, be increased to $1 billion by 1970. Rear Admiral Odale Waters, head of the Navy's oceanographic program, predicted that with this increase the Navy could by 1975 have submarines operating routinely at depths down to 20,000 feet (the average ocean depth is 12,000 feet) and colonies of "aquanauts" living and working anywhere on the continental shelf at depths down to 1,500 feet.

The man-in-the-sea program recently moved ahead with a series of experiments carried by the Navy with the assistance of the Scripps Institution of Oceanography in California. During one 45-day stretch, three teams of 10 men lived and worked in an underwater laboratory moored on the bottom at a depth of about 200 feet. The men entered the lab, which was open to the ocean at the bottom, by swimming in with scuba gear. The atmospheric pressure inside the lab had to equal the pressure of the water outside, so the oxygen-helium mixture now standard for safe breathing at high pressure was used.

The experiment was designed to uncover problems faced by both men and instruments in the ocean depths. An elaborate instrumentation package was included in the laboratory and in the ocean so that the aquanauts could communicate with the surface and monitor a large number of oceanic factors, including the weather at the surface. The data were also telemetered ashore, for handling by storage and data-retrieval equipment.

Electronics is an essential tool in another sector of oceanographic research: the development of manned or unmanned deep-diving research vessels. These specialized sub-



Underwater camera is used for deep ocean research.

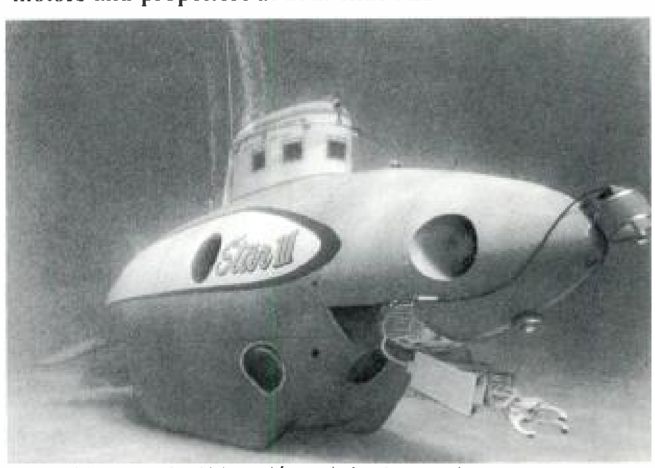
A modern oceanographic research vessel.

marines are eyes, ears, and collection devices for exploring and sampling the ocean bottom. Among the manned types, Westinghouse has built the *Deepstar* series, General Electric the *Star* and the *Aluminaut,* Litton Industries the *Alvin,* and the Navy the *Trieste.* There is a bevy of unmanned types: one of them, CURV (cable-controlled underwater research vessel), with an RCA television vidicon tube in its bow for seeing ahead, helped find the lost H-bomb off Spain in 1966.

Some of the research submersibles can go to great depths. *Aluminaut* will carry three men to 15,000 feet; *Trieste,* three men to 20,000 feet. Typically, *Aluminaut* is equipped with a TV camera and strong light in the bow; sonar depth sounders; three sonar scanning systems for exploring forward, downward, and upward; sonar communications; radio telephone for surface use; and mechanical manipulators for pickup of bottom samples.

By far the largest commercial oceanographic operation is maintained by the American oil industry. Oil companies have invested several billion dollars in prospecting for underwater oil, in drilling wells, and in support systems. The industry has developed salt-water versions of the long-standard seismic prospecting techniques. Electronics is the unifying technology in these efforts. A ship sets off a series of pressure waves in the water with explosives, or high-voltage underwater sparks, or air bubbles that burst at the surface, or mechanical "knockers." These waves travel to the bottom and are reflected from each geological layer beneath to a depth of several thousand feet into the crust. A second ship tows a line of hydrophones (water microphones) that respond to the reflections as they come back through the water. By a correlation of the electrical signals from the hydrophones, an on-board computer "draws" a profile of the bottom and geological layers beneath. The oil geologist studies the data, advising whether or not oil should be sought in that particular configuration.

Anyone who has ever operated a boat will be fascinated by another application of electronics to underwater oil recovery. For exploratory drilling, a large drill ship must be kept close to one position, directly over the drill point, against the constant push of wind, waves, and currents. Seabottom drilling is now being carried out at depths that make it impossible to anchor a large vessel securely. "Automatic dynamic anchoring" has solved this problem with separate motors and propellers at both ends and the sides of the ves-



A deep-diving research vehicle used for exploring the ocean bottom.

"Electronics,
its tools and technology,
will play an increasingly
important role in
the development
of oceanography."

An underwater research vessel operated by the U. S. Navy.

sel. By activating the proper motor or combination, the ship can be pushed instantly in any one direction.

The ship maintains a constant position with the aid of a taut-wire, attached to a heavy weight on the bottom, that comes up to an arm over the ship's side. Any horizontal motion of the ship will change the angle this wire makes with the arm. An electrical sensor reads the angle and sends the information to an on-board computer. The computer automatically activates the motor needed to correct the ship's position. Alternatively, the data for the computer can come from radar reflections from anchored surface buoys or sonar reflections from underwater buoys.

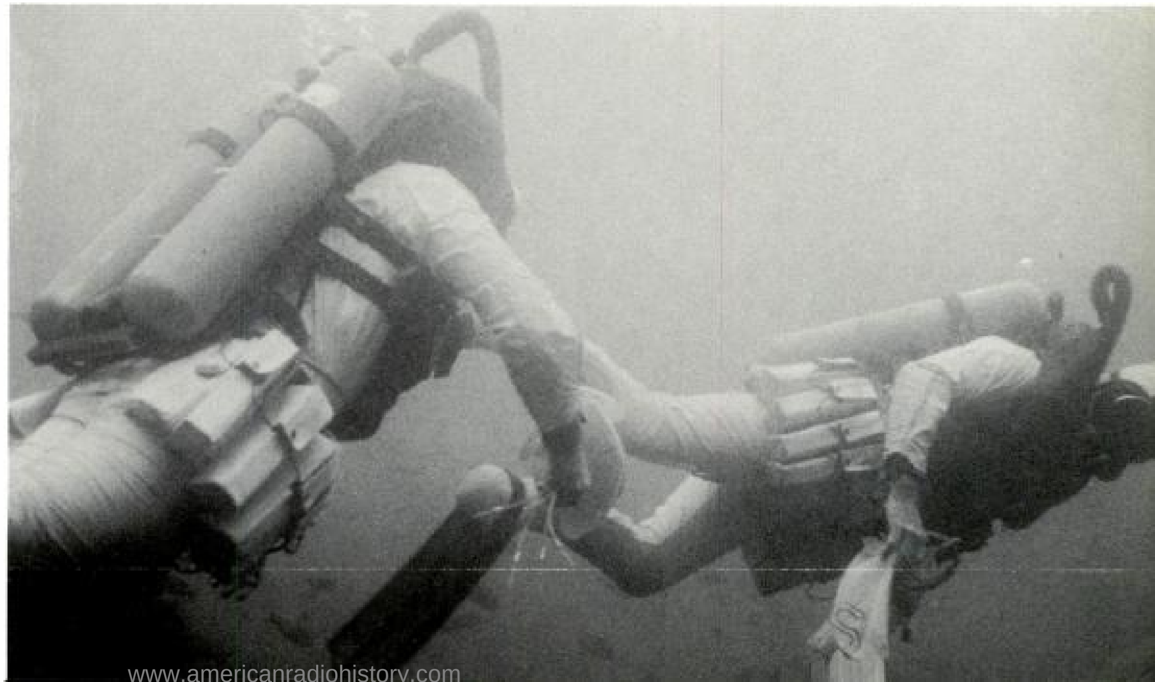
Electronics as an aid to surface navigation is, of course, an old story, starting with radio direction-finding in the 1920s and culminating with radar, for distant and bad-weather seeing, and loran, shoran, and other position-determining systems which use radio signals from fixed-position shore stations. These systems have been in worldwide use for many years, and the most accurate allow the skipper of a ship to determine his position within a fraction of a mile.

But the geologist who has found a source of minerals on the ocean bottom or the Navy rescue team that has spotted a disabled submarine may need position fixes far more accurate than this, along with the ability to return to the fix once established. For these reasons, and others, research is spurring the development of superaccurate ocean navigation.

The most spectacular position-fixing system now in process of development makes use of transmissions from the "Transit" satellites. Equipped with highly specialized electronic gear, a ship can use the "Transit" signals to find out where it is, anywhere in the world, to an accuracy that has been announced as less than a few hundred feet.

The field of oceanography has developed so extensively that the details of other equally important research efforts can only be suggested. The mapping of the ocean bottom is a major area of investigation, as is the experimental growth of marine plant organisms to supplement the world's food resources. These and the scores of other oceanographic enterprises will require an investment, in the opinion of one investment counseling firm, of some $5 billion a year by the early 1970s, an eightfold increase over the $600 million now spent for oceanography. A considerable fraction of this investment will surely be spent for the increasingly subtle electronics that the oceanographer must have. ■

Two aquonauts wearing electrically heated wet suits during an underwater excursion.



"Meet the Press": TV's Hardy Perennial

Few persons of domestic and international prominence during the past 23 years have missed the penetrating glare of broadcasting's most durable press conference.

by Natalie Tiranno

Lawrence E. Spivak with President (then Senator) Lyndon B. Johnson

Former U.N. Ambassador Adlai E. Stevenson

King Hussein of Jordan

U.N. Ambassador Arthur J. Goldberg

Prime Minister Indira Gandhi of India

Abba Eban, Foreign Minister of Israel

"I have been to New Jersey today and Delaware—and to the 51st state, as I call 'Meet the Press'..." So proclaimed the late President John F. Kennedy in a campaign speech in Maryland on October 16, 1960.

As congressman and senator, President Kennedy had been a frequent subject (he appeared eight times) for newsmen's probing questions on the NBC Television and NBC Radio Network's program. He was paying tribute to a genre of electronic journalism that has become a legend in the United States and around the world since the first broadcast of "Meet the Press" in 1945.

Few persons of domestic and international prominence during the past 23 years have missed the penetrating glare of "Meet the Press," a forum for ideas and issues and not infrequently the birthplace of page 1 news stories.

"Sunday audiences have come to realize," wrote former Governor Edmund G. Brown of California in 1962, "that the interviews they hear by able, experienced newsmen on 'Meet the Press' quite often will be major stories in Monday morning's newspapers."

In many instances, "Meet the Press" has been chosen as a showcase by a guest who has timed his appearance on the program to coincide with an important event in his career. Former Senator Barry Goldwater was such a guest in 1964 when he appeared on the program two days after he announced he would run for the GOP Presidential nomination. As a result of this exposure, he managed to have his opinions printed on the front pages of most of the major newspapers.

In addition to establishing a reputation for making front-page news more frequently than any other program in broadcasting, "Meet the Press" has been responsible for a number of scoops. It was on this program that Whittaker Chambers, for the first time and without Congressional immunity, branded Alger Hiss a Communist and started the chain of events that led to Hiss' eventual conviction for perjury.

On another program, General Walter Bedell Smith gave the first public hint that the Russians might have an A-bomb, a fact that was acknowledged by the U.S. government a few months later. On still another show, Governor Thomas E. Dewey announced his withdrawal from the 1952 Presidential race and endorsed General Dwight D. Eisenhower.

Winner of every major award for broadcast journalism, "Meet the Press" has covered virtually the entire spectrum of modern-day life. Through its many guests—poets as well as kings, scientists as well as politicians, labor leaders, and business tycoons—it has focused attention on matters of broad public interest.

The names of those who have appeared on the program read like an international *Who's Who:* President Lyndon B. Johnson, President John F. Kennedy, President Herbert C. Hoover, Vice President Hubert H. Humphrey, Vice President Richard M. Nixon, Emperor Haile Selassie of Ethiopia, King Hussein of Jordan, King Hassan II of Morocco, Prime Minister Jawaharlal Nehru of India, Soviet President Anastas Mikoyan, Premier Fidel Castro of Cuba, U.N. Secretary General Dag Hammarskjold, German Chancellor Konrad Adenauer, British Prime Minister Anthony Eden, President Mohammed Ayub Khan of Pakistan.

Also, President Kwame Nkrumah of Ghana, Madame Ngo Dinh Nhu of South Vietnam, Madame Chiang Kai-shek of China, Abba Eban of Israel, Adlai E. Stevenson, John Foster Dulles, Eleanor Roosevelt, Carl Sandburg, Robert Frost, William Manchester, Dr. Martin Luther King, Professor John Kenneth Galbraith, Alexander Kerensky, Lord Bertrand Russell, British Labor Party leader Hugh Gaitskill, Dr. Linus Pauling, Dr. Jonas E. Salk, Dr. Nathan Pusey, Lt. Col. John H. Glenn, Jr., James H. Meredith, Dr. Michael DeBakey, Prime Minister Indira Gandhi of India, James Hoffa, George Meaney, and Sol Linowitz.

The distinction for having been the most frequent guest on "Meet the Press" belongs to Ambassador Henry Cabot Lodge, who faced newsmen on 14 different occasions. In second place is Vice President Hubert H. Humphrey with 13 appearances.

Whoever the guest, "Meet the Press" seeks to uncover the truth, and the nearly 10 million persons who watch and hear the program have come to expect nothing less from the panel of newsmen and the program's creator, mentor, and producer, Lawrence E. Spivak.

Recalling the circumstances of the program's origin, Spivak said, "I was looking for something to promote the magazine I was editing. I finally hit on a simple news conference in the hope that a network would buy it."

"Meet the Press" hit the air waves as a radio program in 1945. Spivak and Martha Rountree co-produced the program until 1953 when Miss Rountree sold her interest to Spivak. He sold the program to NBC in 1955 and continued as producer and panelist under a long-term contract. The first television show was on November 6, 1947, with James A. Farley, former Democratic National Chairman, as guest. Since then, many producers have tried to emulate "Meet the Press" with varying degrees of success.

Credit for the program's sustaining power has been attributed to the fact that the Harvard-educated Spivak has kept the same simple news-conference format. Someone said recently that the only thing that has changed is the way Spivak combs his hair.

"I think the program will last as long as newspapers if it is properly done," says Spivak. "People are interested in newspapers for their news content. We invite guests who are important in the news. It gives people a chance to see them and hear their views on an important subject at a time when interest in it is high."

