SOLAR ECLIPSE

An accommodating sun

The accessible March 7 eclipse offers astronomers a chance to pull out all their instrumental stops

by Dietrick E. Thomsen

Solar eclipses occur about once a year. But the path that the moon's shadow traces over the earth's surface is so narrow and short that an eclipse visible from a populated or easily accessible area is rare. This year's eclipse, on March 7, is unusually accessible: The path of totality will cross Mexico, run through the southeastern United States from Florida to Virginia, cover the southern coast of Nova Scotia and cross Newfoundland. The partial eclipse will touch the fixed location of some of the nation's most sophisticated radio astronomical equipment, offering an important opportunity for observation.

About 500 professional astronomers, over 1,000 amateurs and tens of thousands of others are expected to camp in the path of totality to see the eclipse. Since March 7 is a Saturday, the number of nonprofessionals with the leisure to go will be particularly large.

But for professionals with equipment to move into place, Mexico is the location of choice for ground-based optical observations. The slice of the Isthmus of Tehuantepec crossed by the total eclipse has dry weather and elevations up to several thousand feet, both important to optimal telescopic observations. The chance of a cloudy day there is about 20 percent, compared to about 60 percent in the southeastern United States and upward of 70 percent in Canada. But the Mexican region is remote and sparsely populated, and lacking in tourist amenities.

For radio astronomers, says Dr. David Buhl of the National Radio Astronomy Observatory at Green Bank, W. Va., the advantage of an eclipse is the opportunity for extreme precision it affords. A radio telescope can locate features to within one minute of circular measure. The position of the moon's edge can be calculated far more precisely than this, and as it cuts off various radio emissions, their positions can be determined from a knowledge of the time they shut off.

While some radio experiments are being done with antennas carried into the path of totality, others can be done with fixed equipment that happens to be in the region of at least partial eclipse. For example, a group including staff members of the National Radio Astronomy Observatory and visitors from the State University of New York, California Institute of Technology and from Czechoslovakia will use NRAO's 140-foot radio telescope and a 36-foot one at Tucson, Ariz., to do high-resolution studies of the so-called active regions that are associated with sunspots and solar flares.

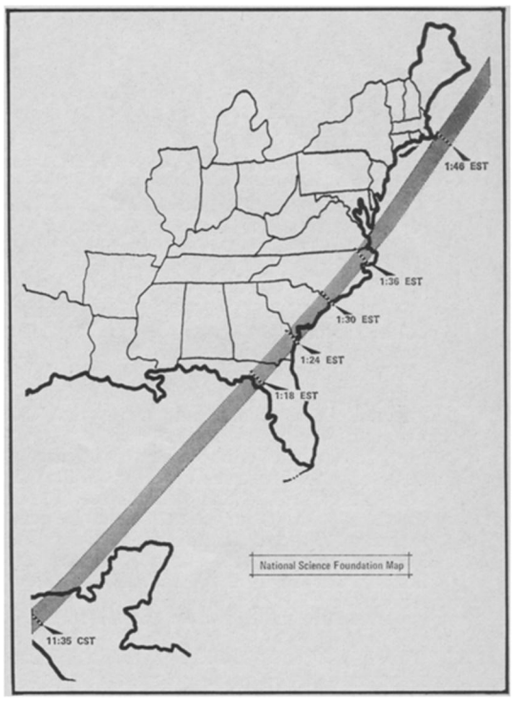
Another thing this group will be looking for is a kind of radio halo around the sun. Because of the high temperatures in the outer corona, the sun should be surrounded by a ring of very bright radio emission. So far, says Dr. Buhl, this ring has escaped detection, but during the eclipse it may show up.

Another especially fortuitous feature of this year's eclipse is that the National Aeronautics and Space Administration's rocket launching station at Wallops Island, Va., is in the path of totality. Thirty-three rockets will be fired from Wallops Island on eclipse day, 20 of them in a 15-minute period, and 12 probes will be shot from seven-inch guns on the site. Other rocket-launching stations include Eglin Air Force Base, Fla., where 17 rockets will be launched, Tehuantepec, Mexico, with 12 rockets and East Quoddy, Nova Scotia, with four.

The experiments aboard these rockets will make observations of the sun that cannot be done through the atmosphere, recording ultraviolet light and X-rays, both of which are absorbed by the air. They will also record conditions in the upper atmosphere. The physical characteristics of the ionosphere depend on the ultraviolet light that comes from the sun, and when this is cut off by an eclipse, sudden drastic changes occur. Experiments of these types will also be done from at least two satellites and two high-flying aircraft.

The temperature of the main body of the sun is about 6,000 degrees C., but the temperature in the corona goes up to millions of degrees. Some observers will seek to determine the temperature at various levels of the corona, the nature of the heating mechanism and the possible role of magnetic fields in keeping hot regions separated from cool ones.

If the corona rotated rigidly with the sun, parts of it would be going faster the farther from the center they happen to be. But there is a limit to how fast things can move. Dr. Keith Pierce of Kitt Peak National Observatory, who is in Mexico with an expedition, says, "The corona just can't get faster and faster." The question, he says, "is how far out do you go before corotation of sun and corona changes"; that is, before the corona starts to drag behind.



Solar spectacle across the Southeast.

In addition studies of iron abundance in the sun, other stars and the earth yield widely different figures. A knowledge of the iron abundance in the corona may help in understanding the differences.

An observation that has been a staple of eclipse expeditions for 50 years, the Einstein light-bending observation (SN: 3/9/68, p. 229) will be done again. Einstein's general relativity theory predicts that when the light beam from a star passes through the gravitational field of a heavy body like the sun, it will be bent. This bending means that stars viewed near the sun will appear in slightly different positions from the ones they occupy when the sun is not in the way.

The light-bending has been looked for on numerous occasions since 1919. Einstein's prediction has been repeatedly confirmed and refined, and the observation is now very low on astronomers' priority lists. Still, two astronomers feel that more can be learned from refinement of the observation. Drs. Mendez Manuel of the Universidad Nacional Autonoma de Mexico and Stanislaus Vasilevskis of the University of California at Santa Cruz will be setting up telescopes between Oaxaca and Puerto Angel to do it again. □

Science Service, Inc. is collaborating with JSTOR to digitize, preserve, and extend access to *Science News*. www.jstor.org