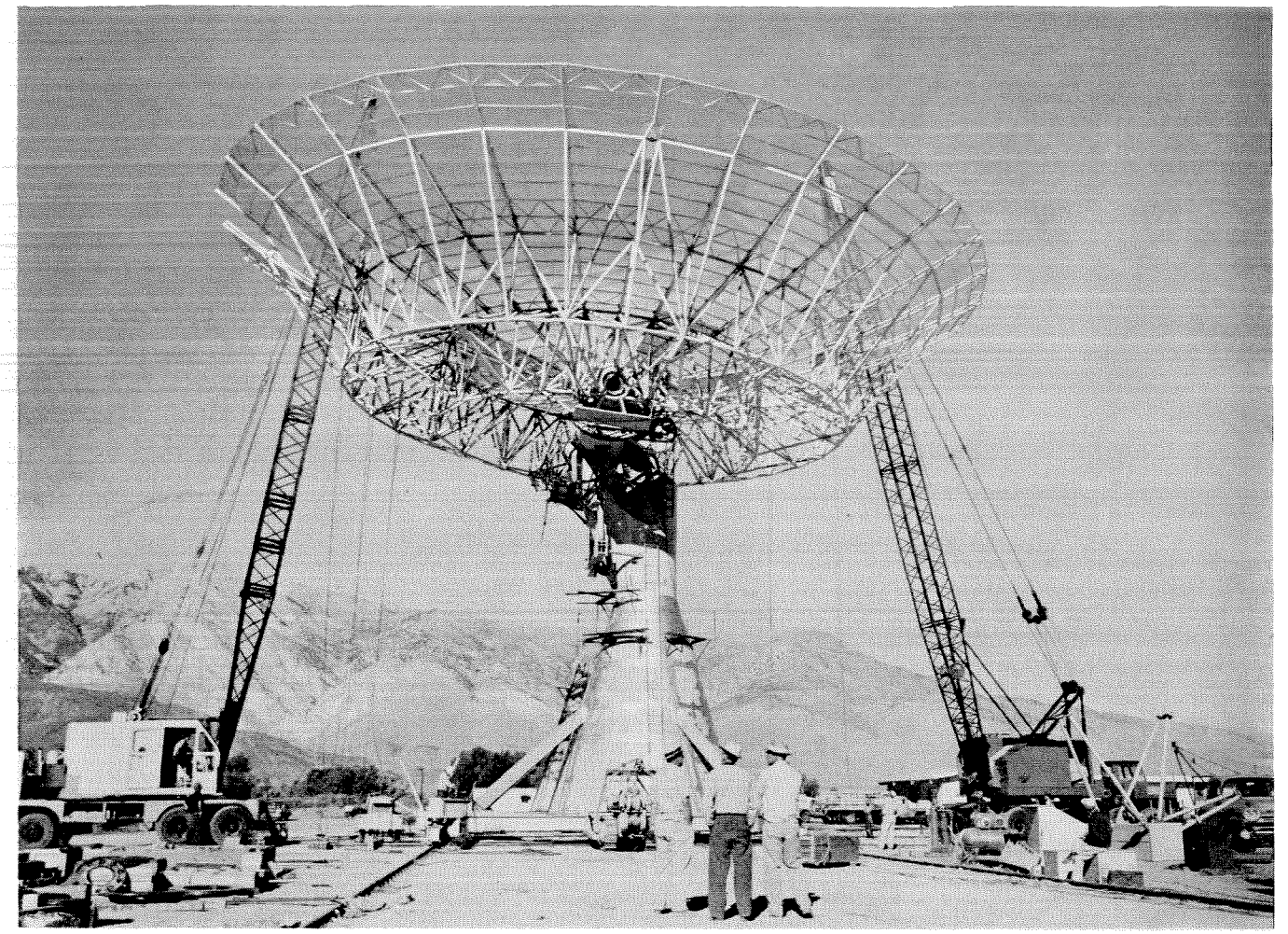


The first of two 90-foot reflector antennas is lifted into place at Caltech's new radio observatory.

Listening to the Stars

A progress report on Caltech's radio astronomy research project

The world's most versatile radio telescope starts operation this month at Caltech's new $1,500,000 radio observatory near Big Pine, California.

The first of two 90-foot reflectors has been hoisted onto its 45-foot pedestal at the observatory and is now ready to start receiving radio signals from space. A twin of this big 150-ton metal dish will be ready for listening in December, and by next spring the two reflectors will be hooked up for use together and the radio observatory will be in full operation.

