RESEARCH FACILITIES AND PROGRAMS

The McMath Solar Telescope

The world's largest solar telescope, located at the Kitt Peak National Observatory in Arizona, has been named in memory of the late Robert R. McMath, in recognition of his many years of devoted service to solar astronomy. Dr. McMath, who died in January of this year, served as director of the McMath-Hulbert Observatory, as professor of astronomy at the University of Michigan, and as board chairman of the Association of Universities for Research in Astronomy, Inc., which operates the new national observatory for the National Science Foundation. He was a leading advocate of the belief that the research needs of the United States demanded the construction of a large solar telescope, and he and Ira S. Bowen, director of the Mt. Wilson and Palomar Observatories, are credited with having been instrumental in bringing those needs to the attention of the National Science Foundation.

The McMath solar telescope has a focal length of 300 feet and will produce an image of the sun as large as 34 inches in diameter. It will be employed primarily in detailed studies of solar spectra and of sunspot and solar-flare phenomena. Sunlight is gathered by an 80-inch heliostat which is mounted at the top of the telescope, 110 feet above ground level, and the light is first reflected to a 60-inch parabolic mirror 480 feet away at the bottom of a shaft bored into the mountain, and from that point is reflected an additional 280 feet to a 48-inch mirror which directs it into an underground observing room. There the sun's image may be photographed or the light may be subjected to spectroscopic analysis. The 60-inch aperture of the new McMath telescope makes it almost three times the size of the next largest solar telescope in operation, the 24-inch Snow telescope at Mt. Wilson, and nearly four times the size of the 16-inch solar telescopes at the University of Michigan's McMath-Hulbert Observatory and the USSR's Crimean Astrophysical Observatory. The Kitt Peak instrument took approximately two years to build.

The Observatory is located near Tucson on the summit of a mountain leased from the Papago Indians. Selection of Kitt Peak as the site of the new national center for optical astronomy was announced by the National Science Foundation in March 1958 and the Observatory was dedicated two years later. Kitt Peak National Observatory is one of two major astronomical research facilities supported by NSF; the other is the National Radio Astronomy Observatory at Green Bank, W. Va., which is operated by Associated Universities, Inc.

In addition to the McMath solar telescope, the optical equipment at Kitt Peak includes a 36-inch reflecting telescope which was installed in 1960 and an 84-inch

The above-ground structure of the new McMath Solar Telescope at Kitt Peak National Observatory. Domes for two of the Observatory's stellar telescopes appear in the background.

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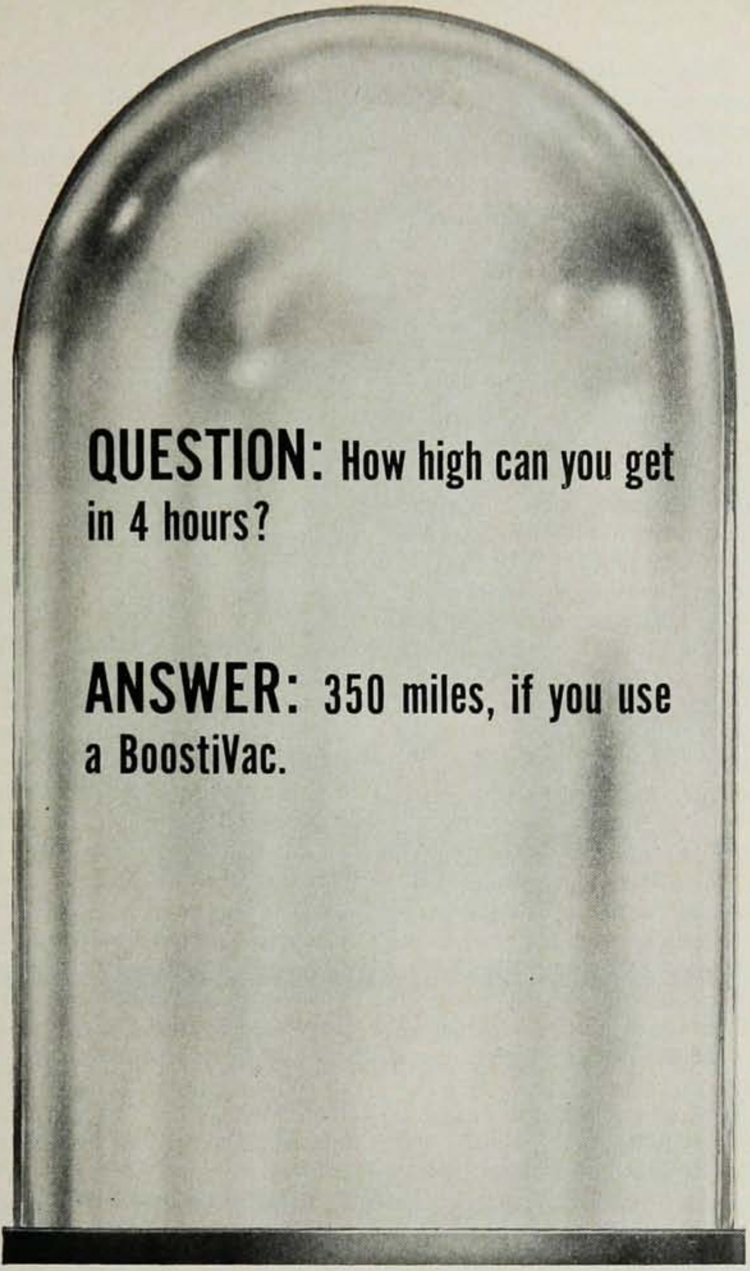

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reflector which has been under construction for the past two years. The Observatory, under the direction of Nicholas U. Mayall, formerly of the Lick Observatory, is also responsible for a long-range project to design a large orbital telescope of high resolving power, capable of making observations on command and of communicating them back to earth.

