TIME

THE WEEKLY NEWSMAGAZINE

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A letter from the PUBLISHER

Bernhard M. Auer

IF the somberly reflective Adlai Stevenson that his friend Ben Shahn portrays on the cover can be said to capture the ambassador's mood during the past week (as we think it does), it must be put down to prescience.

Shahn actually did the sketch some time ago, in the spring of 1960, to accompany an article written by Stevenson for a new magazine. But the magazine never got off the ground, the article never appeared, and Shahn's sketch now reaches print for the first time.

Stevenson did not sit for his portrait, and Shahn mostly relied on his own memory of him. "One has a multiple image of a person seen so often in public, in the press and on TV," says Shahn, who then set out to catch in a few strokes a likeness faithful to that multiple impression that existed in his mind's eye.

TO Washington Bureau Chief John Steele, who did most of the reporting on this week's cover story, Adlai Stevenson is a fascinating and familiar subject. "I remember him first during the 1952 campaign, when he abandoned it to deal with a prison riot back in Illinois. From a hilltop I could see him, a somewhat incongruous figure in a brown Brooks Brothers hat and a Chesterfield coat, walk into the prison courtyard and calmly sway a frenzied mob into returning to their cells with a warning that he would order the guards to fire once at the ceiling and then to fire directly at the rioters. The fusillade aimed at the ceiling was enough; the strike was over."

This first impression kept Steele from ever accepting a too easy view of the man as weak. In the years since, Steele has seen Stevenson often, and in many circumstances—enchanted, impatient, harried, exhilarated or disappointed—and concludes, "One doesn't really know Stevenson, but he's a man mighty easy to like."

POLITICS has its nuances, the arts require discrimination, and science has its complexities. It becomes the business of journalism such as ours to treat of all of these subjects in a way that will hold a reader's interest without insulting his intelligence. In fields of specialized knowledge, we aim to render an account that is plain and simple, yet does no violence to the difficulty of the subject, so that the uninformed reader can understand us while the expert cannot fault us. We try to keep in mind a saying attributed to Einstein—that everything must be made as simple as possible, but not one bit simpler.

For an example of how well Science Editor Jonathan Norton Leonard pursues this double responsibility, we commend his comprehensive report this week, accompanied by four pages of color, on how radio astronomy has created "a second window in the sky."

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ASTRONOMY

View from the Second Window

Three centuries have passed since Galileo peered through his primitive telescope and first saw the moons of Jupiter and the golden crescent of Venus. Telescopes have been vastly improved since then, but men still study the stars through the same window opening on the universe. Their best lenses and most perfect mirrors work with visible light, and what cannot be brought into focus seemed forever beyond man's reach.

Suddenly the view has changed. The burgeoning science of radio astronomy has created a second window in the sky. And astronomers anxious to examine the far reaches of the celestial landscape are busily constructing the strange tools of their new trade. Odd shapes bulge above the horizon from Russia to Australia and all across the U.S. Great dishes of steel lacework sweep slowly across the sky; giant troughs rock like cradles; forests of poles and miles of wire stretch out in geometrical patterns. To avoid electrical interference, most of the radio telescopes hide away in mountain-ringed valleys, far from towns or well-traveled highways. But they are never far from the minds and hopes of scientists. Radio astronomy is barely 30 years old, and new discoveries are being recorded almost every day.

Ham Founder. The radio window was accidentally opened for the first time in 1932 by Karl Jansky, a Bell Telephone physicist who was studying the crackling static that can be so annoying in radio communications. During quiet periods, when no lightning flashes were disturbing the atmosphere, a faint hiss still sounded in his receiving apparatus. It seemed to rise and fall in strength as the earth turned. Jansky studied the hiss more carefully and found that its maximum strength came four minutes earlier each day. The time interval seemed significant.

JET GALAXY
In numberless unexpected ways.

Jansky knew that because of the earth's motion while it orbits the sun, the sidereal day, which measures the earth's rotation with respect to the stars, is four minutes shorter than the 24-hour solar day. He concluded that the hiss in his earphones was caused by radio waves from beyond the sun.

Jansky's work was well-publicized, but it was done during the great Depression, when little cash was available to encourage scientific enterprise. Only a single radio ham, Grote Reber of Wheaton, Ill., followed Jansky's lead. Working alone, Reber built a dish antenna 31 ft. in diameter in his own backyard. With it he made the extraordinary discovery that the sky is full of radio stars that have nothing to do with ordinary stars. Reber had opened wide the radio window on the sky. His crude radio telescope, the world's first, now stands at the entrance of the National Radio Astronomy Observatory at Green Bank, W. Va.