Operated by Caltech and financed by the Office of Naval Research, the observatory is 250 miles north of the campus, in the Owens Valley desert, shielded from man-made radio and television interference by the high Sierra Nevada and the White Mountain ranges.

The science of radio astronomy is only about 10 years old. Actually, it represents an extension of optical astronomy to a range of wavelengths longer than the eye can see. Optical telescopes are sensitive to radiations from stars and other objects which are in the visible or near-visible range—that is, to light whose wavelength is anywhere from about one to- four-100 thousandths of an inch.

With the advent of radar during the second world war, new short-wave radio receivers were developed, which are sensitive to electromagnetic radiations in

the microwave or very high frequency ranges—from a few twenty-fifths of an inch to a few yards in wavelength.

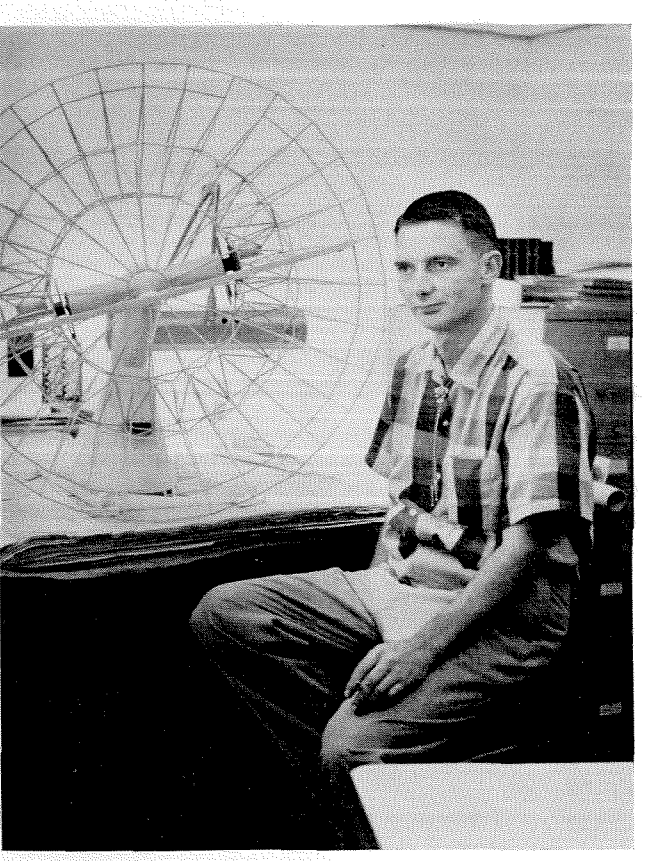
When the new ultrasensitive short-wave receivers were directed to the sky it was found that radio waves were reaching the earth from the sun and from out in space in all directions. This opened a whole new field of astronomy—the systematic investigation of radiations in the radio range coming from a large number of relatively small sources in the heavens. These sources were called "radio stars" for want of a better name.

Caltech's research program in radio astronomy will include attempts to identify several hundred radio stars with visible objects and to study the mechanism responsible for generating the signals. So far, only about 50 of some 2,000 known radio stars have been identified.