Spivak added that "'Meet the Press' also gives viewers an opportunity to see some of the top reporters whose columns they read. And, there is an immediacy about the program... a feeling that something exciting might happen as they watch a reporter trying to get a story from someone who is possibly dodging the issue. This becomes challenging, stimulating, and exciting."

Not all the excitement occurs on the program, however. Sometimes there is an unexpected "warmup," such as the time the late Senator Joseph R. McCarthy (R.-Wis.) showed up for the program with his own form of security. Associated Press reporter Jack Bell tells the story that "before the program went on the air, I asked McCarthy to open his briefcase and show the other members of the panel the pistol he had there. Sure enough, there was the Colt .45. He had no license to carry it, but said that since he was a Senator, he didn't need one."

Pre-air time experiences on "Meet the Press" have been known to be in a lighter vein and, in at least one case, down-

NATALIE TIRANNO is a member of the Press Department of NBC.

right folksy. One Sunday, Ambassador Arthur J. Goldberg, U.S. Representative to the United Nations, arrived at NBC's New York studio with a brown paper sack filled with salted pretzels, which he said he had bought while walking from his New York apartment in the Waldorf Towers to the RCA Building. When he got to the studio, he distributed the pretzels to the news panel. The gesture was regarded as a diplomatic move but did not bind the panel to easy questions later on the program.

"Meet the Press" is a spontaneous and unrehearsed press conference. The guests are sometimes selected well in advance and other times very close to air date. They are asked to arrive at the studio 30 minutes in advance of the broadcast. Three reporters—from daily newspapers, press associations, or news magazines—and one NBC correspondent are selected each week as interviewees.

Each reporter is chosen for his knowledge of the guest and the guest's field of interest, for his ability to ask questions in a fair and challenging manner, and for his articulateness. He does his own research and prepares his own questions. There is no comparing of notes, and there are no planted questions. The guests do not know in advance what they are going to be asked.

Generally, the studio atmosphere, before the cameras start rolling, is informal with light talk and chatter. Coffee and sweet buns are usually set up for guests and newsmen. References to the subject matter coming up on the show are discouraged in pre-broadcast conversation.

"I like reporters to keep clear of the subject they are going to question the guest about," says Spivak. "Many times after the show the discussion is continued. The reporters might ask a question or two, or the guest might say that he was surprised that he wasn't asked a particular question."

The five-foot-three-inch bespectacled Spivak sees himself as the program's "devil's advocate." "The more challenging the question, the more fully and effectively a guest usually answers and the better the audience remembers. The questions should be informed and responsible in order to get to the heart of the issue in question, and even if the guest does not answer it, you can sometimes get a good idea of why he did not want to answer. A failure to answer or an evasion can be revealing to an audience."

Over the years, viewers have written to complain that Spivak is "arrogant" and "impolite" in asking his questions. Others praise his firmness, and many public officials have lauded his fairness and objectivity. He also enjoys a reputation of being tough. Recently, Spivak received a letter from Lord Caradon, United Kingdom Representative to the United Nations, before his appearance on the program. Said Lord Caradon: "I was warned that you are a terrifying inquisitor, but I replied that I have long admired your capacity for exposing pompous platitudes, and I would greatly look forward to the experience of coming under your searching questions."

Spivak admits that it is not always easy to get the right guest at the right time. "We look for someone who is at the height of public interest, and, of course, it is also the time when the demands for his time are the greatest. Once we have the guest, another problem is to find subjects that have not already been discussed. If he is in the news, he may have had many interviews and said a great deal. Then it is up to us to try to find out what is fresh, interesting, and revealing."

Spivak, who has himself been moderator many times, says that what he looks for in a moderator is a person who is professionally competent, with a good news background, so that he knows what is important and what is not. He must be able to know when to move to the next reporter and to see that time is distributed more or less equally among them. In effect, he paces the program.

The moderator for many years was Ned Brooks, now retired. For the past several years, Spivak has shared the role with a number of NBC correspondents, among them Edwin Newman, Neil Boggs, and Bryson Rash.

"Meet the Press" usually originates from the NBC studios in Washington, D.C., although it occasionally is broadcast from New York City or from such "remote" locations as Dallas and Honolulu, sites for recent annual Mayors' conferences: Los Angeles, Minneapolis, Cleveland, and Miami Beach for the annual Governors' conferences; Geneva during the Pacem in Terris II Convocation; and London and Paris where it was televised live by Early Bird communications.

The first intercontinental "Meet the Press" program via satellite was broadcast June 28, 1964, when French Minister of Foreign Affairs Maurice Couve de Murville talked with American reporters during a special half-hour taped program. On September 19, 1965, it broadcast the first live satellite show with Prime Minister Harold Wilson of Great Britain in a London studio answering questions from a panel of reporters in Washington. Later, a Melbourne, Australia, newspaper reported in a front-page story, "the British Prime Minister was able to put his country's case in America yesterday with a force and persuasion never before available to the great British Prime Ministers of the past... introducing a new element in Anglo-American relations."

Although Spivak is the guiding force behind this apparently permanent fixture on NBC, it is an attractive brunette from Oklahoma to whom the producer and permanent panel member of "Meet the Press" must turn for much of the labor of program preparation. She is Betty Cole, associate producer of the program, who helps Spivak select the guests and panelists and makes the production arrangements. Together, they work with a researcher and a secretary to assemble the voluminous information that Spivak requires in order to prepare for each program.

After two decades on the air, what lies ahead for the program? With the confidence of a man who is producing a winner, Spivak says: "We have had considerable evidence over the years that the public likes our format. I think people will continue to watch and listen to us if we continue to do an effective job of interviewing American and world leaders. And a very important factor is the confidence and support we received from the beginning from NBC. I'm sure that there have been times when they might have substituted another program for 'Meet the Press' but they never did.

"The program has brought me a number of different kinds of satisfaction over the years. The first is the recognition we have had from so many world leaders who have said that the program has made an important contribution toward informing the public. The second is the great pleasure that comes from meeting and talking with the men and women who are making today's history." ■

Senator Jacob K. Javits of New York

Vice President C. K. Yen of the Republic of China

Author and columnist William F. Buckley, Jr

Vice President Richard M. Nixon

Emperor Haile Selassie of Ethiopia

Poet Carl Sandburg and Photographer Edward Steichen

"There is an immediacy about the program . . . a feeling that something exciting might happen as a reporter tries to get a story from someone who is possibly dodging the issue."

A vast increase in man's knowledge of the geography of the moon has complicated the task of finding suitable names for lunar features.

by I. M. Levitt

Names on the Moon

Astronauts may one day soon explore a small crater on the surface of the moon that bears the rather unlikely name of *Hell.* This particular crater is not much different, nor any more unpleasant, than countless other lunar craters and, in fact, was not named with any theological significance in mind. Rather, it carries the name of Father Maximilian Hell, S.J., a prominent 17th century Jesuit astronomer and director of the Vienna Observatory.

The fact that there is a crater named Hell on the moon brings into sharp focus a problem concerning the naming of lunar features. In the past, craters, mountains, rills, and seas on the moon have been named for scientists, mathematicians, philosophers, and, sometimes, terrestrial features. Many of the larger lunar landmarks bear names with no relation to what is being identified. Today, with the discovery of thousands of unnamed lunar features by American and Russian picture-taking spacecraft, a further element of chaos has been introduced. Where will these new names come from, and are the previous ground rules of lunar nomenclature still adequate?

To answer these questions, it might be well to review the history of lunar nomenclature and the tradition that evolved over the centuries in the naming of lunar features. Who are the men whose names are found on the moon and what achievements were necessary to warrant such immortality?

The first name on the accepted list of lunar formations is Abenezra who was the "Rabbi Ben Ezra" of Robert Browning's well-known poem. His writings on arithmetic and astronomy are valued by historians of science. There is another rabbi on the moon—Rabbi Levi—who was a philosopher, mathematician, and astronomer. He invented a cross-staff for measuring diameters of the sun and moon.

Because Jesuits were the principal scientists of the 17th century, the names of many Jesuit priests—such as Bettinus, Billy, Casatus, Curtius, Malapert, and Riccius—are found on the moon. Similarly, the names of Arabian astronomers like Abulfeda, Alfraganus, Almanon, Albategnius, Alpetragius, and Arzachel identify other lunar features. Names honoring rulers were also included, and so are found Alphonsus, Alexander, Julius Caesar, and Wilhelm I. Even a Mongol prince, Ulugh Beigh, has a place on the moon.

Explorers such as Kane, Cook, Magelhaens (Magellan), Vasco da Gama, and Colombo (Columbus) are represented. Gutenberg, the inventor of movable type, has a crater. Astronomers are found in great profusion. Newcomb, Hall, Pickering, Delaunay, Draper, and Flammarion are a few. There are also names of several astronomers of a family. For instance, the Herschels are represented by William, Caroline, and John.

Chemists, physicists, geologists, mathematicians, and outstanding representatives of scholarly disciplines abound on the moon. Among those with less common occupations are: Vitruvius, a first century (B.C.) architect and engineer; Seneca, the Roman statesman and orator; Plinius, the natural historian; Macrobius, a grammarian; Linné, a botanist; Lassell, who started out as a Lancashire brewer; Letronne, a French archeologist; and Kircher, a professor of Oriental languages.

To answer the question of how these names came to be found on the moon, we must go back almost to the beginning of the Christian era. About 1,500 years before the invention

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of the telescope, Plutarch of Chaeronea (A.D. 46-120) wrote a literary work, *The Face of the Moon*, in which he described the moon as another earth, covered with deep valleys and mountains. This roughness was deduced from the absence of specular reflections of the sun. He correctly surmised the features could be recognized from the casting of shadows owing to a low sun.

With the invention of the telescope, Galileo discerned its value as a perfect tool to explore the skies and blazed a trail still followed by astronomers. His observations resulted in the first, crude telescopic map of the moon, which he published in his *Siderus Nuncius*. It disclosed only the gross features of the lunar surface.

Distinguishing between the dark and bright areas of the moon, Galileo identified the smooth, dark areas as "ancient spots" and the brighter areas as craters. He insisted that, if the earth could be seen from afar, the smoothness of the ancient spots could be explained as bodies of water while the broken-up areas could be assumed to be land masses. As a point of fact, Leonardo da Vinci had previously suggested that the dark and bright regions of the moon were bodies of land and water. However, Da Vinci had erroneously assumed that the seas would be brighter.

In 1612, Cesare Legalla, a professor of philosophy, published a lunar map in Venice in which he used Biblical names for the lunar features. In 1645, Langrenus of Brussels issued a map that gave names to some of the lunar markings. Shortly after, in 1647, Johannes Hevelius published his *Selenographica* in Danzig, which set the stage for the naming of lunar features.

Hevelius reasoned that lunar features should be named for prominent men in science and philosophy to honor their achievements. However, he also believed such a practice might arouse jealousies and controversy, so he decided on a safer course, which was to name the principal formations after geographical counterparts. To implement this reasoning, he introduced the names of the Lunar Alps, Urals, Carpathian, Caucasus, and so on.

The next book that dealt with this subject was the *Almagestum Novum* (1651), by the brilliant Jesuit astronomer Joannes Riccioli of Bologna, and this contained a lunar map drawn by Francesco Grimaldi, who was Riccioli's student. Riccioli followed the practice initiated by Langrenus of naming craters after mathematicians and astronomers. He proposed about 200 names for these features. He was the one who named the craters Kepler, Copernicus, and Tycho—men who had achieved prominence formulating astronomical theory. It must be remembered that Riccioli used a low-power telescope, for this was all that was available in his era. Thus, the seas and large craters were readily seen while the smaller craters were not visible. The dark areas (maria) were clearly visible, and he gave them rather exotic and picturesque names. The largest he called the Oceanus Procellarum, the Ocean of Storms. An area north of this ocean he called the Mare Imbrium, the Sea of Rains. To the east of Mare Imbrium were two seas that he named Mare Serenitatis, the Sea of Serenity, and Mare Tranquillitatis, the Sea of Tranquillity. He also named some of the readily observable mountain ranges.

Classical names such as Plato, Eratosthenes, Pythagorus, Aristotle, and Strabo also appeared. Hevelius, who was reluctant to name features for people, had a crater named for him. Riccioli's system was unanimously accepted, and virtually all the names he proposed are in use today.

Then, J. H. Schroeter, in 1802, published a two-volume work, *Seleno-Topographische Fragmente*, which contained carefully drawn portions of the lunar surface. He reasoned that these could serve as references if any changes were to take place on the moon in the future. He also rediscovered the Rille, which is German for "rill" and which Huyghens saw around 1680. Rills are present in all sizes and are most numerous, as the pictures relayed back by Lunar Orbiter 3 indicate. Schroeter added the names of 60 more features to the growing list of lunar names.

The next most significant milestone was the publication of the *Mappa Selenographica*, by W. Beer and J. H. Madler, in 1834. They drew a chart of the moon three feet in diameter, which was a model of technical virtuosity and was produced wholly from observations made by these two observers. Because of their painstaking work, they were able to add 145 additional names to the list.

Now, two events took place that were certain to introduce chaotic conditions into lunar nomenclature. The first was that larger telescopes became available, and the second was that independent observers in various parts of the world began charting the moon and providing new names. As an example, W. R. Birt in England and J. F. J. Schmidt in Greece began mapping the moon. Then, almost simultaneously, E. Neison's handbook, *The Moon* (1876), and Schmidt's great lunar atlas (1878) appeared, and still more names were added. Unfortunately, in these great works the same craters were given different names and different craters the same name.

To restore a semblance of order, S. A. Saunder, in England in 1905, urged the formation of an international committee to undertake needed reforms. Finally, in 1907, the International Association of Academies formed a committee for this purpose, and the first fruit of the committee's work was the publication of a book, *Collated List of Lunar Formations Named or Lettered in the Maps of Neison, Schmidt, and Madler*, by Mary A. Blagg. This gave way after World War I to the book, *Named Lunar Formations*, containing about 6,000 lunar place names with their coordinates, brief description, and indication of the original authority for the name. This should have ended the controversy, but it was not to be so—at least, not yet.

