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Culgoora, Australia, radioheliograph. The circle's 96 interconnected dishes observe the sun simultaneously.

A stride in solar astronomy

New radioheliograph studies the sun; Parkes plans survey of southern quasars

The earth's first astronomers began the discipline by studying the sun. Their descendants ever since have peered and puzzled and trained their instruments on the star that, by its weight, holds the solar system together and, by its nuclear burning, fuels all life on earth.

For all the centuries of study, the sun holds mysteries still, and elaborate devices to study it proliferate. One new machine for learning about its workings covers 3,000 acres of barren Australian ground, housing 96 aerials, each 45 feet in diameter. It is the latest effort of Australia's pioneering radio astronomers.

The radioheliograph at Culgoora in rural far northwest of New South Wales is a unique scientific instrument designed to play a specific part in fundamental research.

Conceived and designed by Dr. J. P. Wild and his colleagues at the Commonwealth Scientific and Industrial Research Organization, the installation fulfills the need for practically instantaneous and continuous pictures of the radio sun.

The Culgoora heliograph can take 16,000 radio pictures of parts of the sun each day.

Construction of the heliograph began in 1962, with a grant of $555,000 from the Ford Foundation. This donation, supplemented in 1966 by $80,000, provided the major part of the capital cost of the instrument.

Australian radio astronomers have led the world in this science since the first radio spectrograph was erected near Penrith, N.S.W., in 1949. It used a broad-band rhombic aerial and a simple receiver, which could be mechanically tuned over the range from 70 to 130 megacycles in a fraction of a second.

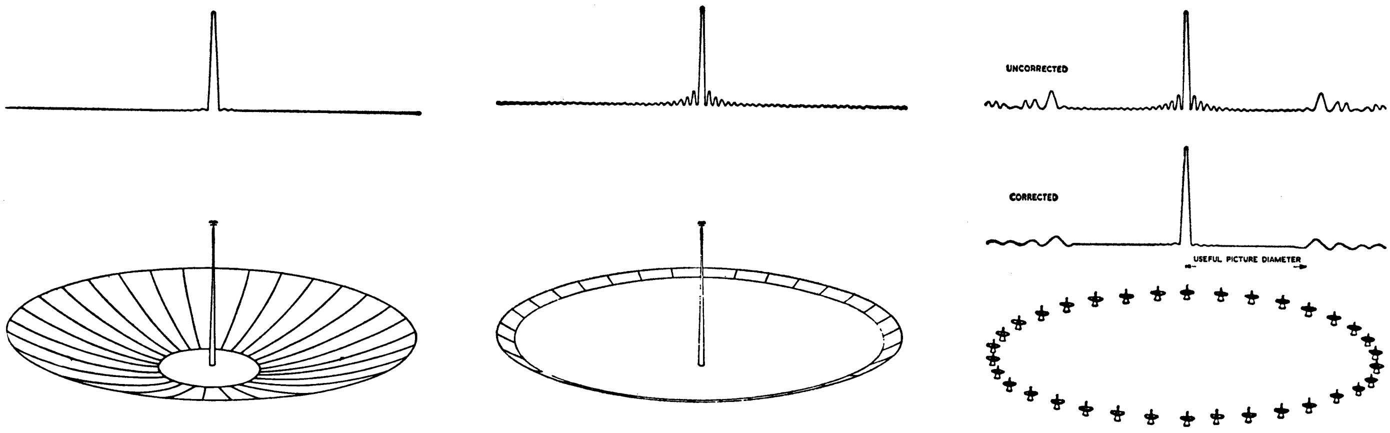
The world's first equipment for checking possible effects of sunspots was set up at a former radar station on the cliffs near the entrance to Sydney Harbor in February 1946. It scored an immediate success.

Exceptionally powerful signals were recorded, and these were located as coming from a limited area on the sun which included a large group of sunspots.

The signals were followed for several days. Their location on the sun changed progressively from day to day, but always included the sunspot group. The discovery that powerful radio waves can originate in the vicinity of the sunspots, was one of the early milestones in radio astronomy.

Regular measurements of the solar radio emission over a period of years show that the general level of radio emission correlates closely with solar activity, as indicated by sunspots and associated phenomena.

The new radioheliograph was designed as a tool for fundamental studies of the solar atmosphere in general, and



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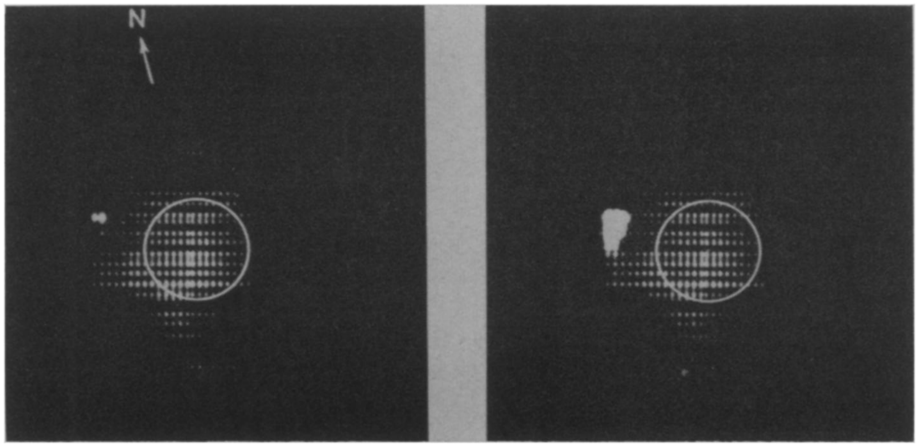
The circular array (right) simulates the beam pattern of an impractical single mirror 3-km across (left).



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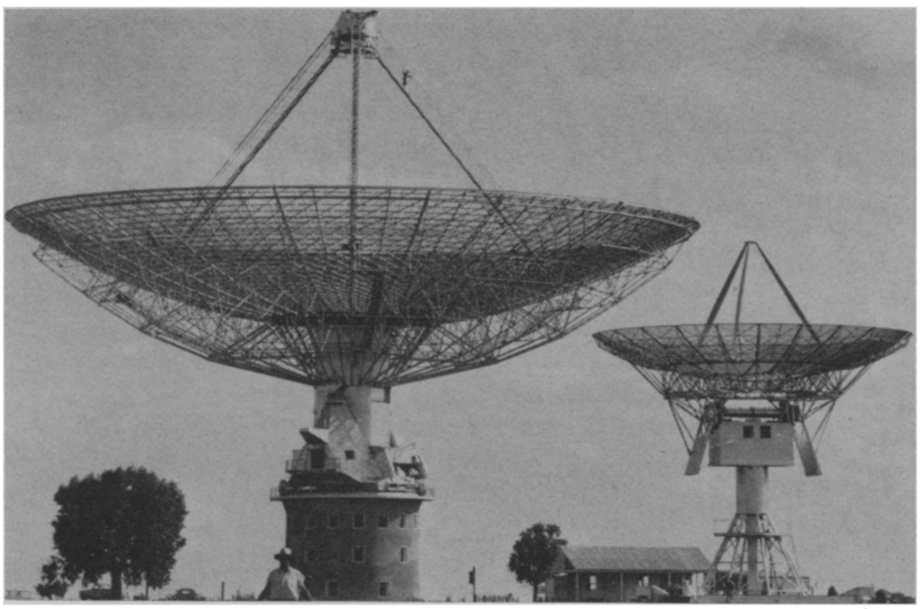
First solar activity recorded at Culgoora, compared to visible solar disk.



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The 210-ft. Parkes radiotelescope and smaller interferometric companion.

of the great explosions of the sun, or solar flares, in particular. The biggest of these emit proton streams which could constitute a hazard for space travelers (SN: 3/9 p. 232). Observations with the heliograph have already produced the world's first pictures of radio flares in the sun's atmosphere.

In Culgoora the 96 dish telescopes are equally spaced around a circle two miles in diameter, and are automatically driven to follow the sun. Radio waves from the sun are first amplified at each dish and are then carried along overhead transmission lines that converge on the control observatory.

The signals are fed into computers and are finally shown on a television tube and recorded on magnetic tape. Because the radiation wavelength is 3.75 meters—several million times that of visible light—even the two-mile-wide aperture of the radioheliograph resolves no more detail than a pinhole camera with an aperture two-hundredths of an inch. The instrument sees only about one percent of the sun's visible disk at one time.

The sun is not the only focus of Australian radio astronomers' curiosity. Precise determinations made with the radio telescope at Parkes, N.S.W., during the past few years have made possible the tentative identification of about 150 quasars. Identification has been based on examination of photographic plates taken at the Lick and Mt. Wilson and Palomar Observatories in California. An object with a pronounced excess of blue or ultraviolet light seen in a position pinpointed at Parkes is likely to be a quasar. These mysterious objects can also be recognized by their radio spectral characteristics. The three objects currently believed most distant from earth are Parkes-discovered quasars.

The Parkes telescope will be used shortly in a scheme to measure quasars from the Southern Hemisphere.

If the quasars are more than 1,000 million light years away, as present evidence indicates, they would be good supporting evidence for the "big bang" theory.

Many new radio stars have been discovered and tests on sample parts of the sky suggest that some 20,000 should be visible from Parkes. The problem of deciding whether or not these radio stars can be identified with objects on long-exposure photographs taken with optical telescopes is a difficult one. The accurate position fixing now available is helping and already several score new identifications, mostly with very faint and distant galaxies, have been made. *William A. Scholes*