ECLIPSES ON MARS

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Mars is perhaps the most interesting planet in all our solar system. Not only does it lend itself most readily to observation, but there is always the question whether the conditions there may be such as to support life. If this be the case the dwellers upon this planet have many interesting and spectacular phenomena to attract and occupy their attention. Chief among these celestial attractions are the two satellites, Deimos (meaning dread) and Phobos (fear), which revolve about the planet at a distance of 14,650 and 5,850 miles respectively. These satellites are both very small. Lowell gives the diameter of Deimos as 10 miles and that of Phobos as 36 miles. Deimos would look like a bright planet while Phobos, when near the zenith would appear a little larger than the moon though not half so bright.

Among the peculiarities of these bodies is their apparent path through the heavens. Phobos revolves so fast, and is so close to the planet, that it gets around in less than a Martian day, its sidereal day being 7 hours and 39 minutes, and so rises in the west and sets in the east after less than six hours. Deimos also is peculiar in its motion as it lingers above the horizon for two days at a time, its period of revolution being 30 hours and 18 minutes, or about a day and a quarter. Since they both revolve about the planet practically in the plane of its equator, they would always follow the same diurnal path across the sky, rising and setting in the east or west points of the horizon.

So much of interest and importance attaches to eclipses upon the earth that it may also be worth while to inquire as to what the eclipse phenomena would be upon Mars, and what kind of spectacle the Martians would have to witness at such times. Even a rather hasty examination of the question becomes quite fascinating.

The possibilities of eclipses would seem to be doubled by the fact of there being two satellites, but the problem is by no means so simple as this for there are numerous other factors, such as their diminutive size, their proximity to the planet, and the greater distance of the sun, which complicate the matter.

Eclipses of Deimos and Phobos by Mars would correspond to our lunar eclipses by the Earth, but they would happen much more frequently. For a period of 70 days, twice a year, Deimos would suddenly disappear every 30 hours for half an hour or more at a time. This periodical vanishing of a planetary object like Deimos would be rather striking, but eclipses of Phobos, whose apparent diameter may be as large as the moon's or larger, would be still more so. Its "eclipse

limit" is about 55°, so that for a long time Phobos would be eclipsed every 7⅔ hours. Its speed is so terrific that these eclipses would not last very long, but successive eclipses would increase in length from a few minutes to nearly half an hour and then decrease again. After this had continued for 200 days or so there would be no more for nearly half a year, when the dramatic performance would be repeated in passing the other node. Three or four eclipses of Phobos would thus be scheduled for nearly a third of the days in the Martian year. But so close is Phobos to Mars that it is only visible within 68° of the equator, so that Martians living in higher latitudes would miss the whole show.

Another curious part in the play would be the "merry-go-round" of Phobos and Deimos, the former overtaking and passing the latter every 10¼ hours. For observers near the equator Deimos would be occulted every time. But this program of occultations would be interrupted during the eclipse season, and of course they could not be seen very well in the day time.

Then there would be the changing phases of both satellites, telescopic for Deimos, but very noticeable in the case of Phobos, which might rise in the west just after sunset, a narrow crescent, and set in the east about midnight in the third quarter, having passed through the first quarter, full, and gibbous phases in the interim. During the eclipse season Phobos would not be seen at the full for it would enter the large shadow of the planet in the gibbous phase before opposition and emerge in the other gibbous phase well after it.

There would be two kinds of solar eclipses as seen from Mars. Those by Deimos, like those of Deimos by Mars, would be relatively unimportant. