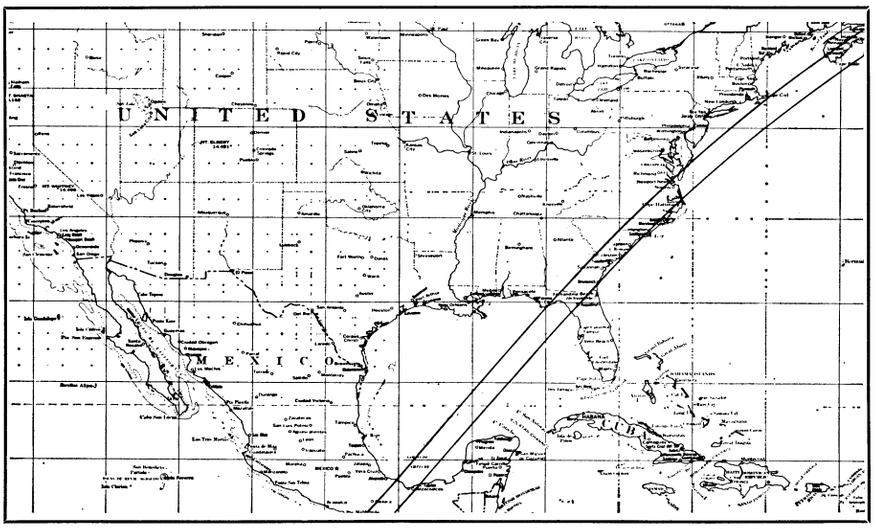
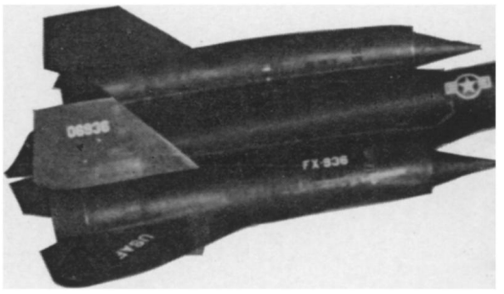


U.S. Naval Observatory



ASTRONOMY

Available, total eclipse

Some 50 million U.S. residents will be within one day's driving distance of totality path

by Ann Ewing

One of the most magnificent spectacles in the world is a total eclipse of the sun, as anyone who has ever seen one will testify. But the number of witnesses is not as large as the average occurrence of at least one a year would suggest; most and sometimes all of the total eclipse path streaks along over ocean surfaces and remote islands.

Even among astronomers who pursue eclipses, not as many of them as would like to have actually seen one; they do their observing with instruments and are usually too busy making sure these are operating to cut into their 3-to-7-minutes' observing time for the awesome sight of the halo-ringed black sun.

Next March 7, 50 million residents of the United States alone will be within one day's driving distance of a total eclipse of the sun.

Not until Feb. 26, 1979, will another total eclipse be visible from the conterminous U.S., and that occurs over the northwestern part of the country, not close to the much more populous Eastern Seaboard and South.

The March 7 eclipse will start at sunrise in the South Pacific. The path of totality, averaging 85 miles wide, will sweep across Mexico and the Gulf, slice through northern Florida and up the southeastern coast of the U.S. and the Delmarva Peninsula, then out over the ocean to Nova Scotia and Newfoundland, except for a brief swipe at Nantucket and the southern tip of Cape Cod.

All of North America, except the northern tip of Alaska, will be in the path of a partial eclipse, when the moon appears to take a bite out of the sun instead of blacking it out completely. The partial eclipse will also be visible in Central America and the northern portion of South America.

For duration of totality and altitude of the sun and for observing weather as well, the Isthmus of Tehuantepec will be the most favored land area for observing, and many scientific expeditions are being planned for this location. The longest solar blackout, called mid-eclipse, is about 55 miles east of Oaxaca, where it will last 3 minutes and 28 seconds, with the sun 63 degrees above the horizon.

An ambitious plan to make the sun stand still during the eclipse—at least for a few scientists for about an hour and a half—has been under study for the Government by Robert D. Mercer of Dudley Observatory in Albany and Jay M. Pasachoff of Harvard College Observatory.

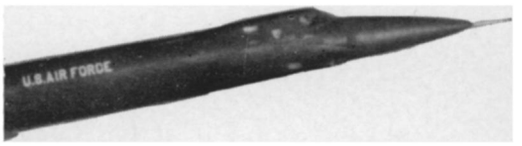
The idea is to race the U.S. Air Force's faster, more muscular successor to the U-2 spy plane, the SR-71A, modified to carry observing equipment, along the track of totality at speeds of about 2,000 miles an hour for 90 minutes, 30 times ground-based observing time.

"The opportunities for studying the sun's coronal and chromospheric features during such a flight are truly unique," says Mercer. "The eclipse would be observed in a dark and cloudless sky, at altitudes up to 75,000 feet, through only one-thirtieth of the atmosphere and almost no water vapor."