The New Mills Cross

Approximately twenty percent of the anticipated cost of constructing one of the world's largest radio telescopes, the new Mills Cross which is to be erected in Canberra, Australia, has been provided by the US National Science Foundation in the form of a grant to the University of Sydney. The instrument is expected to cost about \$700 000, of which \$149 000 has been granted by NSF. The remaining funds will be provided by the University's Nuclear Research Foundation.

The original Mills Cross, with arms measuring 1500 feet in length, was invented by B. Y. Mills and was built in 1954 while he was with the Commonwealth Scientific and Industrial Research Organization. That instrument has had a successful career, having completed a full-scale survey of radio sources in the southern sky with a resolution of slightly better than one degree of arc.

The new telescope, NSF has emphasized, will be useful to the advancement of radio-astronomy technology in the United States because it will serve as a prototype of the large interferometers which are expected to be the antennas of the future. The installation will be made available for use by American radio astronomers for observations of the southern sky, and Dr. Mills will help train US graduate students in radio astronomy at the University of Sydney.

Construction of the Mills Cross will be the concern of the staff of the radio-astronomy center at the University of Sydney, which was established nearly two years ago by the University's Schools of Physics and Electrical Engineering. In the past, most of the outstanding Australian contributions to radio astronomy were made by the group led by E. G. Bowen in the Radio Physics Division of the Commonwealth Scientific and Industrial Research Organization. In recent years, several members of the CSIRO staff, including Dr. Mills and W. N. Christiansen, together with a number of British radio astronomers, have joined the faculty of the University of Sydney, thus making possible the creation of the new center.

The arms of the antenna will each be about a mile long and forty feet wide and will be oriented north-south and east-west. The telescope will not be fully steerable, but it may be aimed, partly by mechanical tilting of the east-west arm and partly by electronic phasing of the north-south arm, at any elevation within 55 degrees of the zenith in a north-south direction in the meridian plane. The resolution of the instrument, described as "unprecedented", will be 2.8 minutes of arc at the main operating frequency of 408 Mc/sec. Simultaneous observations at 111.5 Mc/sec will be used to obtain spectral information on the energy distribution with frequency of the celestial radio sources. It is expected that a total of more than a million distant radio sources will be available to the new radio telescope, and it is hoped that this may lead to an increased number of optical identifications and to information of significance for the understanding of the structure of the universe.

The increased resolving power of the new facility is expected to allow separation of individual sources and other structural features in the Magellanic Clouds and other nearby external galaxies. It may also contribute to greater knowledge of the physics of explosions of supernovae, which are strong radio emitters, and allow a deeper investigation of the problem of the complex structure of the galactic nucleus.

The NRL Magnet

The achievement of a sustained magnetic field of 152 000 gauss, the strongest ever produced, has been reported by the Naval Research Laboratory. The field was produced at NRL's magnet facility in Washington, D. C., with a solenoid magnet incorporating basic design principles described by Francis Bitter of the Massachusetts Institute of Technology in 1938, combined with improvements developed at NRL during the last fifteen years. The present figure is 26 kG greater than the previous record, established a year ago at MIT's Lincoln Laboratory with a solenoid designed by H. H. Kolm.

The maximum field achieved at NRL was limited by the available power supply and not by any characteristics of the magnet itself. A current of 12 100 amperes at 245 volts is required to produce the 152-kG field. Joule heat is extracted by circulating water through the magnet at the rate of 660 gallons per minute. The field is constant over a cylinder one-and-one-quarter inches in diameter and two inches long, slightly larger than the area of constant field (one inch in diameter and two inches long) reported last year for the Kolm magnet at Lincoln Laboratory. The NRL magnet is now being used to study the superconducting properties of niobium-tin alloy in fields stronger than 120 000 G; other experiments will begin soon.

NRL's magnet facility also includes two other magnets of the Bitter type. One can produce a field of 90 000 G in an experimental chamber four-and-one-quarter inches in diameter. The other has an experimental chamber two-and-one-half inches in diameter, now reaches a field of 105 000 gauss, and allows insertion of experimental apparatus into either end of the solenoid. A number of studies are under way with these magnets, including magneto-optical properties of semiconductors, superconductivity below 1°K, galvanomagnetic effects, magnetoresistance, and the effect of large fields on biological systems. A fourth magnet, now under construction, will provide fields for sequential electronic and adiabatic demagnetization.