Total Eclipse of Sun Coming Soon

Astronomy

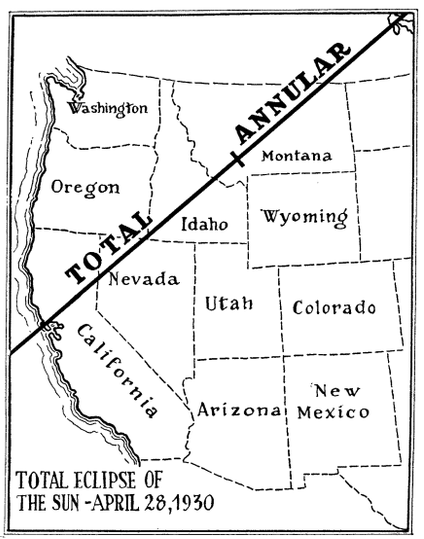
By James Stokley

CHIEF of the astronomical attractions for the month of April, 1930, is the first eclipse of the year. Over a very narrow path crossing the Pacific coast just north of San Francisco Bay, then over California, Nevada, one corner of Oregon, Idaho, and Montana, the shadow of the moon will graze the earth on the morning of Monday, April 28. It will be just a glancing blow that the tip of the shadow will make—quite different from the hearty stroke of the shadow next October, for instance, when a second total solar eclipse will be visible in the south Pacific. But despite the unfavorable conditions, astronomers will journey to points along the path, in California and Nevada, to make the most of the second or so during which the sun will disappear. California is an astronomical center; its astronomers often want money to travel halfway around the earth for an eclipse, and how are they to defend themselves from the charge of junketing if they ignore an eclipse in their own backyard?

In general there are two kinds of solar eclipses. The sun is about 865,000 miles in diameter, compared with 2200 miles for the moon. As a result, the shadow that the moon casts has the shape of a cone, with its base on the side of the moon that is turned from the sun and the tip about 240,000 miles above this side. It so happens that this is the approximate distance between the moon and the earth, a distance which varies slightly. Sometimes the tip of the shadow reaches well beyond us, then the shadow may be a hundred miles or more wide where it touches the surface of the earth. The sun and the earth are both moving, so the shadow sweeps along from west to east, producing the "path of totality" in which the sun's disc is obscured.

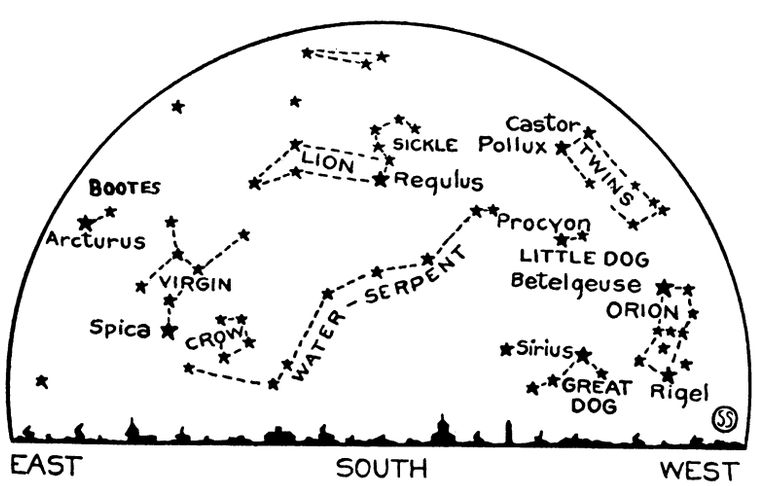
But sometimes the earth and moon are farther apart. Then the tip of the shadow fails to reach the surface, and instead of a "total" eclipse, we have one that is "annular." Because the apparent diameter of the moon is less than that of the sun at the time, the "path of totality" becomes the "path of the annulus" in which a person will see a doughnut-shaped ring of the sun's disc around the black globe of the moon.

