method it has only been performed successfully at Cornell because (1) neutrons are difficult to detect and (2) the electrons must come from an accelerator with a high duty cycle so they arrive in long bursts of low intensity (or else accidental events will hide the actual neutron events).

The Cornell group (Peter Stein, Morris Binkley, Robert McAllister, Ashok Suri and William Woodward) reports values for the square of the neutron electric form factor. Their results at 5.5 F^{-2}, 10.0 F^{-2} and 14.5 F^{-2} are, respectively, 0.0017 ± 0.0070, -0.0037 ± 0.0141 and -0.0055 ± 0.0088. (The experiment is described in *Physical Review Letters*, 28 March 1966.)

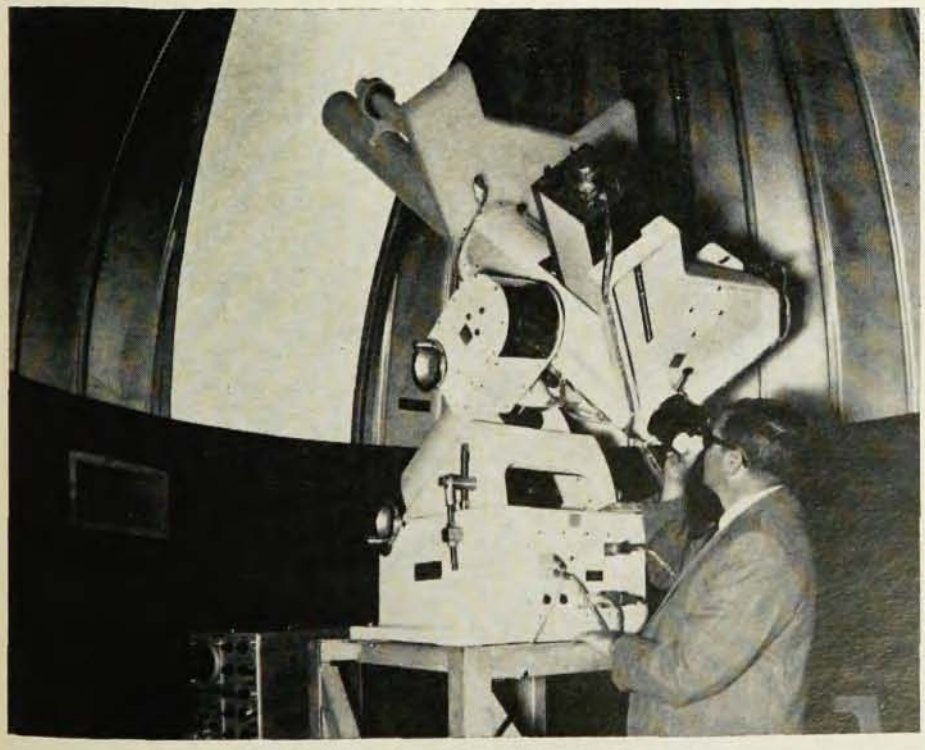
There is a disturbing blemish in the simple picture of a neutron with zero charge density distribution over all regions, however. At extremely low momentum transfers (in which thermal neutrons interact with atomic electrons) the electric form factor is not zero.

Automated solar patrol

The first unit of a worldwide solar patrol network that will attempt to warn astronauts of solar-flare radiation has been installed at the Manned Spaceflight Center in Houston. The instrument is a telescope that automatically tracks the sun and takes photographs at preset intervals. Visual and remote-television observation are also possible without disturbing the camera. The completed network will include similar telescopes at Carnarvon and Canberra, Australia; Maui, Hawaii; Guayamas, Mexico; Johannesburg, South Africa; and an unspecified location in Spain.

The telescope, designed by Razdow Laboratories of Newark, N. J., requires an operator's attention only at sunrise to set the sun's celestial coördinates for the day and to point the instrument's "sun follower" at the sun. Thereafter, the system automatically tracks the sun under control of a servomechanism that responds to signals from the sun follower. Pictures are taken by a camera made by the Giannini Scientific Corporation of Richmond, Va. The Giannini camera can take 35-mm photographs at any rate between one per second and one every 15 minutes. Initially NASA plans to use it at one frame every ten seconds. Each frame contains a 15-mm image of the solar disc along with a record of date and time.

Such series of photographs may



SOLAR PATROL TELESCOPE at NASA center in Houston

yield clues to how to predict solar flares and the outbursts of particulate radiation associated with them. If the flares turn out to be predictable, moon landings and other manned interplanetary flights can then be scheduled for flare-free periods. If not, the patrol system can still give warnings when it notices flares. Since the radiation takes more than half an hour to get to the earth-moon region, people on the moon will have time to take shelter and those who happen to be caught in flight can take evasive action, such as turning heavily shielded tails foward the sun.

Future of space research

A review of the United States space-research program and recommendations for the future by the members of the National Academy of Sciences Space Science Board have been published in three volumes entitled *Space Research: Directions for the Future*. The study began in the fall of 1964 when discussions between members of the Board and members of the National Aeronautics and Space administration suggested that the time was appropriate for it. Plans were made accordingly, and in the summer of 1965 panels of experts in various subdivisions of the topic met for two months of intensive study at Woods Hole, Mass. Their deliberations and recommendations are divided among the three volumes of the report according to the following scheme: volume 1, planetary and lunar exploration; volume 2, optical astronomy, solar astronomy, radio and radar astronomy, x-ray and gamma-ray astronomy, physics and geophysics; volume 3, rocket-satellite research, space research and the university, biology, medicine and physiology, role of man in space research.

With "a surprising degree of unanimity" the report recommends Mars as the first-priority target in planetary research. The planet rates so high because it is a field for the study of all three of what the Board calls "central problems" of planetary research: biology, geophysics and meteorology, and (Mars rates "mildly" on this one) origin of the solar system. Remaining members of the system are ranked as follows: moon and Venus, two and three; major planets, four; comets and asteroids, five; Mercury, six; Pluto, seven; and dust, eight. The report qualifies the priorities with a remark that they are preliminary and subject to modification by further debate among scientists and the application of new data as acquired. The Board recommended that during the next ten years a shift of emphasis toward the planets and away from the moon begin and progress toward a roughly equal expenditure on lunar and on planetary exploration in the period 1970-85.

In about ten years a large telescope (about 300-cm diameter) should be put in orbit around the earth. The Board recommended that the instrument be capable of detecting radiation between 80 millimicrons and one mm. Further recommendations for general optical astronomy include two or more orbiting telescopes of 100-cm or larger diameter and the development of various ancillary equipment for telescopes. Specific proposals were also made regarding special equipment for solar astronomy.

If space astronomy is to fulfill its potential, large and systematic support should be given to ground-based astronomy. Equipment should be extended to the limit of its observational capabilities and provided in sufficient amounts to attract enough people to the science.

For long-wave radio astronomy the report proposes a space radio telescope with an aperture about 20 km. Work should be started now, and such an instrument (with a range from 10 MHz to a few hundred kHz) should be in use in about ten years. Continued use of satellites, rockets, balloons, and ground-based equipment was endorsed. Millimeter and far-infrared telescopes with apertures of about 30 m will be needed for future studies; they should be put in space where they are free of terrestrial gravity. Radar studies from the ground, Voyager space probes and lunar orbiters should be continued and extended.

In further recommendations the Board supported continued engineering development of satellites and rockets, endorsed medical and bio-