In the International Astronomical Union (IAU) Transactions of 1932, the following paragraph indicates the extent of the problem. "Prof. W. H. Pickering called attention to a letter which he had written to the President of the Commission in which he recommended that many of the names, especially of formations near the lunar North Pole, be deleted; also, that certain names of men who had contributed effectively to selenography be substituted for less meritorious names now attached to prominent lunar formations. The President stated that copies of this letter had been sent to the members of the subcommittee with power to act." Apparently, this was an attempt to rearrange the names of some of the formations and features. In the same volume of the IAU Transactions, it was proposed that a committee of leading astronomers, whose prominence would give their decisions proper weight, be involved in the selection of suitable names.

At this meeting, it was agreed that the names or maps that Madler, Schmidt, and Neison have in common should be retained. These would include names such as Halley, Kirchhoff, Luther, Huggins, Helmholtz, and so on. Another category would be names such as Leverrier, Faraday, Beer, Bunsen, and so on, which were not followed by all selenographers. Another list would comprise names such as Flammarion, Schroeter's Valley, and Percy Mountains, which were not selected by any of the three prime selenographers. Names that were proposed, such as Lick, Yerkes, Draper, Hall, Angstrom, and so on, were to be decided on by the committee. All these latter names were adopted despite the fact that Lick and Yerkes were not scientists but financiers who donated large telescopes.

In 1959 came the flight of Lunik 3 and the relaying of pictures of the hidden side of the moon. Although the Lunik 3 pictures were of low resolution and poor quality, Soviet scientists by an ingenious process were able to identify 500 features on the hidden side. Suddenly, an avalanche of names had to be voted upon. Where would this authority originate?

Although the ground rules for lunar nomenclature had been set down in 1932, various selenographers like H. P. Wilkins and P. A. Moore violated the code of using names of deceased scientists only, for some astronomers alive today have been immortalized by having craters named for them.

To keep the situation in hand, in 1961 at the 11th General Assembly of the IAU held in Berkeley, Calif., it was decided that: "For designating the lunar surface features, it is recommended that the previous rules be followed, revised, and improved as follows:

"(a) Craters and rings, or walled plains, are designated by the name of an astronomer or prominent scientist *deceased*, written in the Latin alphabet, and spelt according to the recommendation by the country of origin of the scientist named.

"(b) Mountain-like chains are designated in Latin by denominations allied with our terrestrial geography. Names are associated with the substantive *Mons*, according to the Latin declination rules and spelling. (Three exceptions, Mons d'Alembert, Mons Harbinger, and Mons Leibnitz, are preserved due to long usage.)

"(c) Large dark areas are designated in Latin denominations calling up the psychic states of mind. These names are associated, according to the Latin declination rules and spelling, to one of the appropriate substantives: *Oceanus*, *Mare*, *Lacus*, *Palus*, or *Sinus*. (The exceptions, Mare Humboldianum and Mare Smythii, are preserved due to long usage.)

"(d) Isolated peaks are designated according to the same rules as for the craters, as well as promontories, the latter being preceded by the Latin substantive *Promontorium*. (Example: Promontorium Laplace.)

"(e) Rifts and valleys take the name of the nearest designated crater, preceded by the Latin substantives *Rima* and *Vallis*. (The exception, Vallis Schroter, is preserved.)

"(f) Undenominated features can be designated by their coordinates. They can equally be designated according to the former classical system by taking the name of the nearest crater, followed by an upper-case letter of the Latin alphabet for craters, depressions, and valleys, by a lower case of the Greek alphabet for hills, elevations, and peaks, and by a Roman number followed by the letter *r* (Ir, IIr, IIIr, etc.) for clefts."

Currently, the Soviets are asking the 1967 General Assembly of the IAU to pass on 153 more names for features on the hidden side of the moon. Of these features, 150 are craters and are thus named after individuals. The Soviets have conformed to the regulations in that almost all of these scientists are deceased.

A study of the Soviet list reveals that, of the 150 features, 72 have been named for scientists of old and new Russia. There are 18 which are named for scientists of old Russia who date back to 1728, the year of the birth of the thermal engineer, I. Pulzunov. Other names of old Russia include Kovalski (astronomy), Mechnikov (physiology), Backlund (astronomy), and Golitsyn (seismology). Those Soviet scientists who died after 1917 include Tikhov (astronomy), Friedman (mathematical physics), Gerasimovich (astronomy), Korolev (rocketry), Maksutov (astronomical optics), and Schmidt (geophysics).

These names will certainly be adopted. However, the United States delegation had a minor problem in getting one of its features adopted. The Americans had designated the area between the Mare Nubium and the Oceanus Procellarum in which Ranger 7 landed as Mare Cognitum—the Sea of Knowledge. A question arose about this name since the name of a lunar sea must refer to psychological states. After considerable debate and broad interpretation, it was agreed that this name conformed to the rules, and the name was adopted at the 1964 IAU meeting.

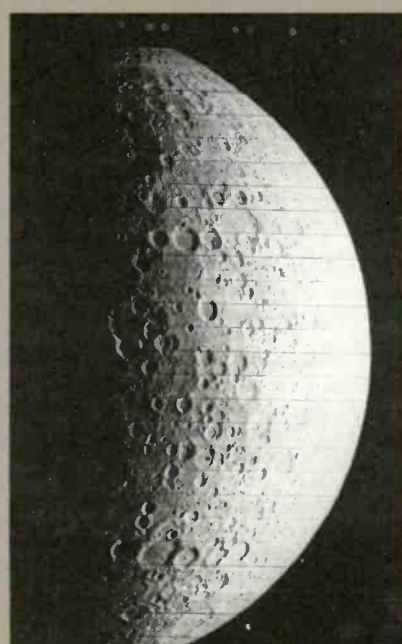
But what of the future? The Soviet Zond 3 spacecraft recorded 3,500 features on the hidden side of the moon, and a fair guess might be that about 100,000 more are to be charted as a result of the American Lunar Orbiters.

If the writer may be permitted to make a recommendation, I would like to suggest that, in the immediate future, the names of dead astronauts—both American and Russian—be accepted for lunar nomenclature. Later, living astronauts could be similarly honored. There should be no objection to these names because of their prominence in astronautics and their participation in a most hazardous undertaking. The American equivalents of Korolev, the chief Soviet space designer—such as Goddard, von Braun, Gilruth, Newell, Ley, Lovelace, Flickinger, Stehling, and so on—should certainly find their way onto the moon.

But more names will be required. Astronomers such as Hoyle, Shapley, Olivier, Menzel, C. P. Gaposhkin, O'Keefe, Whipple, Struve (the third member of this illustrious family), Wright, and others who have achieved prominence must be included. Fleming, Salk, Sabin, White, and other benefactors of humanity are additional candidates. In fact, scientific service to mankind might well be the criterion for identifying the thousands of unnamed craters, mountains, valleys, and seas of our nearest celestial neighbor. ■

The moon as seen through a telescope.

An early map of the moon, showing place names in Latin.

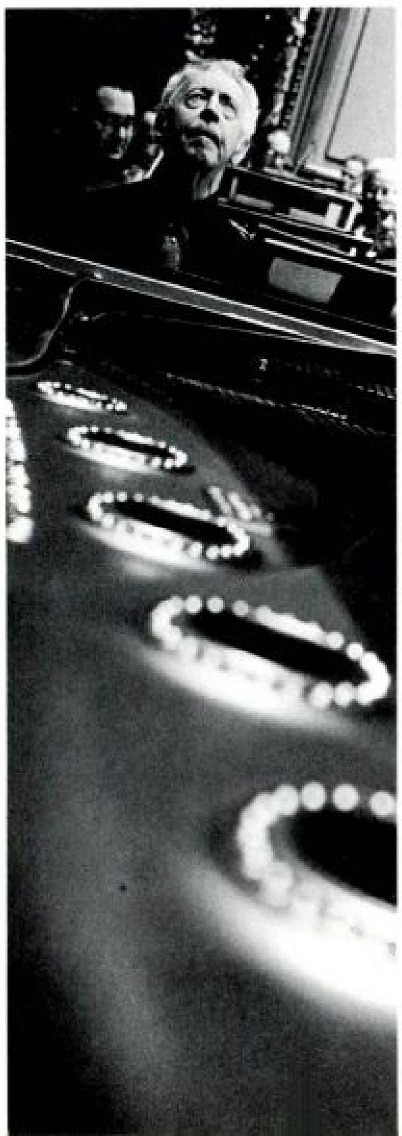


The hidden side of the moon as photographed by Lunar Orbiter 5.

at 80

At an age when virtuosos 25 years his junior are preparing for retirement, Rubinstein is still developing as a more sensitive and communicative artist.

by Ray Kennedy



"I would prefer to die younger than to sniff around living. Life means living, not escaping. People go to doctors and ask, 'What vitamins shall I take?' What good are vitamins, I ask you? Eat four lobsters and a pound of caviar. Live! If you are in love with a beautiful blonde with no brains at all, don't be afraid. Marry her. Live!"

So, in one of his typically exuberant moods, preaches the 20th century's grand master of the piano, Artur Rubinstein. At 80, he is the living—and the liveliest—proof of his credo. At a time when virtuosos 25 years his junior are gearing down for retirement, he has shifted into overdrive. This season, hopscotching from Boston to Bombay as routinely as a suburban commuter, he will play 114 concerts—25 more than he played 30 seasons ago. The wonder is not that he is still playing, but that he is playing better than ever. Though his professional career dates back to the late 1880s, he is no dusty relic of a bygone musical era. Trading on a boundless capacity for self-renewal, he has assimilated the best elements from the romantic as well as the modern school of piano playing and fashioned it into something that is uniquely Rubinstein. His style might best be summed up in one word: youthful. Marvels pianist Rudolf Serkin: "His mind is so young. It's only natural that his music is young too. It's as if he's playing everything for the first time."

Rubinstein nourishes his fresh approach to the classics by infusing a dash of improvisation, "a drop of fresh blood" into each performance. In the middle of a concert, he will even experiment with new fingerings "that suddenly occur to me. It is dangerous, I admit, but that is the way music develops." This development is perhaps best reflected in his recordings on RCA Victor's Red Seal label. In the studio, he is a perfectionist, furiously jotting down notes as he listens to a playback, muttering, "That's good . . . that's terrible . . . too fast . . . too much pedal . . . needs more tone there." Yet even when he has produced an album that lives up to his exacting standards, his satisfaction is short-lived. "At first," he says, "I'm terribly enthusiastic about my own records. But after a few months I would like to change them. I've learned something new and they haven't."

"Most of us," explains Max Wilcox, the RCA Victor artist-and-repertoire man who records all of Rubinstein's albums, "are prisoners of our former selves. Rubinstein isn't. His playing is getting ever simpler and ever more subtle. It's stripped of any sort of excesses. You'd never say about his playing that there are flashes of the old Rubinstein, because there's a new Rubinstein every day. And the one we have today is a more sensitive, more communicative artist than he ever was."

The most convincing evidence of that fact is that Rubinstein has the broadest popular following of any front-rank musician in the world. His recording of Beethoven's "Concerto No. 4," for example, has been lodged among the top best-selling classical albums for nearly a year and a half. He has, in fact, sold more albums (nearly 6 million), grossed more money, and played more concerts before more people than any other classical instrumentalist in history. Few performers can match his charisma with an audience. When he strides out on a concert stage today, it is clearly an Event. A short, stocky figure with a classic brow wreathed with a wispy halo of white hair, he settles at the keyboard like a monarch on his throne. Then, his blue eyes gazing heaven-

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ward, he will hammer home the first chords of a Liszt prelude and sing his way into the poetic soul of the music.

His playing is remarkable for its sanity, its clarity, its healthy emotionalism, and unerring projection of the grand design of the music. His warm, luminous tone fills a concert hall like rays of sunlight. This magic combination of pedal, touch, and heart stems partly from the control he exerts through his powerful shoulders, arms, and hands. His fingers, whose tips are like tiny cushions from years of "cleaning the piano's teeth," are spatula-shaped; his little finger is almost as long as his index finger, and with the long extension of his thumbs he can encompass a 12-note span on the keyboard. Most pianists must strain to encompass a 10-note spread.

Rubinstein uses the sum of these powers to perform what is the largest and most varied repertoire of any living pianist. Though he is best known as a Chopinist, he also excels in French impressionistic and modern Spanish music, and he is equally as fluent with Bach as he is with Stravinsky. He has a photographic memory for music. "When I play," he says, "I turn the pages in my mind, and I know that in the right-hand corner of this page there is a little coffee stain, and on that page I have written *molto vivace*." Although many pianists feel it is necessary to practice a minimum of four to six hours a day, Rubinstein sometimes will go for a week without touching the keyboard, content in the knowledge that, when needed, the music is right at his fingertips. Says one conductor: "Artur is the only pianist you could wake up at midnight and ask to play any one of the 38 major piano concertos."

It is not that Rubinstein despises practicing. It is just that he feels that excessive laboring over the keys will dull that spark of spontaneity that can make the difference between a routine concert and a great one. Regretfully, he explains, many modern pianists overpractice to the point that when they go on stage, "they take the performance out of their pocket and not out of their heart." Though they may not heed his advice that practice makes imperfect, most instrumentalists owe much to Rubinstein in matters of interpretation. "Anyone playing Chopin or Schumann or some of the Spanish composers today," says violinist Isaac Stern, "would have to have in his mind's ear the sound and style of Rubinstein. The rules and standards of performing are almost like a wall around the garden of beauty. Rubinstein shows you the door, and inside a riot of color and scent."

Finding that door was no easy achievement for Rubinstein. The last of seven children, he was born in the grimy industrial town of Lodz, Poland, in 1887. His father wanted him to be a violinist, but after young Artur showed his displeasure by smashing the instrument on the kitchen floor, papa relented and let him take up the piano. At two, he was a full-fledged prodigy. "I didn't speak until I was four," he recalls, "but I recognized everything by songs. I even had songs for food. At the table I would sing, 'La, la, *la*, la,' and my mother would say, 'Artur wants some cheese.'" He was "a terrible little fiend about music," howling like a sick cat when his sisters struck a sour note, slamming the piano lid down on their fingers. At four, he performed at charity concerts, passing out engraved calling cards to everyone he could corner: *Artur the Great Piano Virtuoso.* Miffed at being asked if he was related to the great pianist Anton Rubin-


Rubinstein at age 4


At 10

At 19


At 50

"As the hour for the concert draws near, he becomes increasingly apprehensive. 'Fear before a concert,' he says, 'is the price I pay for my superb life.'"

stein, he strutted around town with the words *No Relation* enscribed on the front of his sailor cap.

It was not long before word of the haughty little *Wunderkind* from Lodz reached violinist Josef Joachim, who had one listen and decided to sponsor the youngster's musical education. Rubinstein progressed so rapidly that in 1906, at the age of 19, he was signed for a tour of the United States. At his debut in Carnegie Hall, he dazzled the audience with his flashy pyrotechnics, but the critics dismissed him as a heady young upstart who sacrificed accuracy for showmanship. Rubinstein pleads guilty to the charge, recalling that during his early career he dropped enough wrong notes during a performance to reconstruct another recital. Thus easily able to charm an audience with his keyboard legerdemain, the young Rubinstein neglected to develop his talents properly.

He settled for a period in London and supported himself by performing in the salons of the aristocrats. He traveled in a circle that included such luminaries of the literati as Joseph Conrad, H. G. Wells, Henry James, and Gertrude Stein and often took part in wee-hour, classical jam sessions with basso Boris Chaliapin, cellist Pablo Casals, and violinist Jacques Thibaud. Migrating to Paris in the 1920s, he roomed with a count and stayed up half the night prowling the cafes with Cocteau and Picasso. "I was a very disreputable character," he confesses. "I loved women, cards, and brandy too much, and I almost never practiced."

It was a gay life but Rubinstein was troubled. "In those days," he says, "I didn't have much respect for the status of a pianist. I thought to be a musician was a heavenly way of living, but to be a pianist, well, there were too many of them. I was too little involved in the job I had to do, which was to develop my repertoire. I could earn 500 francs by playing the whole of 'Salome' at a dinner party. I could play all the violin concertos, whole operas, and symphonies by heart. But it was difficult for me to really finish a Beethoven piano sonata. I was living on the capital of my talent."

All that changed when he met Aneila ("Nela"), the comely, honey-blonde daughter of Polish conductor Emil Mlynarski. Ever the romantic, he proposed to her beneath the Chopin monument in Warsaw, and they were married in 1932. She was 23, he was 45. When they had the first of their four children a year later, Rubinstein felt it was time to change his tune. "When I married Nela," he explains, "I still didn't have much respect for the status of a concert pianist. But then I developed another respect: for my wife and my family, and for the Rubinstein name they were sharing with me. I didn't want that name to stand for anything second-rate."

Fired by that conviction, he retreated to a mountain cottage in southeastern France, installed an old upright piano in a nearby, windowless stable, and working by candlelight spent up to nine hours a day for three months honing his technique and building his repertoire. "Slowly, excruciatingly," he says, "I became a pianist."

The new Rubinstein that emerged toured the world's concert halls to thunderous acclaim. In 1937, he took the United States by storm, later moved his family into Ingrid Bergman's former home in Paris (which, due to mounting record sales, he liked to call "The House That Victor Built"), and began building a reputation that never ceased growing.

He chummed around with the Ronald Colemans and the Basil Rathbones, and his ever-broadening circle of friends included everyone from Hemingway and Chaplin to Einstein and Schweitzer, African diamond merchants and Argentine beef barons to kings and professional gamblers.

He became an idol wherever he went, charming friends in eight languages and playing to S.R.O. houses for the top fee of $6,000 per performance. Despite wars and floods, colds and stomach disorders, he never missed a concert. In 1947, when a tie-up at the Buenos Aires dock left his piano stranded on a boat, he hastily arranged to have another 1,400-pound concert grand flown in from the United States on a DC-4. During a 1952 tour of Israel, he smashed his right hand in a bureau drawer and, though unable to use his fourth finger, played the concert anyway, refingering the pieces as he went along. More recently, when a train taking him to a recital in Worcester, Mass., was delayed, he changed into his concert tails in the lavatory, leaped off the Pullman, dashed to the concert hall, and strode on stage, leaving a trail of wet footprints. "No matter what," he asserts, "I will get to a concert, even if I have to ride on an ass's back."

Six years ago, after he performed a marathon series of 10 different major recitals in 40 days, someone asked him why he subjected himself to such a torturous grind. Rubinstein was astounded at the naiveté of the question: "It's simple. I love to play the piano." Unlike many soloists, who accept the rigors of touring as one of the necessary evils of their art, concert-playing is a happy way of life for Rubinstein. "I love traveling," he says. "I love the challenge of making schedules, getting planes, and all that. It excites me. Besides, that's how I keep my friends; they don't see me too often." If not a pianist, he says he would like to be a travel agent. He knows where to get a good meal in Oslo, where to buy silk ties in Osaka.

Touring also allows him to add to his excellent collection of sculpture, impressionistic paintings, and 2,000 rare books. He is also a renowned gourmet, dines sumptuously at Taverna Flavia in Rome, Scott's in London, and La Côte Basque in Manhattan. Whenever he enters Maxim's in Paris, the waiters line up and give him a rousing Hello-Dolly-style welcome. A connoisseur of fine cigars, he once took a week off to study the tobacco business in Havana. Shortly before Castro's takeover, he bought 3,000 of his favorite Upmann Montecristos at 75 cents apiece, and stored them in the humidor in Manhattan's "21" club. Such refinements give him a gracious, *fin de siècle* air. Strolling down the boulevard in his morning coat and ascot, leisurely twirling his English foxhead walking stick, and gallantly kissing the hands of lady acquaintances, he is the picture of Old World elegance.

Always "that civilized man," as his friend Thomas Mann once described him, Rubinstein likes to arrive in a city a day prior to a concert so he can enjoy his "*grasse matinée*"—cashmere dressing gown, coffee, cigar, and a good book. Or he will watch TV (he knows the plots of all the soap operas), or go to a movie. His taste in films is catholic, though he admits that "as long as we have Brigitte Bardot the world is safe." If the movie is dull, he will run his fingers through a Chopin *étude* under his black beaver fedora.

As the hour for the concert draws near, he becomes increasingly apprehensive, largely because he feels that the audience expects so much of him. "Fear before a concert," he says, "is the price I pay for my superb life." But once he strikes the first chords, all nervousness disappears, and he loses himself in the music. The enjoyment he derives from playing is boundless. At intermission, he will come back stage to thunderous applause and say with childlike glee: "They like it! They like it!"

The inevitable postconcert dinner party is Rubinstein's chance to unwind. As one of the world's most celebrated raconteurs, his performances offstage sometimes rival those onstage. He is a master of dialects and a devastating mimic, screwing his face into the severe glare of a Cedric Hardwicke or the Silly Putty visage of a Harpo Marx. "I love to talk," he says. "If I tell you I like this lamp, I'm likely to start talking about Nietzsche or pre-Bach music or Chinese art or God knows what." He also jumps around physically, mounting a chair to imitate a conductor, jerking and wiggling as he tells an anecdote about two fat Italian women dodging traffic.

One of his favorite stories concerns the time he developed a sore throat at the height of the cancer scare from smoking. Panicked, he went to a throat specialist who made tests and told him to come back the next day. Suspecting the worst, Rubinstein got his will in order and, determined to be brave, returned to the specialist's office. "Tell me, doctor," he cried. "I am prepared. Is it cancer?" The doctor looked at him sternly. "Mr. Rubinstein," he said solemnly, "the only trouble I can see is that you talk too much."

As far as music lovers are concerned, Rubinstein can never play too much. And there is no doubt that he will continue to satisfy them to the utmost of his abilities. "You mustn't tell my manager, Sol Hurok," he confides, "but the fact is, I would go on giving piano recitals just for the fun of it whether I got paid for it or not." The flame still burns brightly. As RCA Victor's Wilcox says: "The way Rubinstein is going now, at the age of 100 he'll play the C major scale and reduce us all to tears." ■

The All-Seeing Eye of Infrared

Scientists are performing a number of exacting feats of measurement and detection through recent advances in infrared technology.

by Robert E. Tolles

Scientists and engineers have recently been devoting increased attention to a portion of the electromagnetic spectrum whose basic attributes have long been known but whose commercial performance has never quite lived up to its promise.

The portion is infrared, which includes those frequencies of the radiation spectrum ranging from visible light to microwaves, or, in terms of wave length measurement, from .75 to 300 microns. What makes infrared radiation so useful a medium for scientific analysis is the fact that all physical objects emit electromagnetic energy in proportion to their temperature. This radiation occurs over a wide range of wave lengths, and infrared covers a broad band of these emissions. Recently, scientists have been developing a number of electronic instruments and techniques that can measure this infrared radiation with extreme sensitivity.

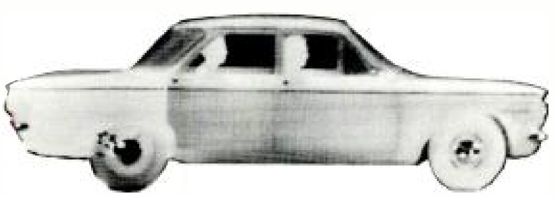
In astronomy, for instance, a new instrument that measures infrared radiation from planets can show the presence of chemicals in the planetary atmosphere when the concentration is as low as one part in a billion. Astronomers have described the initial results of this infrared analysis as impressive.

Agricultural scientists are equally excited about so-called remote sensing that analyzes infrared and other radiation from the earth to identify plant species, measure land acreage, predict crop yield, and detect plant disease. They believe that the use of such techniques, whether from a satellite or a high-flying aircraft, could have an extraordinarily beneficial impact on society by leading to increased food production and more effective control of plant disease and pests than is now possible.

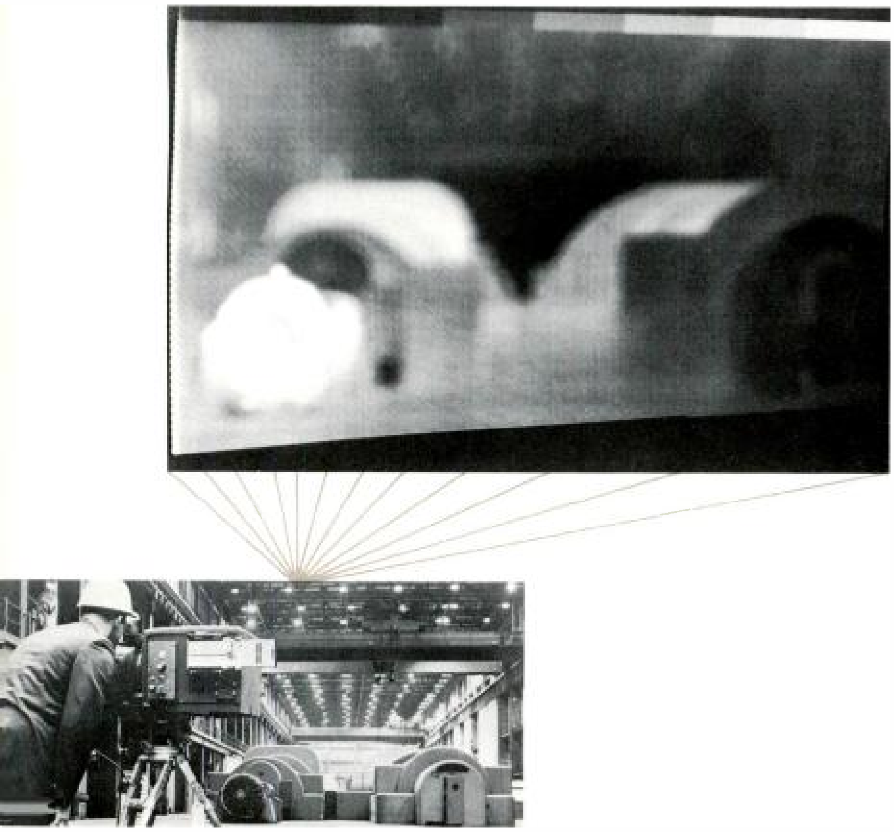
A team of University of Michigan and U.S. Geological Survey scientists similarly used infrared detection to make a startling discovery while conducting volcano research in Hawaii. In scanning the shore with a detector from an old B-25 bomber, they found large areas of water emerging from the coast that were as much as 12 degrees cooler than their surroundings. Like an aerial divining rod, the detector had spotted huge quantities of fresh water flowing into the ocean, a discovery of great potential importance to the water-short island.

Industrial and commercial uses of infrared have also begun to proliferate. The infrared micrometer, for example, measures the thickness of hot metal to a tolerance of .001 inch as it travels at speeds of 90 miles an hour in a rolling mill. A structural weakness in a weld can be spotted by infrared analysis. Firefighters can detect forest fires from miles away before the first wisp of smoke is seen. In medicine, an infrared thermograph can detect temperature differences in the human body to a fraction of a degree and thus indicate whether a malignancy is present. And in aviation, an infrared scanning device has shown promise during recent tests in warning pilots of approaching clear air turbulence.

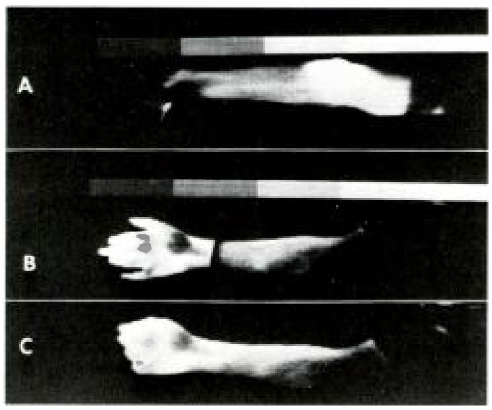
The principle of energy emission, on which all these applications are based, can be illustrated with reference to an iron poker that has been heated in a fire to white heat. When the poker is removed from the fire, the intensity and color of the light that it emits slowly change to orange red, then red, then dull cherry red, and then disappear. Heat is still emitted from the poker until it cools to room temperature, but even at that temperature, it is still radiating energy. In fact,



An infrared photo of a car. Because of the heat of the motor, rear engine compartment appears whiter.



An infrared camera is used to make a thermal map of a turbine generator. The resulting thermogram (upper photo) shows temperature distribution within the generator.



Infrared thermograms of the human arm, showing abnormal blood flow in photos A and B and normal flow in photo C.

it continues to do so until cooled to absolute zero.

Infrared radiation is divided into two regions, the near infrared or the "hottest" part, which embraces those wave lengths just beyond the red of visible light up to 1.5 microns; and far or "cold" infrared, which covers those frequencies from 6 to 300 microns. In the near infrared, thermal variations can be detected on photographic film or by a family of cells, image converters, and imaging tubes. The far infrared covers those regions where objects at body temperature radiate and is the area of greatest potential. Current research is directed at developing detectors that are sensitive in this region and thus will be able to identify objects at very low levels of generated heat.

Most of the work in infrared for the past 20 years has been to sharpen the surveillance and reconnaissance "eyes" of the military. RCA's early work in the development of the "Snooperscope" and "Sniperscope" of World War II, which were devices to enable a rifleman or observer to "see" in the dark, set the stage for later developments. Details of postwar military development of infrared are still largely secret, but enough is known to indicate the substantial advance of the technology.

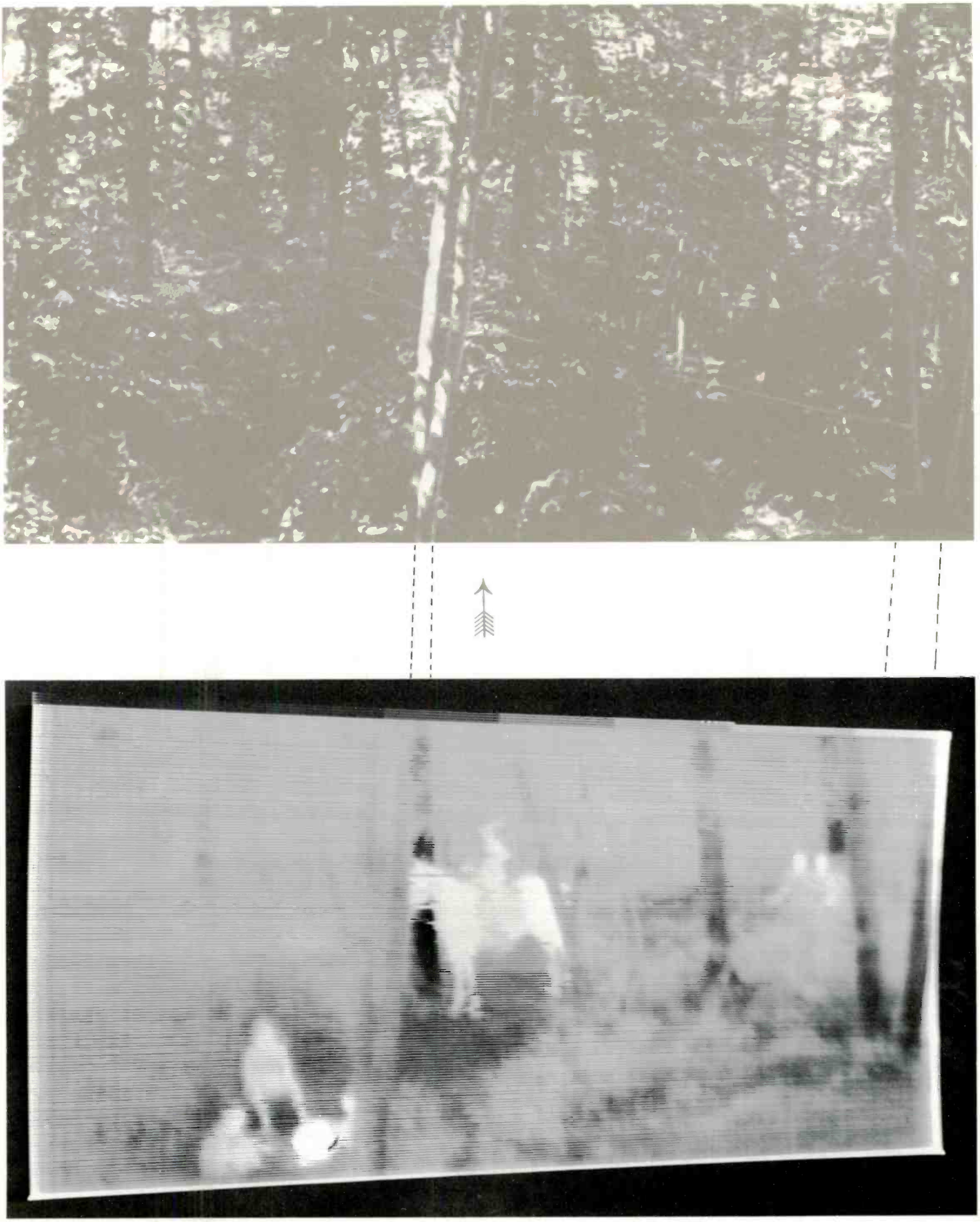
Infrared surveillance, as an example, can pick out the shadow of an airplane on a runway for as long as an hour after it has taken off. Or it can detect the presence of enemy soldiers in a dense jungle by the heat that their bodies give off. A better known military application of infrared is the heat-seeking guided missile that "homes in" on the hot exhaust gases of a rocket or jet engine.

Some of the supersensitive infrared techniques developed for the military are now being extended to nonmilitary fields, and this is where much of the current excitement concerning the technology is centered. For example, new measurements of photographic infrared radiation of Mars have revealed that the Martian atmosphere may be too rarefied to support either a winged vehicle or parachute. Space probes may thus have to carry braking rockets to land on the surface of the planet. The key to this discovery was the fact that carbon dioxide absorbs infrared radiation at characteristic wave lengths. From the new measurements, astronomers concluded that carbon dioxide was less plentiful and therefore the Martian atmosphere less dense than had been indicated by earlier observations.

A new infrared instrument, the multiplex interferometric Fourier spectrometer, can detect with great sensitivity the chemical constituents of planetary atmospheres. Attached to a 1,000-inch telescope, astronomers believe it could be used to confirm the existence of extraterrestrial life by identifying compounds that are given off by biological processes. Used in conjunction with a computer, the spectrometer has been found to be 1,000 times more sensitive than have older devices in observing Venus and Mars.

Potentially more useful information from infrared analysis can be obtained by lifting the detector above the earth aboard an airplane, a balloon, or a satellite. The advantages gained are a wider field of observation and the ability to obtain a thermal image of earthly objects, whether visible light is present or not.

The National Aeronautics and Space Administration has flown a number of satellites, beginning with TIROS and continuing through the Nimbus series, that have carried infra-



Two views of the same scene. The upper one was taken by a conventional camera and shows a peaceful and unpeopled area of woodland. In an infrared thermogram of the same scene, the woodland is seen to be populated by a number of figures, including a horse and rider and people seated around a glowing fire.

"Infrared surveillance can pick out the shadow of an airplane on a runway for as long as an hour after it has taken off."

red radiometers. These devices have supplemented the visual information obtained of the earth and its cloud cover by sensing the temperature changes, for instance, in the successive cloud layers above the earth. Such information provides a third, or depth, dimension that otherwise cannot be obtained by visual photography, and is particularly useful to meteorologists in rounding out the information they need to make accurate weather predictions.

RCA's Astro-Electronics Division is currently working on a more sensitive radiometer that will transmit both visual and infrared pictures of the earth at a substantially smaller resolution than existing equipment.

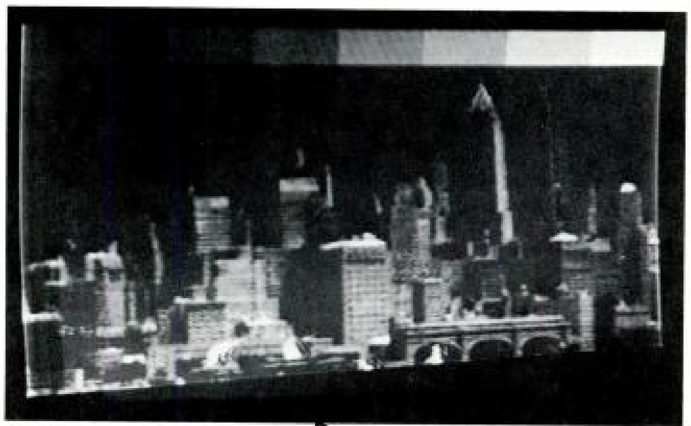
Infrared serves another vital function in satellite technology, and this is to provide the spacecraft guidance system with a reference point so that its cameras can be kept pointed in the desired direction. The horizon sensor, as its name suggests, obtains this point by finding where earth meets sky through their differences in temperature.

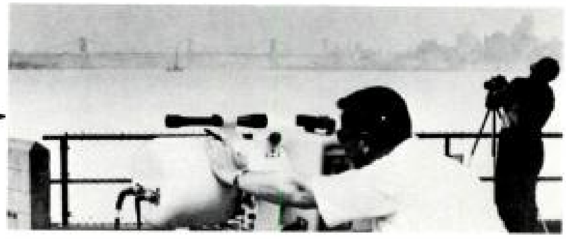
The ability of infrared sensors to detect very subtle temperature changes even in growing things provides agricultural scientists with a unique plant thermometer. And just as a change in the normal temperature of man indicates the presence of disease or illness, so does a change in the normal temperature of plants indicate disease. These changes in plants usually occur in advance of any outward signs of abnormality.

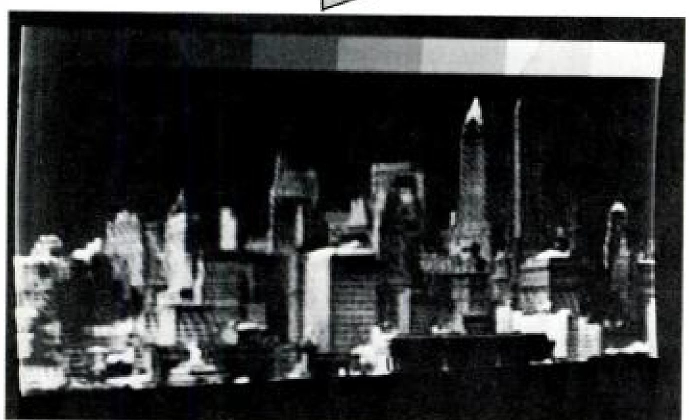
Infrared detection of plant abnormality, as well as dozens of other facts concerning soil and ecological conditions, has stimulated intense interest among agriculturalists, geologists, and other earth scientists. In recent testimony before the House of Representatives Committee on Appropriations, Dr. George L. Mehren, Assistant Secretary of Agriculture, described remote sensing as one of the greatest technological breakthroughs of modern times, perhaps equal in importance to the development of atomic energy, the computer, and recent advances in genetics.

Research in the field is now concentrated on obtaining "spectral" or radiation signatures of major plant and forest species that contribute to the agricultural economy of the world. Each species has a distinctive signature, just as every human being has distinctive fingerprints. These signatures can then be used to check on plant abnormalities caused by drought, soil salinity, nutrient deficiencies, poor drainage, insect and disease attacks, and even slight changes in soil moisture and temperature.

As was told to the congressional committee, the chief advantage of remote sensing is to provide timely, accurate, and in some cases, never-before-available information on the exact nature of crop and soil conditions anywhere on earth. In a world where population may soon surpass available food resources, such information, and the determination to act upon it, could mean the difference between death and survival for large masses of humanity. ■

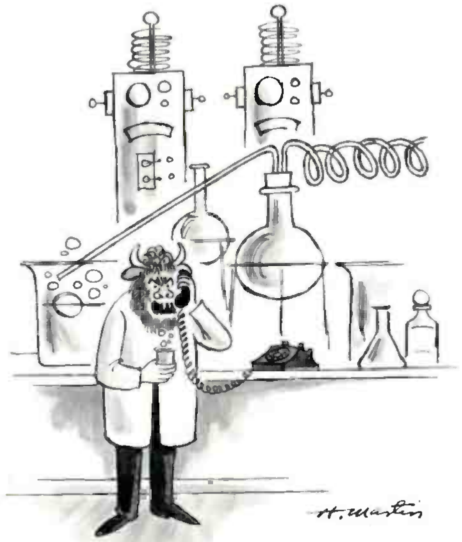




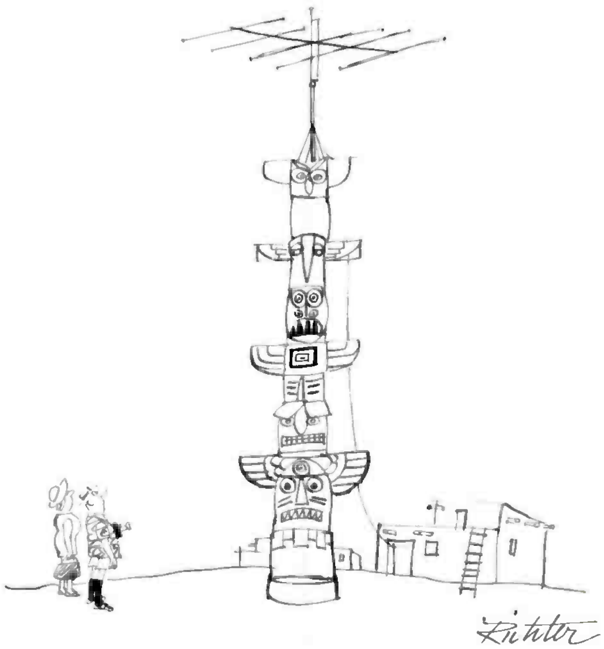


Two views of New York City, as taken at different times of the day with an infrared camera (right). The upper one shows the city at 10 A.M. with the sun striking the east faces of the buildings. The other, taken at 4 P.M., shows a different pattern of temperature distribution.

This Electronic Age...



"Bellevue Labs. Dr. Mayburn speaking."



Airborne Weather Radar

With a meeting in Washington, D.C., the next day, a West Coast engineering representative boarded a Los Angeles-to-Chicago flight the night of April 30, 1952. His connecting flight was scheduled to arrive at Washington National Airport at 6:50 the next morning, adequate time to make the 9:00 A.M. conference. Near Omaha, a huge weather front welled up before the DC-6. The pilot could see only persistent flashes of lightning that occasionally illuminated monstrous thunderheads soaring to altitudes well above the operating limit of the aircraft.

With no more information about the storm-filled environment ahead than a horizon full of lightning and a weather report of extensive thunderstorm activity, the pilot had no choice but to avoid the weather front—a 400-mile detour.

Thus, the engineering representative did not make his connecting flight in Chicago for Washington. He got to the meeting—one of great importance to the airline industry and its passengers—about 2:00 P.M., when it was all over. The meeting, called by the airlines through the auspices of the Air Transport Association of America, was held to draft a set of operational requirements for a new tool to provide in-flight information about thunderstorms. The tool was airborne weather radar.

The need for such a device had long been evident to the airline industry. The chances of survival for an aircraft caught inside those giant clouds known variously as cumulonimbus, thunderheads, or just plain thunderstorms are about like those of Russian roulette. Updrafts and downdrafts rip through the clouds at speeds as great as 150 miles an hour. Often, vortices of tornadic intensity reach like invisible tentacles from these storms. And on their leeward sides, hailstones of devastating size can pound out of shape an aircraft's control surfaces. Turbulence of sledgehammer ferocity can exert the equivalent of up to 10 times the gust-load design limit for transport aircraft, resulting in certain airframe failure. Wind speeds can be so great that, in one instance, a transport pilot, who inadvertently found himself climbing through a severe storm, suddenly saw his air speed drop to zero, completely canceled out by a tremendous tail wind. Deprived of all lift, the plane dropped like a 300,000-pound lump of lead. Fortunately, the pilot was able to pull out of the dive and avert a crash.

The first time airborne radar was used to look at a thunderstorm has never been established, and probably never will be. It could have happened in this way. The pilot of a Navy F4F Hellcat, equipped with an AN/APS-6 general-purpose radar used for beacon navigation, ground mapping, and gun laying, is flying some dark night during World War II. He sees a large, bright echo on his radar screen with rounded characteristics and fuzzy edges. He knows that there is no land mass there to produce such an echo, nor any aircraft capable of it. In fact, its form is unlike any other solid target. Perhaps the last thing he sees, as he flies into the storm's central core, is the lightning-illuminated black mountain of cloud, soaring as high as 60,000 feet.

Occurences similar to the above happened many times during World War II. Thus, before war's end, pilots began using their general-purpose radars for weather avoidance, even though this equipment was never designed for such an application. Later, these pilots, transplanted to the cockpits of postwar airliners, told of this ability of airborne radar to detect storms, and the airlines began taking steps to develop similar electronic devices for their planes.

Among the pioneering airlines in weather radar research were Trans World Airlines and American Airlines. From late 1945 and into 1946, TWA conducted tests with a makeshift radar put together from military war-surplus equipment. The somewhat negative results of the project sent no one scurrying to build a radar around the TWA set. But the tests did inspire enthusiasm in TWA about the possibilities of such a system, and the result was a recommendation that airborne weather radar be developed specifically for storm avoidance by transport aircraft.

Then, for six months during the 1947–1948 period, American Airlines, working with the U.S. Navy, proved out the practical airborne application of a technique called "iso-echo contour." Developed during World War II by meteorologists using ground-based radar, the technique is used to identify the most dangerous part of a storm. Weather radar keeps planes out of turbulence because those areas within a storm with the most intense rainfall are associated with the most severe turbulence, and the radar gets its strongest signal from the heaviest rainfall. With the iso-echo contour—or simply "contour"—system, the strongest echoes, signifying the most hazardous part of the storm, are blanked out. This relieves the pilot of the task of determining the difference between bright and brighter on his radar scope—a problem that would be similar to reading a newspaper printed in ink a little whiter than the paper. What the pilot sees when using the contour circuitry in his radar, then, is a bright area, indicating rainfall of significant intensity, and a black hole in the middle of the bright area, indicating very heavy rain and, therefore, heavy turbulence. He scrupulously avoids the black holes.

These early tests of radar for weather avoidance by TWA, American, and others, including the Naval Air Test Center at Patuxent River, Md., convinced almost everyone that transport aircraft must have this radar. However, there were formidable problems to deal with before the dream of an airline fleet completely equipped with weather radar could become a reality. First, all radar used in these experiments had been modified versions of military equipment. As such, it was too heavy—200 to 300 pounds per unit—and far too complex for the weather mission. In addition, it broke down frequently and was difficult to maintain. Another major problem was that all of the radars used in the weather experiments operated on the same frequency, approximately 9,000 megacycles—or "X-Band." Many of the men involved in developing airline weather radar had serious doubts that X-Band was the best frequency.

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The phenomenon that was bothering these people is the tendency of electromagnetic radiation, as its frequency increases, to act more and more like visible light. With progression through frequencies in the thousands of millions of cycles, the signals are absorbed and scattered by smaller and smaller particles—such as rain—just as light is absorbed and scattered by the fine mist of a cloud or fog. The experimenters began to realize that X-Band frequencies were being stopped by moderate to heavy local rain, preventing the radar from showing more distant storms behind the rain. This fact led the Navy's Patuxent River center, after testing contour circuitry on an AN/APS-33 radar, to conclude in May of 1951: "The iso-echo-contour attachment will be of little value, however, when employed in conjunction with present X-Band radars as an aid to select least turbulent traverses once an aircraft has entered a storm. This fact is due to severe propagation attenuation (scattering and absorption) in heavy precipitation at X-Band frequencies, which results in shortened radar ranges and false contour separation displays."

But by this time airline traffic was increasing rapidly. Already there were known turbulence-caused crashes, and many more were suspected. Something had to be done, and the May 1, 1952, meeting in Washington was called through the auspices of the Air Transport Association of America.

The Association drew up a list of 10 operational requirements for an airline weather radar. These were turned over to Aeronautical Radio, Inc. (ARINC), an organization established by the airlines. ARINC's job: turn the 10 requirements into electronic equipment characteristics.

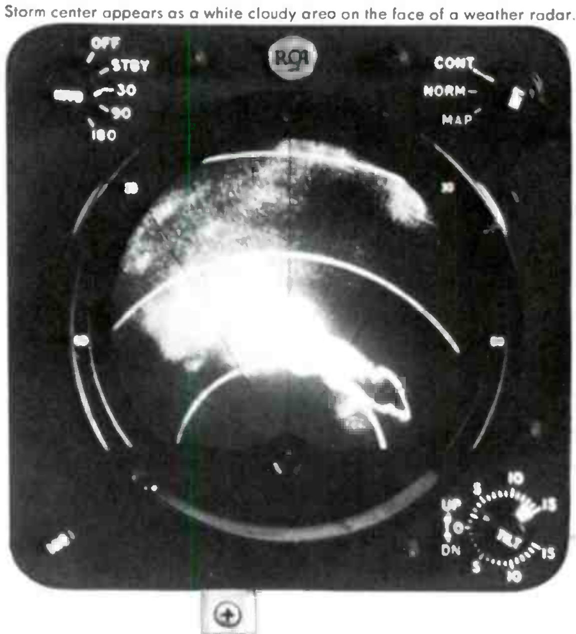
The toughest of these requirements was the one dealing with attenuation. ATA specified that: "The equipment must be capable of penetrating and displaying at short range rainfall rates of 60 mm. per hour to a depth of 15 miles." In other words, the radar had to penetrate for 15 miles rain falling at a rate of 2⅜ inches per hour—a veritable deluge. The feeling was that this requirement ruled out X-Band. To make doubly certain, ARINC turned to scientists at McGill University, Montreal, where extensive meteorological research had been conducted, to recommend a frequency for airline weather radar. In a report dated February, 1953, McGill said about X-Band: "It is not just a matter of the range being limited. There is also the uncertainty of whether one sees light rain through a small amount of intervening precipitation, or heavy target rain through much intervening precipitation."

McGill's conclusion was that a frequency approximately one-half that of X-Band, about 5,400 megacycles, or C-Band, "...would provide optimum performance for weather mapping radar from the standpoint of providing maximum sensitivity with minimum attenuation of signal in heavy rain."

The ink was hardly dry on the McGill report when United Air Lines, in association with RCA, began a program that was to become the most extensive test of weather radar to date: a test to determine whether the mathematical con-

"For the future,
engineers are putting
the final touches on the design
of a new generation of radar
for a new age of transportation—
that of the giant
300- to 500-passenger aircraft and
the supersonic transport."

Storm center appears as a white cloudy area on the face of a weather radar.



clusions of the McGill scientists were valid in the wild and woolly summer skies of America's Midwest.

In February, 1953, RCA's aircraft electronics center in Los Angeles undertook the job of building the world's first airborne C-Band weather radar. The schedule: have the new radar installed and operating in a DC-3 by June 1, in time for the thunderstorm season in the Denver–Omaha area.

The assignment was a tough one. In going to C-Band, all radio frequency components had to be changed, and these components were not readily available because airborne radar up to that time was largely X-band. A new magnetron had to be found, a new antenna had to be designed, and the radar had to contain the iso-echo contour circuitry developed by American Airlines. But delay could mean lives, and the RCA team went to work. On May 27, 1953, United Air Lines DC-3 N-17890 landed at Los Angeles International Airport with an empty radome nose cone installed by Douglas Aircraft Company. On May 29, it took off for Denver equipped with an experimental C-Band weather radar, and project "Sir Echo" was under way.

United flew N-17890 around, near, and through thunderstorms in the Denver area until October 16, 1953. Forty flights were made, totaling 133 hours in all. Of this time, 80 hours were spent in the immediate vicinity of or inside thunderstorms. The DC-3 was manned by United and RCA engineers, and recording equipment installed in the plane took more than 6,000 pictures of the radar display. In order to determine the density of rainfall through which the radar was seeing, the pictures were correlated to rain-gauge readings from the ground, and at one time N-17890 flew into a squall line in formation with a Navy R5D (military DC-4) equipped with X-Band radar for comparison purposes.

Almost all the results were positive. The radar easily penetrated 15 miles through rain falling at the rate of 2⅜ inches per hour. Extensive storm fronts were safely negotiated with a delay of only minutes. The flight crew found it easy to distinguish between the rounded, fuzzy appearance of storm areas and the concentric arc characteristics of ground clutter. And, as an unexpected bonus, the team was able to correlate fingers and hooked fingers extending from weather echoes on the radar screen with hail, a relationship later substantiated in tests by Braniff International Airways. All of United's questions were answered. With small deviations in flight-plan route, C-Band radar does permit detouring away from moderate to heavy turbulence and damaging hail. C-Band radar does see through enough heavy rain so that a pilot will not be led blindly into the hard core of a storm. The only negative aspect was that the presence of tornadoes could not be deduced from anything presented on the radar screen.

By the time the airlines had completed their specifications for weather radar, RCA and other manufacturers were already designing production radars. Some airlines, placing emphasis on storm avoidance rather than penetration because of the nature of weather along their routes, chose X-Band designs. RCA's AVQ-10 C-Band radar, today the most common airline radar in existence, was ready for production in 1954, and early the following year the first production prototype was delivered to United Air Lines for evaluation. Soon, radar-equipped aircraft, with their characteristic black noses, began appearing at the nation's airports. A few years later, the Federal Aviation Agency made this equipment mandatory for airliners.

But this did not complete the job. Business flying was on the increase, and the small business planes were flying in much the same environment as the airlines. On-time schedules were just as important to the business executives as to the airline passenger, and their planes gradually became almost as well equipped as transport aircraft. However, their radar requirements were slightly different. These craft were too small to venture too close to storms, and the large, relatively heavy C-Band radar was too cumbersome for them. So, radar manufacturers turned to X-Band, with its lighter components, smaller antennas, and narrower, more concentrated beam, in order to develop radar suitable for guiding these aircraft around the storm cells. By 1962, RCA was delivering the AVQ-20, a 47-pound, 180-mile-range X-Band radar, to this mushrooming fleet of business and executive aircraft.

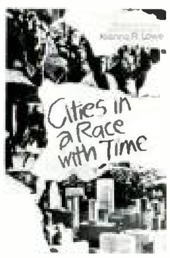
Today, only 12 years after the airlines received their first production radar, this equipment is available for any plane with a place to put it. One newly developed X-Band radar, for example, can provide the lightest twin-engine plane with 80 miles of warning about storms in its path.

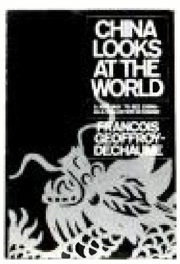
For the future, a team of RCA engineers at the Los Angeles facility is putting the final touches on the design of a new generation of radar for a new age of air transportation, the era of the giant 300- to 500-passenger aircraft and the supersonic transports. Designated the AVQ-30, this radar, produced in either C- or X-Band models, will have even longer range—300 nautical miles—and many other new features. But most importantly, it will show a marked improvement in reliability, a feature made necessary by the unprecedented cost incurred when one of these high-capacity aircraft has to sit on an airport ramp because of equipment failure. A single system AVQ-30 will have a mean time between failure of over 1,000 hours, more than twice that of existing radars. When it is installed in a dual system as recommended by the new airline radar specifications, reliability soars. Under these circumstances, when an aircraft is used about 10 hours a day, and all radar and associated equipment are operating properly at the beginning of each day, the average aircraft will operate for 18,000 hours or 1,800 days without a total radar system failure. This is a 36-to-1 improvement over today's equipment.

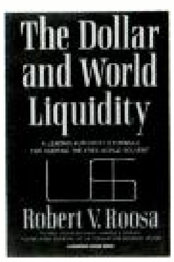
The battle against turbulence does not end with the perfection of microwave radar. Another weather phenomenon, as stealthy as its name implies—"CAT" for Clear Air Turbulence—remains to be conquered. Many companies and government agencies are working toward devices for detecting this invisible turbulence that is completely unassociated with clouds or rain, yet on rare occasions is so violent that it has dropped jet liners with such force that engines have been torn loose. The Federal Aviation Administration has tested a promising device that uses an infrared spectrometer to tell the differences in temperature between clear air masses causing the turbulence. But to date, no foolproof solution has been found, and CAT still challenges the ingenuity of the aircraft electronics industry. That challenge will be met, and the day will soon come when another step will have been taken in the continuing effort to make air travel the safest, most comfortable, most reliable way of getting around. ■

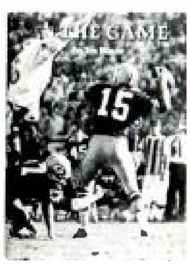
Books at Random...