This month's eclipse will be both annular and total. The eclipse will start at sunrise out in the middle of the Pacific Ocean. Here the shadow will fail to reach the earth and the eclipse will be annular. The annulus will sweep along to the east. But the earth is round, the tip of the shadow approaches nearer and nearer to the surface, while the bright ring, or annulus, gets narrower and narrower. Finally, just off the Pacific coast, where the earth's surface is several thousand miles closer to the moon than at the place where the eclipse started, the tip of the shadow touches the earth and the eclipse becomes total. Thus it crosses California and other western states, a point in eastern California being the closest to the moon and the place where the eclipse is longest. Even here the shadow will only be about half a mile in diameter, and totality will only last about a second and a half. As the shadow speeds on, its diameter becomes less and less, and finally, about 50 miles east of Butte, Montana, the tip of the shadow leaves the earth. From then on the annulus reappears, passing across Saskatchewan, Manitoba, Hudson Bay, Labrador, and departs from the earth completely at sunset in the middle of the North Atlantic. Such an eclipse, both annular and total, is called a central eclipse.



With an eclipse of such short duration, astronomers will have their difficulties. There will just be time for one brief photograph of the corona, instead of several, with exposures varying from a second or so to some thirty seconds or more. But most difficult of all will be the determination of the exact path of the eclipse. It is perfectly true that astronomers can predict the path of an eclipse a century in advance, and could go to a place where it will be seen, set up their telescopes now, leave them for a hundred years and come back and find only a few minor adjustments necessary. But this is only true of a really favorable eclipse. The exact calculation of the moon's wanderings is one of the most difficult problems of modern astronomy, and at best predictions are merely very close approximations.

A motion of a half mile of the moon's shadow means motion of the moon itself of approximately the same amount. Calculating in advance



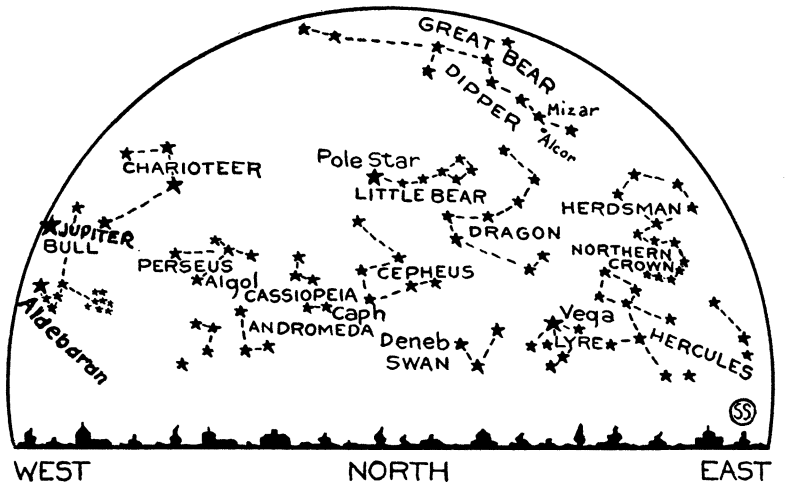
HOLD THESE MAPS in front of you to see the arrangement of the stars in the April evening sky. This one shows the southern sky, the one on the next page shows the stars in the north.

the position within half a mile of a body 2200 miles in diameter and some 240,000 miles away is a very tricky procedure.

With the eclipse path this month only half a mile wide, however, such a difference between the predicted path and what it actually is would mean the difference between being in the path or out of it! For that reason the predictions of this eclipse have probably been carried out with greater precision than ever before. They were completed last month at the Nautical Almanac Office, in Washington, and observations of the moon made as recently as March 12 were used in the computations. Probably no astronomer whose selections of an observation post is guided by these calculations will find himself outside the path completely, though such an outcome is not inconceivable. What may happen is that he may choose a point that he believes to be in the center of the path, and that the real center may be a few hundred yards to the north or south. Then, instead of the eclipse lasting the full second and a half, it may only last a half second and he will get only a fleeting glimpse.