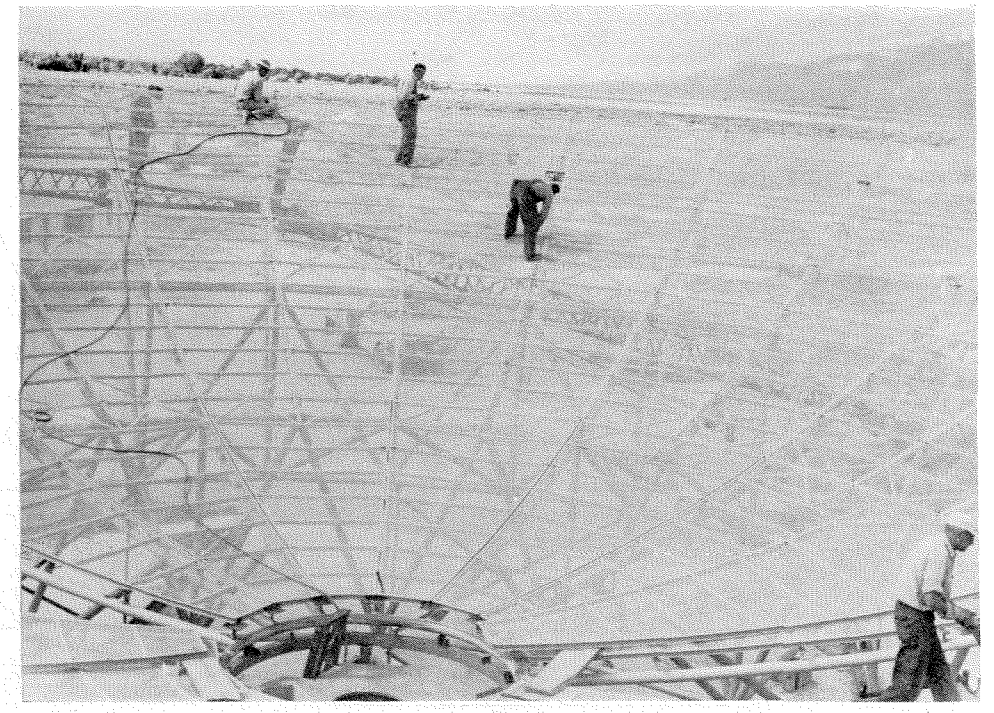
Some of the radio stars are associated with grand catastrophes in nature—such as the remnants of an exploded star, or the collision of two galaxies near the limit of the visible universe. In fact, some of the objects detected by the Owens Valley telescopes may be beyond the range of the largest optical instruments.

The research program will also include studying solar outbursts which are believed to be due to streams of ionized matter, or pieces of atoms, blasted into space from the sun, and responsible for the aurora borealis.

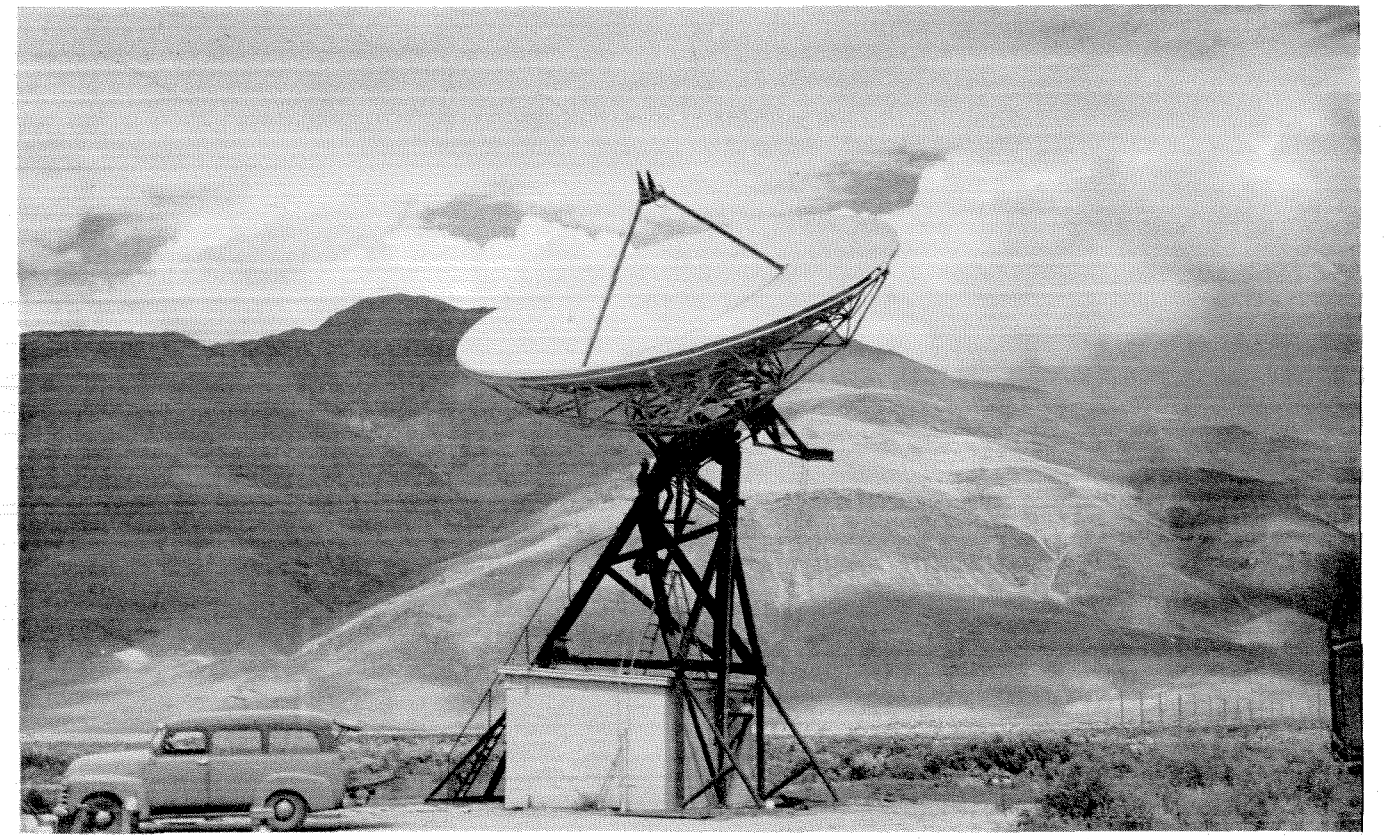
Though there are a number of other large radio telescopes in use throughout the world (including England's 250-foot dish—the largest of all), the Caltech instrument will be the most versatile because of its twin antennas. Stellar signal sources can be more accurately pinpointed by a team of two dishes operating as an interferometer. In order to detect very weak signals, the two antennas can be steered to follow a star. To measure the angular diameter of the faintest objects, each antenna is set on a wheeled mounting, riding on railroad tracks 1,600 feet long. The telescopes (each dish carries more than 6,000 square feet of steel as its reflector) are built to take winds of 80