Bulges & Squiggles. Soon after World War II, radio astronomy really got into high gear. Scientists in many lands, especially Britain and Australia, built improved radio telescopes to take advantage of the second window. Their task was not easy. Radio astronomy depends on electromagnetic waves, which are much harder to handle than the visible light that the human eye receives with such marvelous ease and precision. Radio waves are many thousand times longer than light waves, and because of inflexible laws of physics, this means that radio telescopes must be enormously wider than optical telescopes before they can distinguish objects equally small.

Instead of taking quick pictures of large parts of the sky, radio telescopes must scan slowly, gathering details one by one. As a radio telescope's beam (its field of sensitivity) moves across the sky, the radio waves collected by the dish are focused on an antenna and detected as an extremely feeble electrical current. This current is amplified by intricate electronic apparatus until it is strong enough to move a finely balanced pen and draw a wiggly line on a strip of paper. Small wiggles mean little or nothing, but a good-sized bulge means that some object deep in space is sending radio waves down the telescope's beam.

Dishes & Holes. Parabolic dishes make by far the most versatile radio telescopes; they can be used to tune in on several wave lengths at the same time. The most famous dish, the 250-foot monster at Jodrell Bank, near Manchester, England, started work in 1957 and is still going strong. Probably the most effective dish is the 210-footer at Parkes, Australia. The biggest dish, 300 ft. in diameter, is at Green Bank, W. Va.

Big steerable dishes that can be turned to point all over the sky are extremely expensive. For large area and proportionately high sensitivity at reasonable cost, radio astronomers dig cylindrical or hemispherical holes in the ground and line them with radio-reflecting metal. These immovable reflectors cannot be steered except by electronic trickery, but their sheer size gives them enormous power. The cylindrical telescope at the University of Illinois has 3½ times the area of the Green Bank dish.

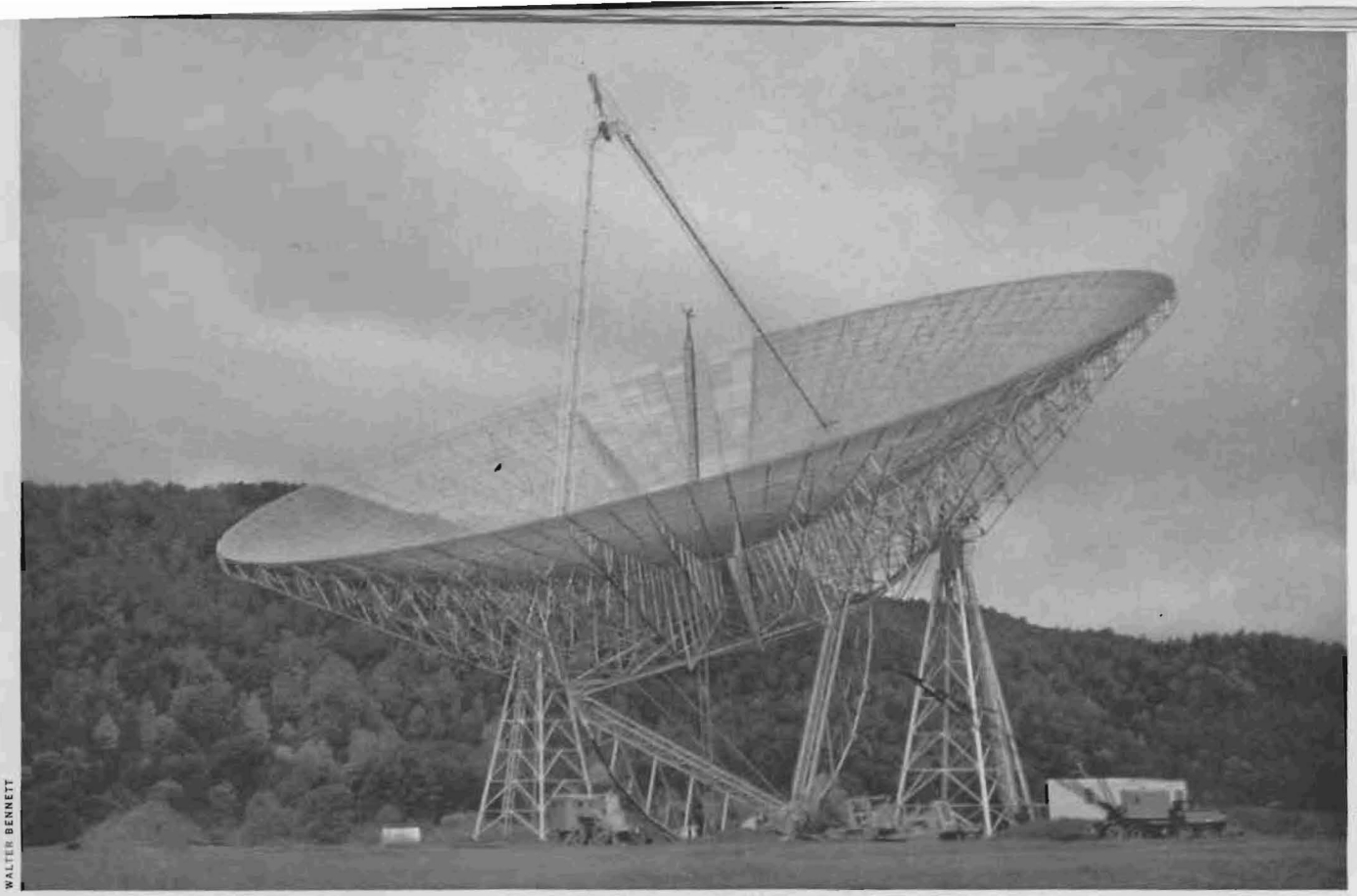
One important type of radio telescope does not try to observe celestial objects with a single antenna. Instead, two antennas are placed a considerable distance apart and connected electronically so that they function like parts of a single, very large dish. Since a telescope's resolution is proportionate to its width, the double antenna has a far narrower beam than a single dish. Even finer resolution is obtained by long, rocking metal troughs that gather radio waves and focus them so that they interact with waves gathered by another antenna running at right angles to the first. In Australia, and at Cambridge University, England, such intricate apparatus record information on punched tape and feed it into electronic computers for analysis. They have an effective beam so slender that it can distinguish objects many billion light-years distant in space. The most complex setups of all use two dishes scores of miles apart, feeding their information by microwave beams to a common center.