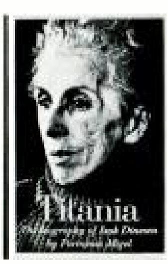
OTHER RECENT RANDOM HOUSE BOOKS

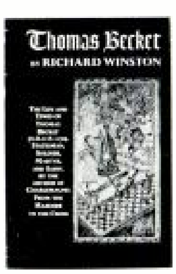


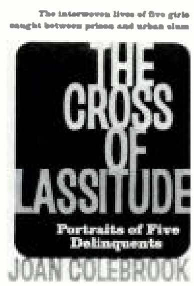








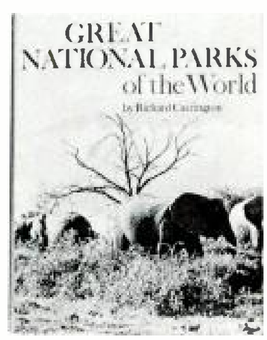




THE CROSS OF LASSITUDE: PORTRAITS OF FIVE DELINQUENTS

by Joan Colebrook *(Knopf)*

The underworld of crime, sex, and drugs in our city slums is the subject of *The Cross of Lassitude.* This fictionalized account of the actual lives of five young girls follows them for four years along their various paths to violence, thievery, drugs, and promiscuity. Already damaged and mutilated by life, the girls drift back and forth between prison cells and hospital rooms, bedrooms, and street corners. They are soon caught up in a tragic cycle as they are punished by the restrictive laws of their society, only to return to "the life" of the streets and further trouble with the law. A former social worker and officer in women's prisons, Mrs. Colebrook penetrates deeply into the lives and minds of these deprived and desperate individuals.



GREAT NATIONAL PARKS OF THE WORLD

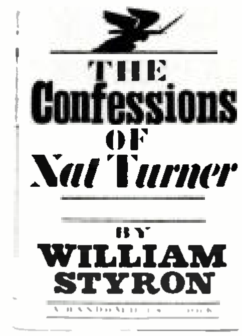
by Richard Carrington *(Random House)*

This handsomely illustrated, well-researched book takes the reader to some of the world's major national parks, sanctuaries, and reserves, where wild nature is being preserved in an unspoiled state for enjoyment and scientific study. The author gives considerable attention to many national parks all over the world, and especially to those in North America and Africa. There are 206 illustrations, including 48 pages in color.

THE CONFESSIONS OF NAT TURNER

by William Styron *(Random House)*

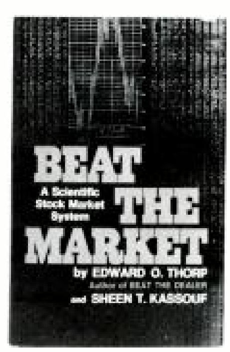
William Styron, author of *Lie Down in Darkness*, is one of the foremost novelists of his generation. *The Confessions of Nat Turner*, the Book-of-the-Month Club selection for October, was featured in the September issue of *Harper's Magazine* and is based on the single effective slave revolt in American history. The insurrection, led by Nat Turner, took place in Virginia in 1831.

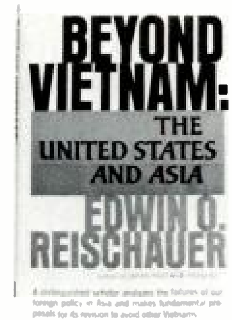


BEAT THE MARKET: A SCIENTIFIC STOCK MARKET SYSTEM

by Edward O. Thorp and S. T. Kassouf *(Random House)*

A stock market strategy developed by the authors has averaged earnings of 25 per cent each year in the five years they have tested it in every type of market. Their system, which applies to convertible securities and their related common stocks, has been perfected by mathematics, economics, and computer analysis. The authors detail their actual investments and give clear instructions on how to conduct your own successful investment program.

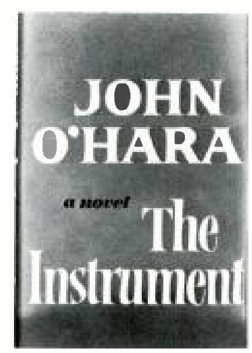




BEYOND VIETNAM: THE UNITED STATES AND ASIA

by Edwin O. Reischauer *(Knopf)*

Edwin O. Reischauer, distinguished scholar and former Ambassador to Japan, analyzes our foreign policy in Asia and makes fundamental proposals for its revision to avoid future Vietnams. Mr. Reischauer contends that the waves of change in Asia have been stirred up not by communism but by nationalism in many political forms, and that Americans have been unrealistic to expect all Asian countries to develop democracy immediately. His proposals for a more stable Asia include improvement of our relations with Japan and a more relaxed attitude toward China.



THE INSTRUMENT

by John O'Hara *(Random House)*

"Maybe you don't need anybody. That goes with genius sometimes." Yank Lucas believed he didn't—couldn't—need anybody. He could put people on paper or in his plays with a sure, deft touch, but in real life he did not seem to have the ability to care about anyone. Yank's realization that he has become the instrument of someone else is the irony of this new O'Hara novel. Set on Broadway and in small-town Vermont, *The Instrument* displays John O'Hara's sure instinct for describing people and places, as well as his storytelling talent.

The Choctaw Story

A far-reaching program
to help the Choctaw Indian adjust
to urban society may
provide a blueprint
for resolving problems
of chronic poverty.

by Patty Cavin

U.S. Commissioner of Indian Affairs Robert L. Bennett (left) with the Nathan Thompson family, one of the first families to enroll in the Choctaw project.

A new approach to resolving chronic poverty among the Choctaw Indians of Mississippi is beginning to pay dividends in human welfare. Designed to put the Choctaw, low man on the economic totem pole, back on his financial feet, it may even provide a successful blueprint for other underfed, undertrained, and underprivileged minorities.

Twenty-five chronically poor sharecropper Indian families in Central Mississippi are the pioneers in this far-reaching social experiment called the Choctaw Family Training Project. The program is funded by the Interior Department's Bureau of Indian Affairs (BIA), and its goal is to train entire families—mothers, fathers, and children—in how to live, work, and compete in an urban society.

The Choctaws were chosen for the pilot program because they are a large tribe with special poverty problems. Members of the Mississippi branch of this Indian nation, now largely centered in Oklahoma, are among the poorest citizens today in America. The 3,500 Indians who reside on the Choctaw Reservation and in nearby Neshoba, Leake, Scott, Newton, Jones, and Kemper counties of East Central Mississippi live in conditions even worse than disadvantaged Negro families of this depressed agricultural area.

This is country where "chopping" cotton pays Indian workers as little as 10 cents an hour. If the Indian's wife and children pitch in, he may earn $2 a day in season. If his total yearly income reaches $700, he considers himself lucky.

In exchange for his labor, the Indian generally gets a two-room, tar-papered shack without running water or lights as a supplement to his wages. He "shares" the crop, which he farms with a mule. There are times when families are reduced to a diet consisting mainly of grits and beans.

The Choctaw project, the idea of Robert L. Bennett, the U.S. Commissioner of Indian Affairs and himself an Indian, was launched last November under a contract to the RCA Service Company, whose responsibility is to provide the know-how needed to run the training project.

It is the Commissioner's hope that the project will be expanded into an intertribal, cross-country program of prevocational and vocational training. "Total" is the key word. While Choctaw fathers acquire educational and vocational skills, mothers learn home management, children attend school regularly instead of chopping cotton in the field, and the babies are cared for in a controlled and sanitary nursery.

Immediately after the contract was signed, teams of RCA specialists began drawing up a program of basic vocational training, remedial reading, housing, and recreation. At the same time, a select group of BIA officials began to work with a committee of Choctaw tribal chieftains and to tour the Mississippi countryside in order to recruit as many Indians as possible before the end of December, when most Choctaws, in order to ensure shelter for themselves and their families, sign up to work the landlord's land for yet another year. But recruiting the Indians raised problems that might not be apparent at first glance.

In the past 100 years, the Indian sharecropper has replaced the traditional Negro tenant family. Driven off the barren Choctaw Reservation by the necessity for survival, he has through the years become an integral part of the local economy. He asks for—and gets—little but a roof above his head, and he works hard when there is work to be done. Landowners are touchy about their rights, and it is to their

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economic advantage to maintain the present structure with its cheap Indian labor. Complicating this social situation is the problem of race. The neighboring community of Philadelphia has, in the past, been torn with racial strife, the most shocking incident being the murder of three civil rights workers in 1964.

In order to get the program off the ground and avoid violence, a great deal of tact and quiet diplomacy was required. The BIA recognized this and was successful in its efforts not to alienate the local population. Between December and March of 1967, when the first 25 Choctaw families moved into their new homes in the Pearl River Community, headquarters for the Choctaw Training Project, there were no incidents of violence or obstructionism.

The Indians themselves were given strong incentives to join the program. Instead of the tar-papered shacks, there were 10 two-bedroom trailers for the smaller families, and 15 trim, pre-cut, white-frame bungalows for the larger families. Each unit is equipped with a bathroom, modern kitchen, and simple but adequate furniture. Five air-conditioned vans and a modified three-bedroom house were set up for classrooms and offices.


A 19th century painting by George Catlin showing the Choctaw Indians at play in Oklahoma.

Depending on their size, the families are paid a stipend ranging up to $262.50 a month, which they are learning to budget as they make outlays for food, rent, and utilities. In contrast to the sharecropper's $700 a year, it is a great deal of money.

The 172 trainees who moved in on March 1 were a bewildered but eager group. Their program began with indoctrination lectures, tours of the housing units, demonstrations on how to light the gas stoves, and, most importantly, a battery of achievement tests. All the trainees were given physical examinations, complete with chest X-rays and eye tests. Because of their isolated existence in the past, many were socially maladjusted, and psychological counseling was made available to those who found it difficult to adapt to their new existence. The resultant statistics are somber but significant.

The average number of members per family was 6.84. Fathers averaged 30.8 years of age, had attended 2.2 years of elementary school, and spoke poor English. Their wives, on the other hand, averaged 28.5 years of age, with 2.6 years of schooling, and spoke or understood very little English. Most of the 122 children had never been to school and spoke only Choctaw. The tests also showed that mothers, fathers, and children had above-average hand and eye dexterity, patience, and tolerance.


Sharecropper's cottage occupied by a Choctow Indian family.

These findings did not come as a surprise. Commissioner Bennett has pointed out that "while the Indians are not very competitive, as a group, they are extremely adaptable. Their natural physical traits, such as manual dexterity, lend themselves well to the electronic industries, but, unfortunately, few have enough basic education to take advantage of on-the-job industry training. That is the problem we must solve."

This type of situation was well suited to the RCA Service Company, which has had long experience in training men for jobs. RCA's staff of 28 is headed by C. R. ("Bob") Murray, a crew-cut young high-school teacher from West Virginia with experience in training Job Corps boys. He and Commissioner Bennett agreed that the skill level of many of the men starting the project was too low to qualify them for industrial on-the-job training. Thus, they must first be taught to read, to do simple arithmetic, and to use a ruler.

To this end, fathers spend half a day in basic education classes, learning the rudiments of reading, writing, and arithmetic. Classes are no larger than six, and students are encouraged to progress as rapidly as they are able. This approach has been highly successful. As an example, within three and one-half months, some previous nonreaders were scanning lines at 100 to 200 words a minute.

The other half of the working day is spent in prevocational training. Classes are organized into a 10-step program that begins with basic instruction in wood and metal work. The instructional emphasis is upon the use of basic hand and power tools, and this instruction is supplemented by schematic diagrams of the kind that assembly-line workers, or craftsmen working alone, would be required to master. Less sophisticated courses are also a necessary part of the training program. These include such basics as driver education, household maintenance (how to repair torn front-door screens, for example), and tool care.

RCA's Manager of Administration Don Scheel admits the greatest difficulty the staff has had to overcome has been teaching the men interpretive drawing. "Most of them have never had to visualize a problem on paper before," he explains. "They have not had enough education to read a ruler, and they also need to learn about fractions. But they are coming along just fine. When we finish with them, we hope some can start out on jobs at $1.60 an hour, a wage leading to annual earnings of slightly over the $3,000 cited by President Johnson as the poverty level."

This is an ambitious goal but not an impossible one. Commissioner Bennett, who visited the Mississippi program in July, is optimistic about the end results. No formal cutoff time has been set for the training period, but some members of the group may need two years to master the prevocational skills. Another two years may then be needed to develop the vocational prowess needed to guarantee lasting economic independence.

The minimum training period will be nine months. Within this period, a few of the fast learners are expected to graduate to placement in cities such as Memphis, Jackson, or perhaps New Orleans. When this happens, both BIA and RCA will coordinate their efforts to provide a follow-up program for on-the-job placement and conditioning of the families to their new locale.

Additional study opportunity for some Choctaw project graduates may also be available from private industry. The RCA Service Company, through the efforts of Division Vice President Joseph F. Murray, has offered a one-year scholarship for an RCA Institutes' computer systems course to be given at Cherry Hill, N. J. The $1,260 scholarship will cover both tuition and books and should qualify the recipient as a computer technician.

While the men labor at learning, Choctaw mothers are taught home economics and receive a liberal sprinkling of the "3 Rs." They, too, must know how to read in order, for example, to scan the newspapers for specials in food and clothing. Three home economists have undertaken this part of the instruction. They are also teaching the fundamentals of nutrition, menu planning, cooking, baby care, how to give a home permanent, and family planning.

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and others to come,
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Indian children at play in the nursery of the Choctaw Family Training Project.

Nursery school children have a fenced-in area in which to play.

Classes are held on a half-day basis, with one teacher always free to make daily home visits as a follow-up to the classroom instruction. The women, like the men, go on frequent field trips to the Philadelphia and Meridian communities for purposes of learning comparison shopping.

Despite their eagerness to learn, the children have been the most difficult to train because of the language barrier. Bobbie Mills, the nursery instructor, and her two female Choctaw aides have had to use phonics, sign language, pictures, and imagination to explain to the 47 pre-school tots how to work with the blocks and the shiny new toys, the swings and rings that keep them amused while their mothers are in class.

A full-time tutorial program for children in the primary grades has also been established to provide concentrated remedial instruction in the areas most needed—reading, spelling, and arithmetic. The first students to enroll were third, fourth, and fifth graders previously taught at the Pearl River Choctaw School built by BIA in 1965. First graders by achievement, they will rejoin their classmates at Pearl River when they have attained their normal grade levels.

During the summer, a special recreation program on the school grounds kept the 7-to-12-year-olds busy with story hour and such outdoor games as ping-pong and baseball. The teen-agers, 19 in all, were also treated to special summer conditioning in the form of a month away at summer camps in nearby Tennessee. As one project counselor explained, "We were exhausted by the time they got off, as we had to outfit them from head-to-toe and the skin out in order to get them ready for camp."

How are the Indians accepting this revolutionary concept? At a tribal chieftains' luncheon for Commissioner Bennett during his July visit to Pearl River, Choctaw spokesman Clay Gibson, a Baptist minister who doubles as Chairman of the Mississippi Choctaw Tribal Council and Project Director for the now active Neighborhood Youth Corps, summed it up this way. "We are all for the project, now that we know how it works. The most impressive thing is the opportunity for families to learn something else besides sharecropping."

James Hale, superintendent of the local Choctaw agency, agrees. A complete skeptic at the start of the program, Hale now calls it "one of the greatest things that has ever happened to the Indians."

The local community has also been generally receptive to the project. A delegation of 20 members from the Philadelphia Chamber of Commerce and a group from the Mississippi Research Development Center in Jackson, who toured the center in early August, were openly enthusiastic. Many felt the training program was a constructive approach towards improving the low economic status of the Choctaws.

The government has been sufficiently encouraged by the initial results of the project to renew RCA's initial $402,258 contract. The new contract of approximately $700,000 will expand the original program to include 30 new families. This will enlarge the pilot project to 55 families by December of 1967. More trailers for offices and classes have been ordered, and construction has been started on 30 new houses. A call has gone out for the additional teachers needed to instruct the growing community.

While it is still too early to arrive at exact figures, Commissioner Bennett estimates that the dollar cost of a year's operation will approximate $4,600 per trainee, significantly under the cost of training an individual in the standard Job Corps program. He is quick to add that the initial investment has already paid a major dividend by giving American Indians new hope for their future.

Perhaps the most significant outside development of the initial Choctaw project is the interest that has been evoked among other corporate industries. Philco-Ford Corporation is already administering a second and similar, but intertribal, project in Madera, Calif. Called the Madera Employment Training Center, it is located on a remodeled Air Force base. Like the Choctaw program, it offers a variety of classes for all members of the Indian family. A third major training center is currently in the planning stage, and a number of corporations have expressed an interest in bidding. Designed for more than 70 families and 140 single Indians, it will be located in Roswell, N.M.

The Bureau of Indian Affairs is pleased with the success of its joint venture with RCA and the interest being shown by other corporations. The Commissioner himself grew up on the Oneida Reservation in Wisconsin. It is his hope that these projects, and others to come, will build a bridge for young Indians to cross over from the reservation into modern America, where they can take advantage of the opportunities around them without losing their heritage.

As a group, Indians are victims of what Commissioner Bennett calls "reservation culture," a long-standing and enforced dependency on the U.S. Government. With training and encouragement from Congress, the Bureau, and industry, he is confident that they can move into the mainstream of society and take their rightful place in the economic and political life of America. ■

For the Records...

NEWS OF RECENT OUTSTANDING RCA VICTOR RECORDINGS

MAHLER: SYMPHONY NO. 3

Boston Symphony Orchestra, Erich Leinsdorf conducting, Shirley Verrett, mezzo-soprano

(RCA Victor LM/LSC 7046)

This RCA Victor Red Seal record is a fitting companion piece to the recordings of the composer's First, Fifth, and Sixth symphonies by the Boston Symphony under Maestro Leinsdorf. The recording was made in October. 1966, five days prior to the Carnegie Hall performance of the work, and features Miss Verrett, the New England Conservatory Chorus, conducted by Lorna Cooke De Varon, and the Boston Boychoir, under the direction of John Oliver. Together with the three previously recorded productions of the Mahler works, "Symphony No. 3 in D Minor in Six Movements" further enhances Erich Leinsdorf's reputation as an expert performer of the composer's work.

"CLASS OF '67"

FLOYD CRAMER

(RCA Victor LPM/LSP 3827)

Following his successful packagings. on two previous albums, of many of the hits of 1965 and 1966, Floyd Cramer's RCA Victor Dynagroove recording, "Class of '67," offers a dozen contemporary favorites in the distinctive Cramer piano style. Included in this collection are two movie themes, both by Burt Bacharach and Hal David: "Alfie" and "Casino Royale." Also featured are "My Cup Runneth Over," "Release Me (and Let Me Love Again)," "Music to Watch Girls By," and others from the past year's "Top Ten" lists.

"GUNN"

Music from the film score composed and conducted by Henry Mancini

(RCA Victor LPM/LSP 3840)

It took six years for TV's most famous private eye to make the transition from the video to the theater screen. He is, of course, Peter Gunn—and the same trio responsible for the television success has been reunited: star Craig Stevens, director Blake Edwards, composer Henry Mancini. This recording of the music from the film score marks the third RCA Victor"Peter Gunn"album for Mr. Mancini, and, except for a new, updated version of the popular theme and a vocal of "Dreamsville," also from the TV show, all the melodies and themes have been written especially for the film. Leslie Bricusse wrote the lyrics to "I Like the Look," and the team of Livingston and Evans supplied the words for "Bye Bye" as well as "Dreamsville," all three of which are sung by the Mancini Chorus.

PUCCINI: LA RONDINE

Anna Moffo, RCA Italiana Opera Orchestra and Chorus, Francesco Molinari-Pradelli. Conductor

(RCA Victor LM/LSC 7048)

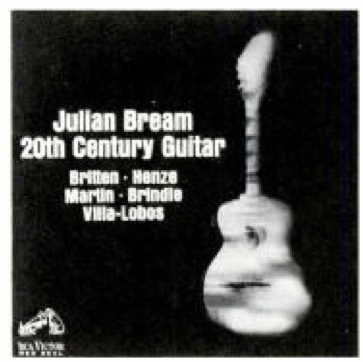
This RCA Victor Red Seal recording marks the first complete stereo production of the seldom-presented opera. The work, first presented on March 27, 1917, at the Monte Carlo Opera House, represents a continuation of RCA Victor's policy of reviving infrequently performed symphonies and operas by the great masters. The recording features Anna Moffo and Daniele Barioni singing the primary roles of Magda and Ruggero. As the secondary pair of lovers, Piero De Palma is Prunier and Graziella Sciutti is Lisette.

"CLASSIC JAZZ PIANO STYLES"

Albert Ammons, Earl Hines, Pete Johnson, "Jelly Roll" Morton. "Fats" Waller, and Jimmy Yancey

(RCA Victor LPV 543)

The latest collection of jazz classics, culled from the RCA Victor archives and released in its Vintage Series, features 16 definitive piano solos by men who made the piano a jazz instrument. Included are three solos by the legendary "Jelly Roll" Morton, recorded in 1929. The stylish "Fats" Waller is represented by four selections from the mid-to-late Thirties. Earl "Fatha" Hines performs his memorable "Rosetta" and three other early-Forties classics. Jimmy Yancey's two contributions demonstrate the earliest of boogie-woogie, and the society team of Pete Johnson and Albert Ammons rounds out the set with a pair of 1941 recordings.



"20th CENTURY GUITAR"

JULIAN BREAM

(RCA Victor LM/LSC 2964)

The most exciting contemporary performer of the classical guitar is the young Londoner, Julian Bream. Often spoken of as the successor to Segovia, Bream has recorded in his latest RCA Victor Red Seal album a number of firsts. With the exception of two Villa-Lobos Etudes—No. 5 in C and No. 7 in E—the artist performs previously unrecorded works of 20th century composers: Benjamin Britten's "Nocturnal, Op. 70," written especially for the virtuoso; Reginald Smith-Brindle's "El Polifemo de Oro"; four short pieces by Frank Martin: and three selections from Hans Werner Henze's composition "Kammermusik 1958."

Electronically Speaking...

NEWS IN BRIEF OF CURRENT DEVELOPMENTS IN ELECTRONICS

PRINTED COPY FOR THE HOME

An experimental system that can broadcast printed copy into the home along with standard television programming is ready for on-the-air testing.

The system has the potential to bring about a dramatic advance in home information services by making it possible to print information of a newsworthy nature right in the living room or elsewhere in the home, although it will be a few years before an operating system might be available to the public.

To evaluate the technical performance of the system under actual operating conditions, an application has been filed with the Federal Communications Commission for permission to make on-the-air tests between New York City and Princeton, N.J., the site of RCA Laboratories, where the system is being developed.

The system works by converting printed copy into a series of electromagnetic signals which are blended at the transmitter with those of regular TV programs by means of an electronic "hitchhiking" technique. The blended signal is broadcast for reception by standard TV home antennas. The signal is fed from the antenna to the printer without affecting home TV reception in any way.

Experimental printers currently under evaluation for this application produce the equivalent of a page from a standard paperback book every 10 seconds. They employ an RCA-developed electrostatic printing process which is already widely used in office copiers. Suggestions for use of the new system range from printed news briefs, sport scores and stock market reports, charts and cartoon strips, to TV program schedules, syndicated columns, news magazines, and copies of presidential addresses.

TWO-POUND TV CAMERA FOR SPACE

A tiny television camera, about the size of a home movie camera and weighing about two pounds, has been developed for potential use in space exploration missions.

The new miniature camera is suited for a wide variety of uses where size and weight are vital considerations. Installed in a manned spacecraft, it could observe astronaut actions and reactions during a flight. The camera could be detached and hand-held by an astronaut to provide panoramic views of the space environment or used outside the spacecraft following a lunar or planetary landing. Working in conjunction with a signal converter, the camera could relay live pictures from space to home television audiences. It can function equally well unattended by human beings. On unmanned programs, for example, it could "watch" experiments and spacecraft elements requiring visual observation by scientists on the ground.

The camera, which with lens measures 6¾ inches by 3 inches by 1½ inches, is the smallest TV camera ever built at the RCA Astro-Electronics Division in Princeton, N.J. The Princeton Space Center facility has produced more than 150 TV cameras for American space programs, including the TIROS and Nimbus weather satellites and the series of Ranger spacecraft that gave the world its first close-up views of the moon.

Key features that make possible the compact size and reduced weight of the camera are the extensive use of integrated circuits and improvements in design of the deflection and focus coil. Other design features of the camera include discrete components and a one-half-inch vidicon imaging tube.

NEW ULTRAVIOLET LASER

The first gas lasers to produce intense beams of ultraviolet light continuously for up to 1,000 hours are now being offered to industry.

Because of the short wave length of ultraviolet light, organic substances such as dyes, photographic emulsions, biological materials, and even human skin—as witness the phenomenon of sun tanning—are especially susceptible to it.

For this reason, the compact new units might be used to help the effort to decipher the "code of life" thought to be carried by the DNA molecule in the human cell; in the effort to build more versatile microelectronic computer circuits whose construction depends critically on photographic processes; and to trigger chemical reactions that could lead to the synthesis of new wonder drugs and new antibiotics for use against disease.

Still other applications are expected in optical recording on materials that are insensitive to visible light, in contact printing, and also in the chemical processing industry where ultraviolet light is being used to initiate oxidation, polymerization, and decomposition reactions.

The "heart" of the device, developed at the RCA Laboratories, is a sealed quartz tube resembling a common fluorescent light. The tube is filled with neon gas which, during operation, is ionized by an electric current passing through the tube. The excited ions emit light as they change from one energy state to another. This ultraviolet light is amplified and emitted as a pencil-thin laser beam through an arrangement of optical windows and mirrors.

MULTIPURPOSE COMPUTER DEVELOPED FOR AIR FORCE

A new multipurpose computer, compact enough to serve as a self-sufficient data processing center aboard aircraft or spacecraft, has been developed for the U.S. Air Force. The computer occupies 3.1 cubic feet of space and weighs only 120 pounds, yet it is capable of performing a wide range of data processing operations that previously required computer complexes many times its size. Designated VIC, for Variable Instruction Computer, the device has been under development by RCA since 1965.

Small computers have been used in aircraft and spacecraft for some time, but they have been specialized devices not designed for general data processing tasks. A key feature of the VIC computer is the RCA-conceived variable instruction technique, which allows a programmer to vary the source of information fed into the computer, the function performed on the information, and the destination of the results.

In a conventional computer, the programmer must use the instruction set wired into the machine, resulting in a compromise that is usually less than optimum for the application. The VIC will thus bring to aircraft and spacecraft a computing capability that to a large extent will make them independent of ground-based facilities with respect to their data processing requirements.

With customized programs stored on magnetic tape, a VIC aboard a spacecraft could easily fulfill all flight computation requirements. These might typically include performing guidance and navigation computations, monitoring the control and life-support systems, checking astronaut performance, and processing scientific measurements. The VIC could also find vital utilization aboard such facilities as airborne military control centers.

Among the VIC's design features is the extensive use of integrated circuits to reduce the number of components and interconnections with a resulting increase in reliability. The computer also employs redundancy and a type of modular construction in which each major functional unit has been made as nearly independent of other units as possible.

COMPUTER NETWORK TO SPEED BANKING

Three national, eight state, and 209 branch banks of Marine Midland Corporation throughout New York State will be linked through a computerized communications and information processing network that will provide instant information on any of Marine Midland's more than one million customers.

The computer installation, employing nine RCA Spectra 70 computers, will be one of the largest third-generation banking systems in the United States. These systems utilize integrated circuits, operate at very rapid speeds, and possess language compatibility not available in less modern computer systems.

An information "hub" will be established by Marine Midland at each of three regional centers located in Buffalo, Syracuse, and New York City. Each center will have two large Spectra 70/45 computers and a smaller 70/35 unit. Several hundred million characters of information will be filed in the computer storage devices at each center.

Communications lines will link the information hubs with several hundred computer inquiry terminals at the 11 chartered banks and the 209 branch offices. A variety of video display, voice response, and teletypewriting devices will be used.

The new system will permit key personnel of the bank to receive instantly a complete banking history on any customer. It also will store and report information on corporate and personal trust accounts and a variety of business service applications. Installation of the complex system is scheduled to begin in the last quarter of 1967.

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A multiple-image view of Artur Rubinstein, the 20th century's grand master of the piano. The photographic effect was achieved by placing a prism in front of the camera lens. An article on Rubinstein at age 80 begins on page 16.

Electronic Age

AUTUMN 1967