Some astronomical observations will be made from the air. Dr. H. M. Jeffers of the Lick Observatory, will make a flight in a U. S. army airplane. By flying at a high altitude, a very slight advantage can be obtained in the length of the eclipse, and by flying along with the shadow of the moon, there is a further slight advantage. But again there comes up the difficulty of navigation. Even if the path were predicted precisely, it would test the skill of a pilot to fly the plane right along the center line, and with the uncertainties, it is quite likely that a pilot would find himself outside of the path, too late to rectify his error. Recognizing this, the Lick observers plan to make one observation that can be made from outside the path nearly as well as in it. This consists in aerial photographs of the shadow as it sweeps across the earth. Such photographs would give a permanent record of the eclipse path, and provide very accurate means for checking the positions of the moon.

On the ground will be another group from the Lick Observatory, located in Yuba County, about 125 miles northeast of San Francisco, and under the leadership of Dr. J. H. Moore. With him will be Dr. D. H. Menzel. Another ground party will be under the direction of Dr. H. D. Curtis, director of the Allegheny Observatory at Pittsburg and a veteran eclipse observer, who will be on the edge of the Black Rock desert, near Gerlach, Nevada. Near Honey Lake, in eastern California, will be Dr. S. B. Nicholson, from the Mt. Wilson Observatory.



The main observations by these parties will be of the flash spectrum. For an instant just before and just after totality, when only the outermost layer of the sun is visible above the moon, the so-called "reversing layer" can be observed. The ordinary solar spectrum, obtained when its light is analyzed by the prisms of a spectroscope, consists of a colored band crossed by dark lines. These dark lines are produced by absorption of certain colors of sunlight by this reversing layer. When the reversing layer can be observed by itself, however, the spectrum shows bright lines of colors the same as those ordinarily absorbed. From such photographs of the flash spectrum many solar puzzles have been solved. As they can only be made at the beginning and end of an eclipse, the duration is immaterial, though some complication is produced by the fact that the higher parts of the reversing layer will be visible completely around the sun. However, this can probably be corrected by the use of a screen in front of the telescope so that only half of the sun's image enters the lens. Even if one is just out of the path of totality, valuable photographs of the flash spectrum can be made. But to record the corona, the important outer layer of the sun that can only be observed at eclipse time, the camera must actually be in the shadow. To avoid the possibility of missing the corona, the Lick Observatory astronomers will have three cameras, located along a north and south line at intervals of about a third of a mile. Then one will surely succeed.

After this month astronomers will have to wait until October when a much better eclipse, astronomically, will be seen from Niuafou Island, a tiny bit of land in the South Pacific.

In other parts of this country and Canada, the eclipse of April 28 will be visible as partial, the sun appearing as a round cookie from which a bite has been taken. The nearer you are to the path of totality, the larger will be the bite. The approximate times of beginning and end of the partial eclipse are as follows: Eastern States: begins 2:00 p.m. E.S.T., ends 4:30 p.m., E.S.T.; Midwest and Southeastern states: begins 12:30 p.m., C.S.T., ends 3:15 p.m., C.S.T.; Mountain states: begins 11:00 a.m., M.S.T., ends 2:00 p.m. M.S.T.; Pacific states: begins 9:40 a.m., P.S.T., ends 12:30 p.m., P.S.T.

About two weeks before the eclipse of the sun, when the moon is on the other side of the earth, it will partly enter the earth's shadow and so on the night of April 12 there will be a partial eclipse of the moon. At 12:58 a.m. E.S.T., early on the thirteenth, about a ninth of the moon's diameter will be immersed in the shadow, and will appear darker than the rest of the lunar surface.

The planet Jupiter is still to be seen in the April evening sky. It is in Taurus, near Aldebaran, but more brilliant than that star. At the end of the month the seldom-seen planet Mercury will be visible low in the western sky just after sunset. Those who see the total eclipse will probably notice this brilliant planet to the east of the eclipsed sun, as well as Venus. The planet Venus is now coming into the evening sky. It is the brightest of the planets now visible, and can be seen all month in the western sky for an hour or so after sunset.