Living Universe. A list of the radio sights visible through these varied telescopes would fill an enormous book, but radio astronomy is developing so fast that no such book is likely to be written for years. Still, the radio window has already brought the universe to life in numberless unexpected ways. Even the moon, just about the deadest object in the solar system, sends out radio waves that tell something about its temperature and about the material on its surface.

The planets have come to life too. Venus sends waves which hint that the temperature under its clouds is much too high for earth-type life. Jupiter pulsates with many kinds of radio waves. One kind comes from an easily observable shell

WIDE WORLD

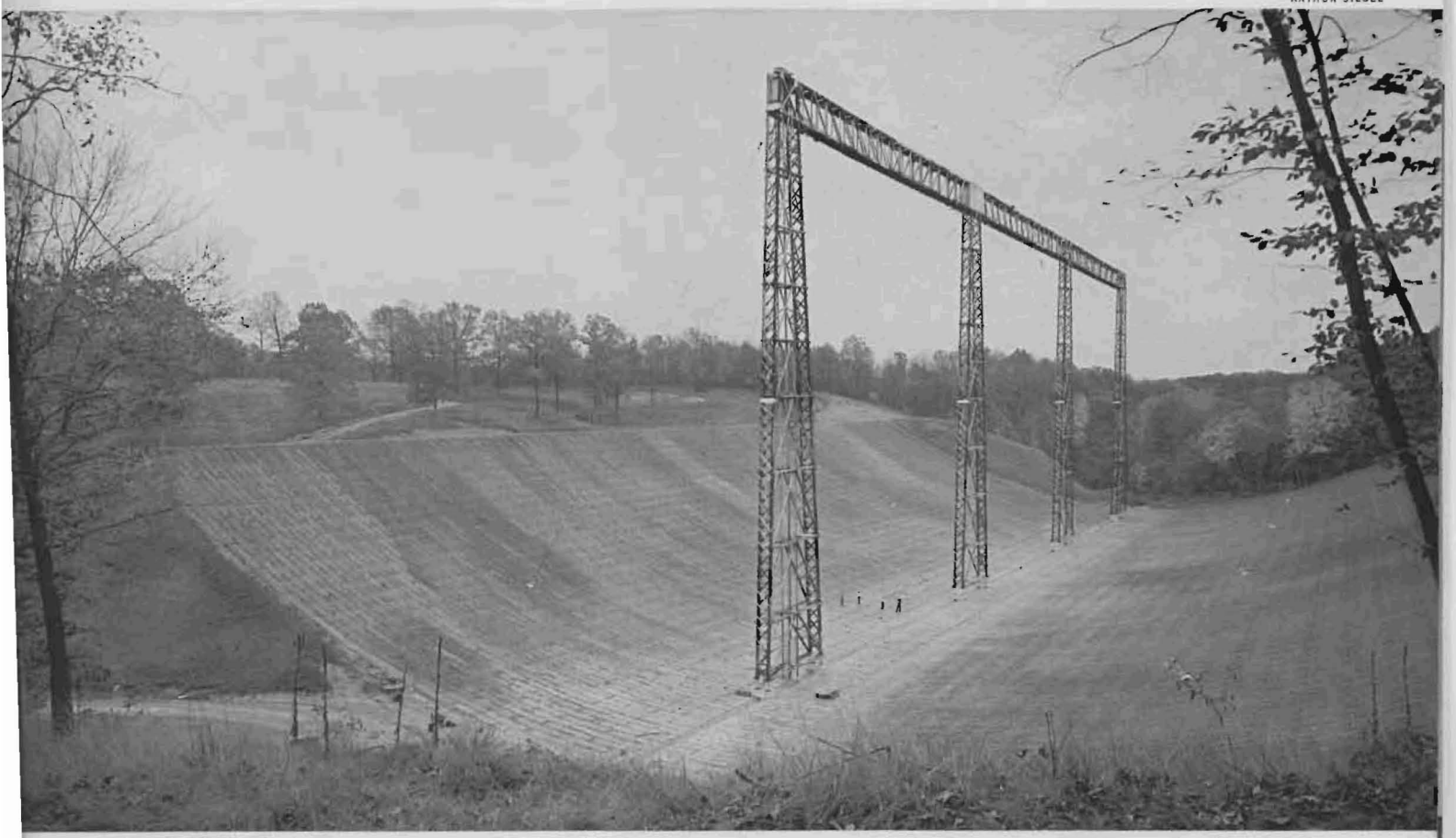
FIRST RADIO TELESCOPE
By an amateur in a backyard.