John Bolton, professor of radio astronomy, is scientific director of the new Caltech radio observatory.



Workers adjust the expanded aluminum mesh which covers the 90-foot telescope. When accurately adjusted (at 324 different points) the mesh forms a reflecting surface that accurately focuses all rays coming in from space.



Auxiliary 32-foot telescope, with its highly accurate solid surface, is used mainly for experimental purposes.

mph, and Bruce Rule, Caltech's chief engineer, who designed them, admits that the structural problems were more severe than for Caltech's 200-inch optical telescope at Palomar.

In Caltech's twin telescope, radio signals are caught in the dish-shaped reflector antennas, which focus the radio waves to a point, just as telescope mirrors focus light. The incoming signals are funneled into a radio receiver that amplifies them. Then the signals are presented on pen recorders, oscilloscopes or magnetic tapes.

The 90-foot antennas will be used to study signal wavelengths ranging from about two inches to nearly forty inches long. A 32-foot dish for picking up short radio waves is already in operation at the observatory, as are two networks of wire antennas (called "arrays") for collecting the long ones. The 32-foot reflector, which used to operate at the Palomar Observatory, is used for waves two-fifths of an inch to two inches long. It will also be used to develop and test instruments. The arrays (one of which covers 2 acres, the other, 10) are used to investigate the earth's upper atmosphere. They have been studying broadcasts on wavelengths ranging up to 40 feet for about a year.

John G. Bolton, professor of radio astronomy, is scientific director of Caltech's radio observatory. Though he is only 36, Bolton was one of the pioneers in the field of radio astronomy. With Gordon J. Stanley, who is now also at Caltech, he discovered the first radio stars in 1947. Formerly principal research officer of Australia's Commonwealth Scientific and Industrial Organization, he came to Caltech in 1955 to help design the radio observatory and supervise its construction.

Gordon Stanley, senior research fellow, has been responsible for the design and construction of the sensitive receiving equipment to go with the big dishes at the observatory.

The research staff also includes Dr. J. A. Roberts, senior research fellow; Dr. T. A. Matthews, research fellow; and Dr. K. C. Westfold, visiting associate professor of astronomy.

The observatory includes a one-story concrete block building containing electronic receiving equipment, living quarters for four people, two offices and a workshop.

The Caltech observatory is one of several radio astronomy research projects being supported by the Navy. Aside from basic research, the Navy can expect some very practical applications to result from these studies. Research in this field will require advances in electronic techniques such as low-noise receivers and antennas, which may find future application in military equipment. The research will contribute to our knowledge of the propagation of radio waves through the ionosphere and the troposphere and so may be of value in achieving improved radio communication. And, in time, radio stars may be used for navigation of aircraft and ships, and for the tracking and guidance of missiles and space vehicles.