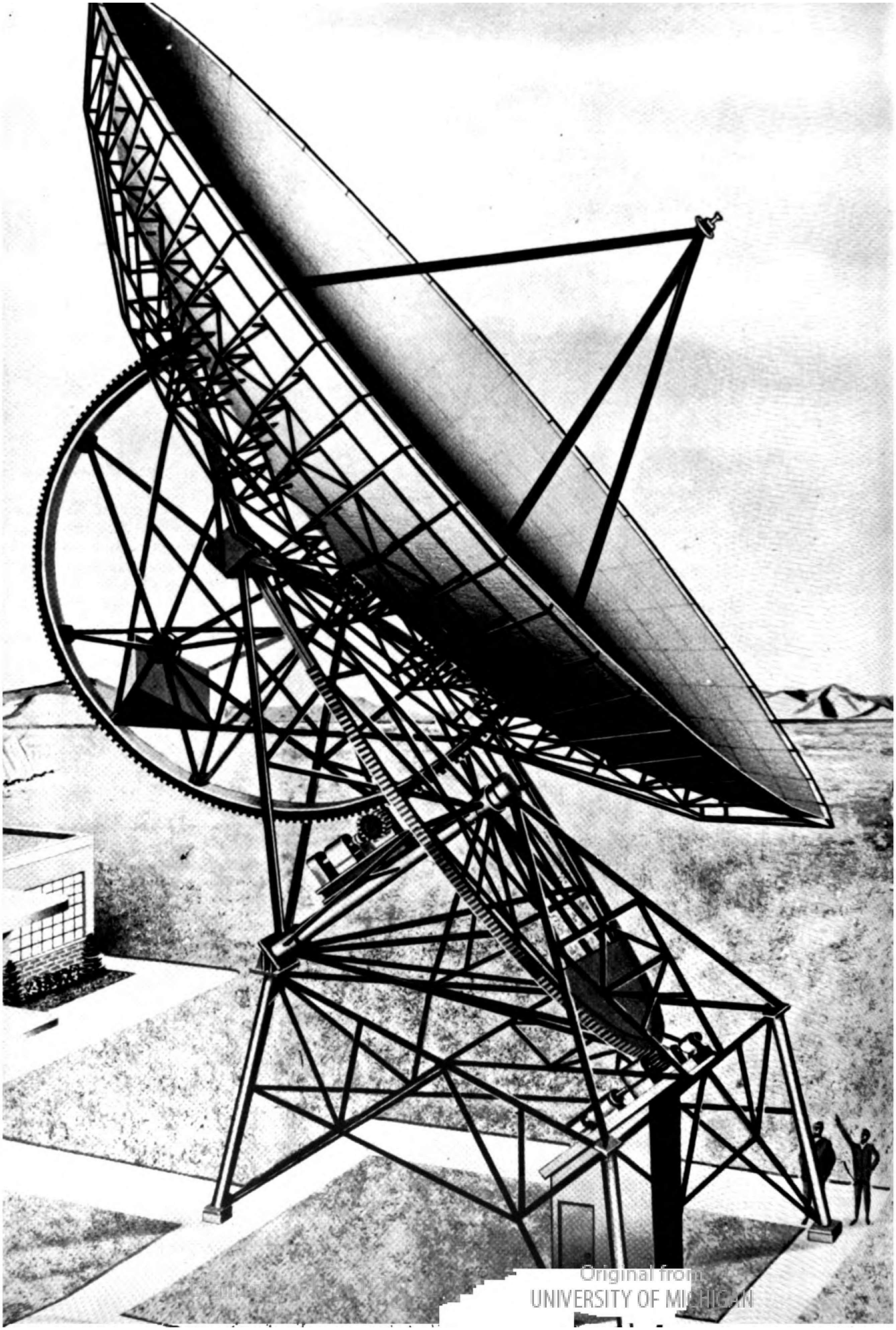

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New Radio Telescope

Michigan's new telescope, en completed this summer, l be the second largest in the rld.

by ROGER BARNES, '60E

85-foot-wide ear for listen- to radio signals from our uni- e and remote heavenly sources be built this spring at the ersity of Michigan with funds ided by the Office of Naval earch. Second largest steerable o telescope in the world, the ision instrument will follow the by day and tune in on the erse by night.

Peach Mountain, sixteen miles from Ann Arbor, will be the scene of increased activity come next June, for that is the date set for the construction of the University of Michigan's giant radio telescope that will serve to increase man's knowledge of the universe. An 85 foot solid aluminum reflector will be part of the second largest steerable telescope in the world as well as one of the most precisely made. Upon its completion, the telescope can automatically follow the sun across the sky by day and penetrate the far reaches of interstellar space by night, continually recording radio waves that radiate from these sources.