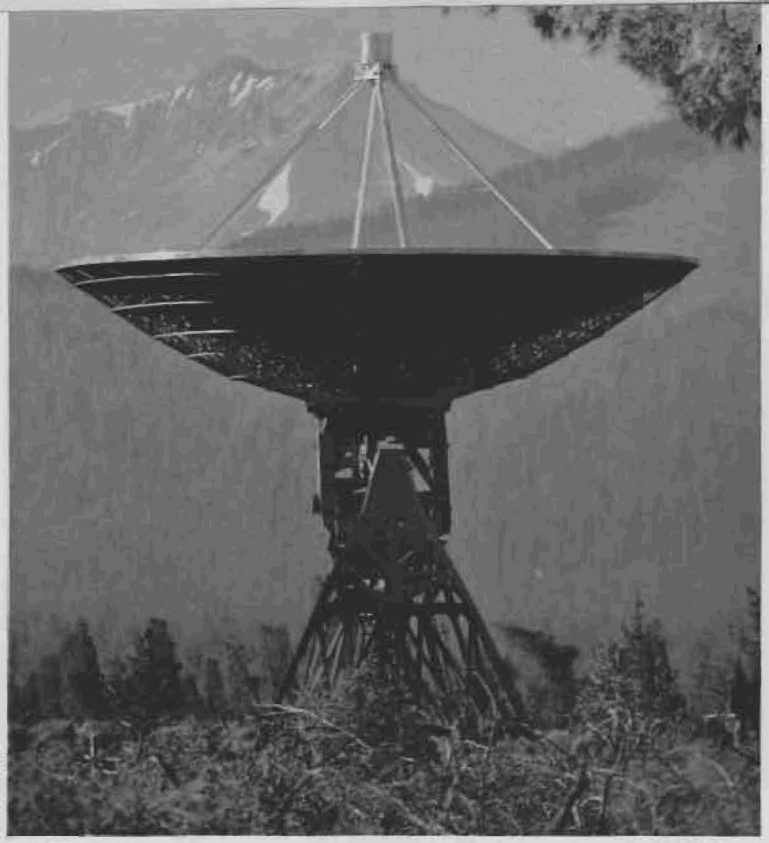
WALTER BENNETT

WORLD'S LARGEST movable telescope, standing 23 stories high, began to scan skies at National Radio Astronomy Observatory, Green Bank, W. Va., this fall. First task for $850,000 telescope will be to decipher radio waves from Van Allen-like belt that surrounds Jupiter. Later, scientists will focus it on the radiation belts that surround planets Uranus and Neptune.

ARTHUR SIEGEL



NEWEST SKY SCANNER, size of five football fields, is University of Illinois' giant, 600-ft. trough, which can detect unusually weak signals from vast distances. Scientists will use it first to study Cygnus X, a complex region near Milky Way; then they will embark on a project that should take decades to complete: a mapping of radio emissions in the universe.

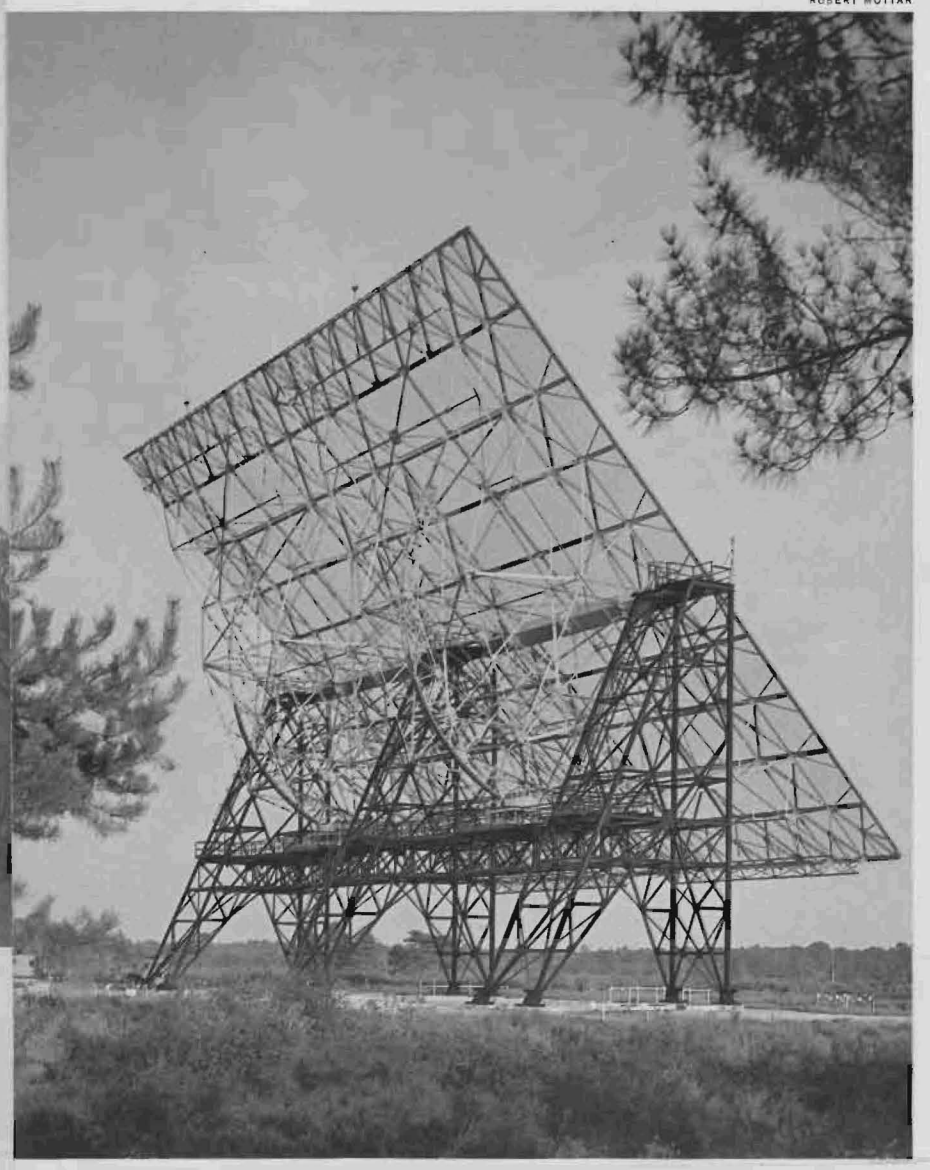


JON BRENNEIS

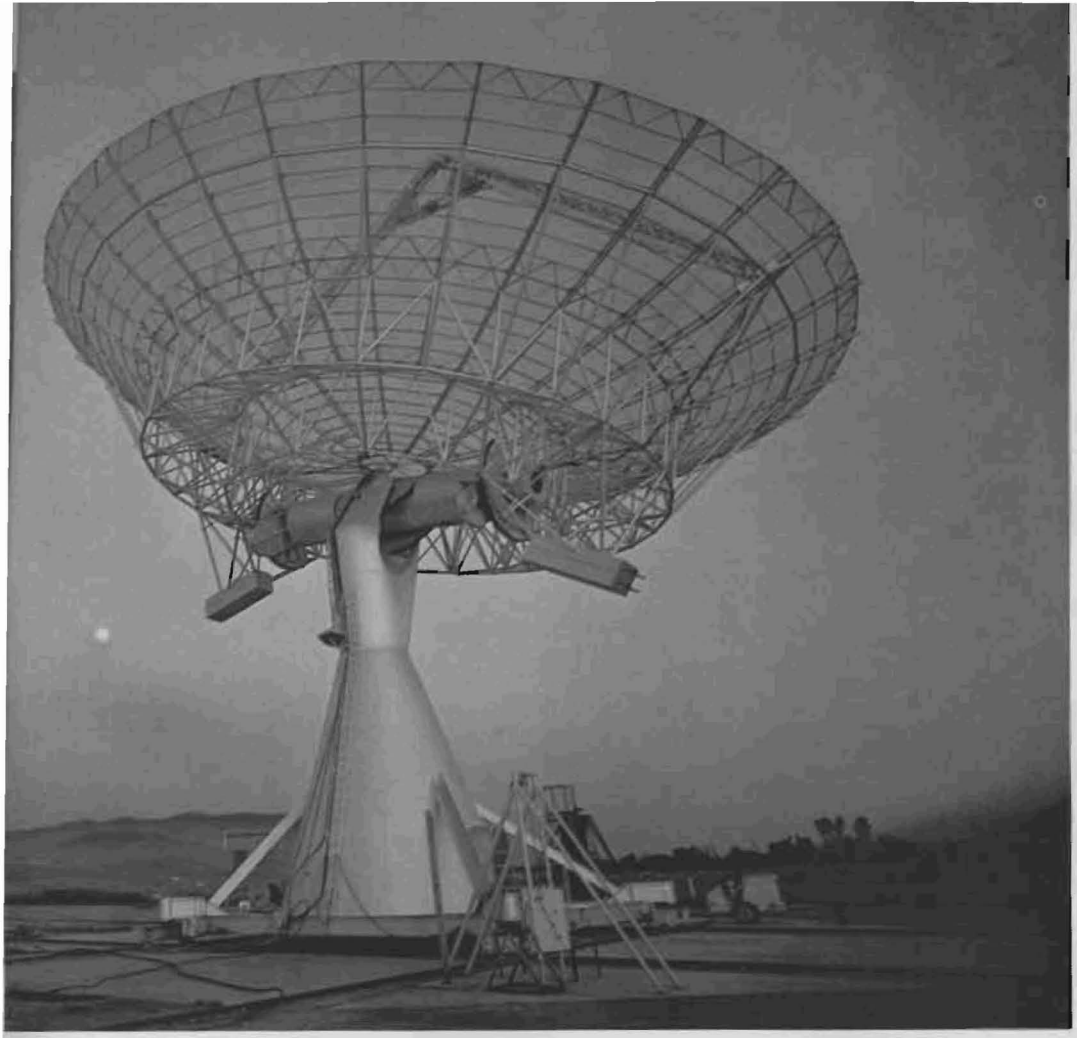
FULLY STEERABLE 85-ft. dish at Hat Creek, Calif., is shielded from extraneous noise by high mountains and a volcano. Put in operation earlier this year, it is being used to study hydrogen in the Milky Way.

J. R. EYERMAN

ROBERT MOTTAR



MATTRESS-SHAPED antenna is being built at Nançay, France. By end of 1964 it will be four times as large, have range of 10 billion light-years.