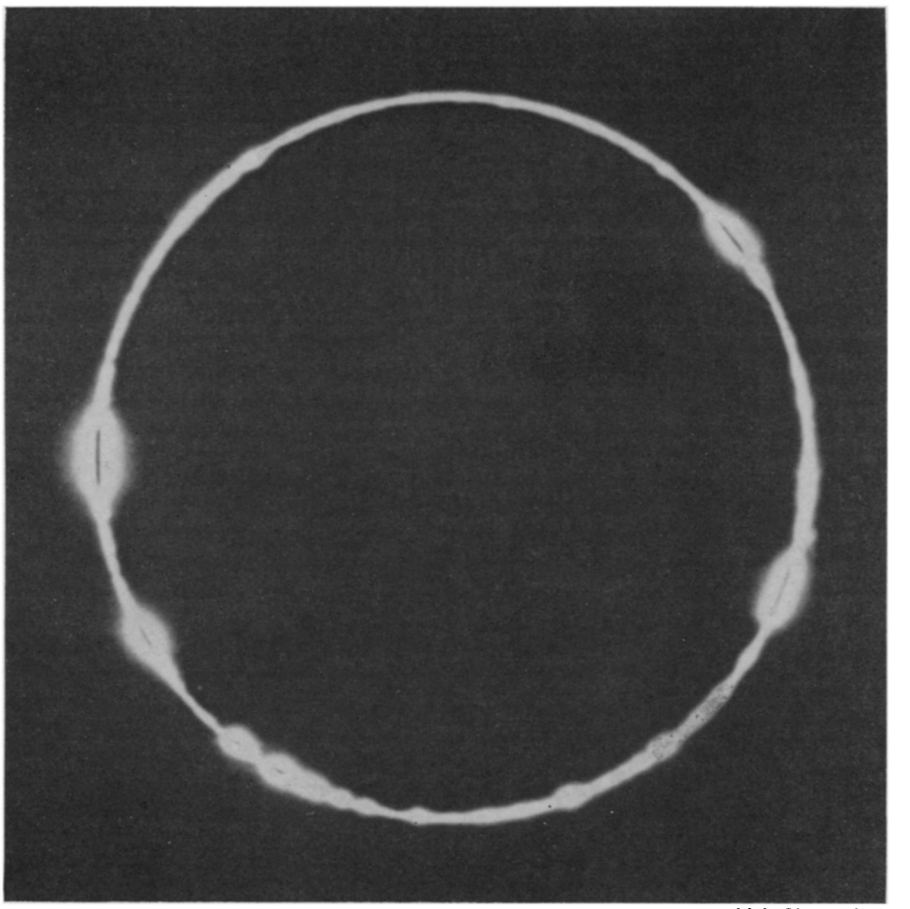
Although balloons, rockets and earth satellites reach even greater heights, there is no way to control their movements in relation to the sun and moon to achieve such an extraordinary lengthening of the total eclipse.

From the ground, observers with good weather conditions can view the sun during totality for an average of about three minutes, with an upper limit of about seven under optimum conditions. This time has been lengthened by mounting equipment in airplanes, including jets, but even then the total time the sun is completely hidden has been stretched to no more than about eight minutes.

The SR-71A data-collecting run would begin after aerial refueling 1,000 miles southwest of Mexico, then fol-



U.S. Air Force



Lick Observatory

Path of totality sweeps across Mexico and southern United States; an Air Force reconnaissance plane could stretch eclipse-watching to 90 minutes. The instant before totality, Bailey's beads shimmer.

low the path of totality northeastward, passing diagonally above the Gulf of Mexico and Florida over the Atlantic Ocean. Such a flight would extend by several hundred times the duration of what is called the chromospheric flash spectrum, usually observed for only a few seconds at stations on the surface of the earth.

The sun's visible surface, called the photosphere, has a temperature of about 6,000 degrees K. The temperature then decreases outward, reaching a minimum of about 4,600 degrees in the lower chromosphere, where the lines of the flash spectrum originate. It then rises until it reaches millions of degrees in the corona.

"One of the goals of solar studies is the determination of the chemical composition of the sun's outer layers," says Dr. Donald H. Menzel, retired director of Harvard College Observatory. A total eclipse, when the moon has blacked out the visible surface, is the only time available to examine the composition and structure of the outer solar corona.

Since the effort, time and money involved in getting to the path of totality is so high for so few minutes of observational return, Dr. Menzel offered himself as a replacement for the ballast carried in the SR-71A. His only proviso —"an instrument porthole to look out of."

The plan is still under consideration both by the National Aeronautics and Space Administration and the Air Force, though cost and time factors may wipe it out.

Among the many expeditions planned for March are two major ones, both to Mexican sites near the longest totality. The National Center for Atmospheric Research in Boulder, Colo., expects to send about eight scientists and engineers who will undertake several experiments on solar physics and coronal temperatures both from the ground and from their Saberliner aircraft flying in the eclipse path above the cloud level.

The other is being planned by scientists from Kitt Peak National Observatory in Tucson. They hope to send four teams of scientists and engineers to measure solar atmospheric temperatures and the intensities of coronal radiation at various wavelengths.

Not counting the SR-71A and the Saberliner, seven airplanes, carrying scientists and their equipment, are scheduled to fly in the totality path, with possibly another being chartered by amateur astronomers. This will create a possible problem of airborne traffic jams in the 85-mile-wide path.

One of these planes will be the National Aeronautics and Space Administration's Convair 990. Unfortunately, this plane has its solar observing ports on the wrong side for this eclipse. Therefore it will have to fly westward during the eclipse, decreasing the duration of totality to less than a ground observer will have. However, it will fly above the clouds, and scientists would rather have a brief glimpse of totality than none at all.

Even more serious than the congestion is how the contrails these planes track along the sky will affect ground observations. The scientists involved in the aircraft flights are scheduled to meet in Washington during May to work out optimum schedules.

Also adding to the scheduling difficulties are the rocket launches, probably about 30, planned from the NASA test station at Wallops Island, Va. Aircraft will have to avoid that vicinity as they track the eclipse path. Coronal characteristics again, from the far infrared to X-rays, will be measured by instruments carried in the rockets.

Although measuring the deflection of starlight to test Einstein's theory of general relativity was once an essential aim of scientists on eclipse expeditions, there are no plans now to do so in 1970. This work can now be done more easily and cheaply in the laboratory. ◇