Specifications for the highly sensitive instrument were drawn up by Fred T. Haddock, associate professor of astronomy, and electrical engineering. Standing over 100 feet high, the telescope will require 160 tons of steel and aluminum and 50 tons of lead counterweight. Two hundred fifty cubic yards of concrete foundation will enable the telescope to be operated in winds up to 45 miles per hour and withstand windstorms of 120 miles per hour. A declination gear and an hour angle gear together will be capable of being controlled automatically so that the telescope can focus on its target for long periods of time without straying due to the earth's rotation. In all, the facility will cost about $300,000, with the greater part to be financed by the Office of Naval Research.

A radio telescope such as the proposed University one is the optical telescope's counterpart, but detects electromagnetic radiation rather than visible light wavelengths. Its sensitivity depends largely upon the type and shape of the antenna. A dish-shaped, parabolic reflector, made either of a solid such as aluminum or wine screen, is the most widely used type. So perfect will be the antenna of the new University telescope that its solid aluminum surface will not vary more than a quarter of an inch from a true parabolo and will prevent the leakage of signals at all wavelengths. Located at the focal point of the parabolic reflector is a small dipole to which the signals are directed. From there the signals are converted into varying electrical energy which, in turn, will be graphed.

Radiation from Interstellar Space

Radio astronomy had its beginning in the United States when Karl G. Jansky, a Bell Telephone Company engineer, first detected radio waves of extraterrestrial origin in 1932. These signals were found to be produced by the interaction of electrons with atomic particles or with magnetic fields, and to yield information about the regions in which they originate. Unlike light, radio waves can penetrate the clouds, haze of the earth's atmosphere and the vast dust clouds of interstellar space, and be detected by a radio telescope without absorbtion. The new discovery of these radio waves was indeed

A spiral galaxy in the Big Di which astronomers believe to look much like the one in which our system is located.

significant, and within a short time, astronomers had before them a completely new picture of our galaxy, thoroughly mapped, and yielding far greater knowledge than visual telescopes could produce.

With the development of larger and more precise radio telescopes, astronomers soon became aware of two varieties of sources in interstellar space that "broadcast" radio waves. The first was associated with relatively motionless hydrogen gas which composed the major part of matter in space and 10% of the Milky Way. It is easily detected as a steady humming note at a frequency of 1420 megacycles. So concentrated is this neutral hydrogen in our galaxy that the shape and extent of its spiral arms have been traced out in detail from the graphs of the radio signals. In a like manner, the graphs also revealed the amount of the gas along a particular line-of-sight. Although this first variety of interstellar radio sources is invaluable in the mapping of the galaxy, it is the second source variety that is more remarkable. This second radio source, which is very distinct, appears to be associated with highly turbulent gas masses. Although they seldom correspond with optically known objects in the sky, several outstanding ones have been definitely linked with *two types* of interstellar occurrences.

Supernovae Linked with Radio Sources

The first type of occurrence from which intense radiation has been detected is the three known supernovae, or stellar explosions. For example, the third most intense radio source in the sky coincides in position and size to a supernova that occurred in 1054. Likewise, the position of the 1572 supernova is now occupied by a radio source. Radiation has also been detected from the remains of the third great stellar explosion, thougl yet, no radio telescope of any size been able to study it.

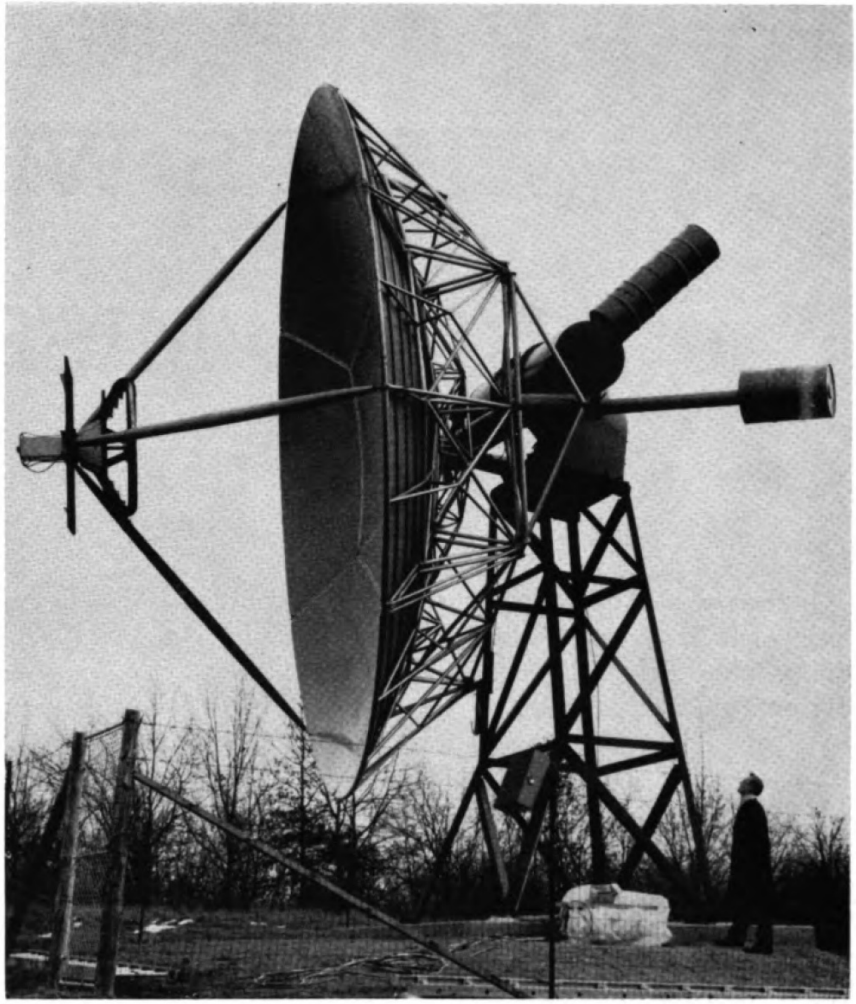
More remarkable than the supen association was the discovery made a Palomar with a 200 inch optical scope. In a very intense study of of the sky where radiation had reported, a region of diffuse ga nebulosity having very unusual prop was discovered. A clue to its identit possibly other radio sources was in 1955 when the Mt. Palomar tele observed that the other bright source, Cygnus A, shows a pair of ies in collision, 300 million light away! The radio energy given off single second by this source wa termined to be enough to supply the heat and power requirements on for the next trillion years!