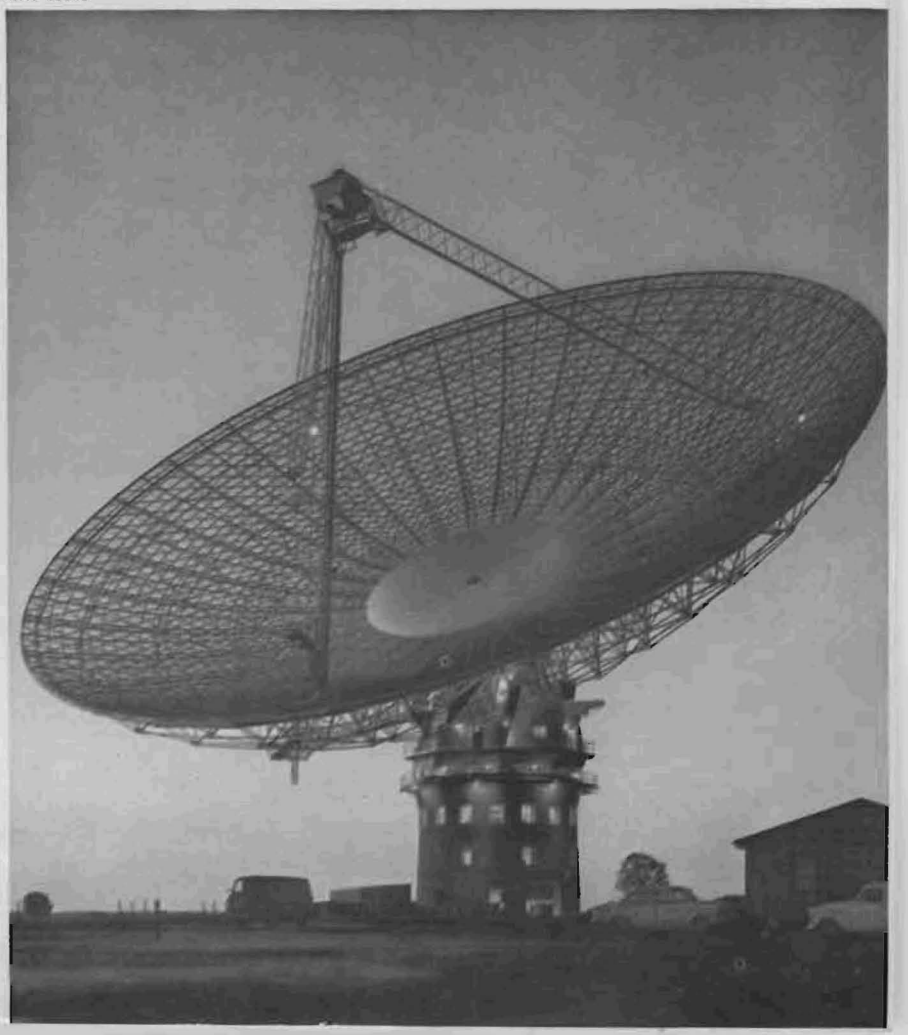


RIGGED IN TANDEM, dishes at Caltech's Owens Valley Station can seek out source of incoming radio waves so that scientists are able to get more precise fix on far-off stars.

JOE MUNROE

TREE FARM of 40-ft. booms at Stanford receives radar impulses bounced off moon by transmitter. The dish (*right*) is for higher frequencies.

DAVID MOORE



LARGEST SCANNER in Southern Hemisphere is 210-ft. dish at Parkes, New South Wales. Australians are using it to map Earth's own galaxy.

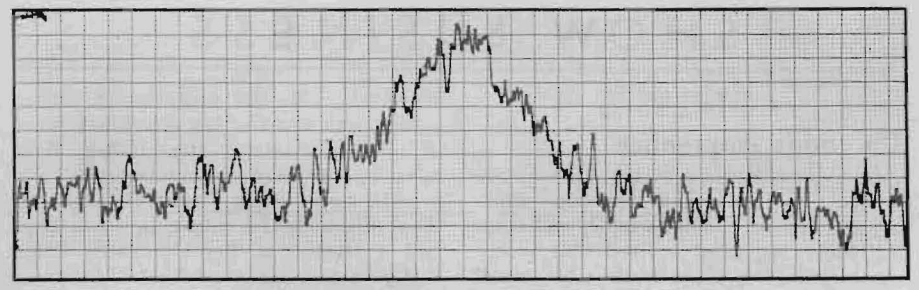
around the planet, is apparently generated by a powerful radiation belt similar to the Van Allen radiation belt that surrounds the earth. Other Jovian radio waves seem to be generated by gigantic thunderstorms.

But the planets are not the main concern of radio astronomers, who tend to think of them merely as distant parade grounds for space cadets. Even the sun, which sends out rich chords of radio waves, is not a chief attraction. The astronomers' keenest interest is focused on much more distant space, from which the waves bring news of strange occurrences. The third strongest single source in the sky is a famous astronomical object, the Crab Nebula, the turbulent, gaseous wreck of a star that turned into a supernova and blew itself to shreds on July 11, 1054 A.D.—an event that was duly recorded by Chinese astronomers. After 908 years, the Crab's gases are still churning violently, and as the electrons that they contain move through magnetic fields, they still send out a vast amount of radio energy.

Radio Galaxy. The strongest "radio star" in the sky had the astronomers baffled for many years. Its powerful waves came from a patch of sky in the constellation Cygnus, and optical astronomers could find nothing there. At last the Palomar telescope, guided by a new and extremely accurate radio fix, photographed an extraordinary scene that looked like a collision of two enormous galaxies 500 million light-years away. Galaxy collisions are possible, though unlikely, and they might emit radio waves because of churning gases between their hundreds of billions of stars.

But most radio astronomers no longer think that such a collision can properly explain the stupendous radio energy that streams out of Cygnus A. For one thing, the energy does not come from the central part that is optically visible. Strangely, it comes from two spots on opposite sides of the center. The sky is full of these double radio sources. One theory holds that they are galaxies that have exploded. Electrons released in the explosions may have been steered by magnetism and finally gathered at spots far away from the central wreckage. A vast catastrophe of this sort might well be a normal stage in the long life of a galaxy. Perhaps man's own Milky Way galaxy will end in this manner, its stars popping like firecrackers and its death cry sounding in radio waves across the universe.

Radio astronomers are willing to advance such gaudy theories, but only as conjecture. They cannot be sure about anything; the sky is too full of mysteries that they cannot begin to explain. A strong radio source that has been labeled M87, now proves to be a galaxy that can be photographed in visible light. It has a strange jet of glowing material that extends from one side and reaches many thousand light-years beyond its normal circumference. Does this jet have something to do with the galaxy's radio waves? It probably does, say the radio astronomers, but they do not know why.

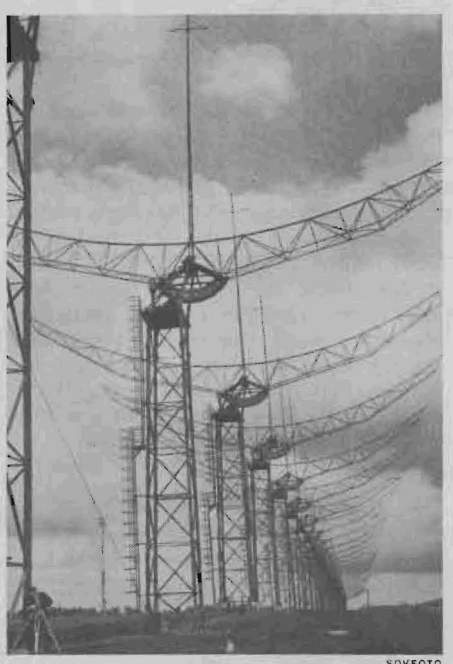


VENUS PASSING THROUGH BEAM OF EWEN KNIGHT RADIO TELESCOPE
Bulges mean more than wiggles.

Another exciting mystery results from the recent discovery that magnetic fields are common in space, perhaps even in the empty reaches between the galaxies. Radio waves reveal the fields and measure their strength, but no one knows the origin of this mysterious force. Apparently it is an important feature of the universe, and may affect its behavior in many different ways.

Loud Stars. Most true stars in the Milky Way galaxy maintain fair radio silence, but a few of them transmit powerful radio waves that have the astronomers baffled. About half a dozen radio stars have been identified optically, and they prove to emit peculiar assortments of visible light. Astrophysicists are busily studying these spectra, hoping to find some connection between them and the stars' radio loudness.

Radio astronomers are particularly intrigued by the special waves given off by cold hydrogen floating between the stars. These waves are a little longer than 21 cm. long when they leave the hydrogen cloud where they are generated. If they are slightly shorter than that when they are measured by an earthly radio telescope, this means that the hydrogen cloud must be moving rapidly toward the earth. If the waves are longer, the cloud is moving away. So the 21-cm. waves provide a handy tool for measuring the speed of the hydrogen clouds that form an important part of the Milky Way galaxy. Some of the clouds are moving close to the galactic nucleus, which looks in optical telescopes like a close-packed, featureless mass of glowing stars. But the 21-cm. waves reach deep into this stellar fog. They report that vast streams of hydrogen are flowing out of the nucleus, and none are streaming back. Where does the hydrogen come from? One theory holds that it collects from the thin halo that surrounds the galaxy. Another suggests that it is transformed out of some unobserved and heretofore unimagined state of matter.



SOVFOTO

SOVIET RADIO TELESCOPE
The past is as mysterious as the future.

Life in the Universe. The bold radio astronomers are ready to tackle anything, even the ancient problem of alien life in the universe. Most astronomers agree that the Milky Way galaxy has millions of stars with planets capable of supporting earth-style life. Few if any of them believe that human space voyagers can ever cover the enormous distances that separate the stars. But radio waves cover that range already, and perhaps some not-too-distant stellar system, which includes a planet that has developed a high civilization, is even now sending radio messages in the hope that someone will hear them. Radio astronomers at Green Bank have done a little listening for such messages. They have heard nothing meaningful, but they hope to try again.

Few mysteries seem beyond the soaring ambition of radio astronomers. In the past, most cosmographical theories were concocted by mathematicians sitting in quiet rooms and struggling with streams of abstractions. They were safe from experimental check because optical telescopes could not see far enough into the depths of the universe. But radio telescopes are keener-sighted. They have located radio-galaxies that seem to be 7 billion light-years away. And their eyesight is bound to improve.

Since radio waves travel at the same speed as light, when radio telescopes peer deep into space, they also look into the far-distant past. Galaxies 7 billion light-years away are studied on earth just as they were 7 billion years ago, before the earth was born. Little is known thus far about these ancient galaxies that have been fossilized by time and distance. Perhaps when more is known, man will get some idea of what the young universe was like and when it was born. Or, perhaps, when the radio astronomers have improved their skill, they will prove that the universe is eternal—that it was never young, and will never grow old.