Our Solar System Is Also a "So

The new University telescope wil be capable of observing six known

Roger Barnes, an active member of the *Technic* staff and author of this special report on the new radio telescope is also President of the Executive Board of the Class of '61E.

In high school at Broad Ripple High in Indianapolis, Roger was active in Key Club, National Honor Society, Junior Historical Society, and high school newspaper as well as being a sports correspondent for the *Indianapolis News.* At the University Rog is working toward a B.S. degree in Engineering Science.



This 28 foot radio telescope, already in daily operation by the University on Peach Mountain, has detected some new and unusual signals from the sun.

sources in our own solar system. The first is the sun from which astronomers have detected a constant signal when it is in a "quiet" state and a variable note when disturbances on the sun are evident by radio fadeouts and magnetic storms on the earth. A smaller 28 foot radio telescope in operation daily on Peach Mountain has already recorded some new and unusual signals from the sun. With the new instrument, it will be possible to focus on only three per cent of the sun's surface at a time, enabling a concentrated study of the sun to be conducted. Secondly, our moon also radiates radio waves which recently were used by the Naval Research Laboratory to plot the temperature across its surface with their 50 foot unit. In addition to the sun and the moon, the radiation from four of the planets, Jupiter, Mars, Saturn, and Venus, will also be studied.

It has also been proposed that radio telescopes could be used to bounce waves off nearby planets, our sun, and the earth's satellites. The Jodrell Bank 250 foot radio telescope in England is so sensitive that it can detect radio waves that man bounced off the moon. Changes in the reflected waves reveal how many electrons exist in space between the earth and the moon. In like manner, waves could be bounced off the planet Venus and be detected by a telescope, even though it would be nearly 10 million times harder. In the few months that it has been in operation, the Jodrell Bank telescope has already done a great deal of the tracking of the earth's artificial satellites by bouncing radio waves off them.

Michigan Telescope To Be Second Largest

Compared with the English telescope, the proposed University of Michigan instrument will be the second largest steerable telescope in the world, but will be capable of operating at wavelengths 5 to 10 times shorter than the English unit. At the present time, however, the largest unit in operation in the United States is an 84 foot telescope at the Naval Research Laboratory. This Laboratory, using both the 84 foot and an older 50 foot paraboloid, has done extensive research to confirm the high velocities of radio sources relative to the earth. Harvard University has also contributed to radio astronomy by substantiating the theory of star formation. At the same time that the University of Michigan will be building its 85 foot radio telescope, the National Science Foundation will be completing an exact counterpart of it on a 2,000 acre grant of land in the hills of West Virginia. The Foundation also plans to build a 140 foot paraboloid steerable telescope at this same site by 1960. Perhaps the most interesting antenae that have been used in telescopes are the salvaged "giant Wurzburgs", 25 foot dishes built by the Germans in World War II for radar systems. Over a dozen nations in Europe, and Asia and the United States are known to be using these dishes!

Though radio astronomy is in the same stage of infancy as was visual astronomy in Galileo's time, great forward strides have been made since 1932. Not only have countries all over the world striven to build as large and nearly-perfect a radio telescope as posible, but they have also mapped an entire new picture of our universe. Yet, even as the University of Michigan is completing plans for the second largest steerable telescope in the world, Dr. Chihiro Kikuchi of the University is working on a new, low-temperature device, known as the solid-state maser, which would amplify the very faint signals and increase manyfold the range of our present day scopes. Thus, radio astronomy finds a rebirth and can expect an active future in the United States, the country in which it had its beginning.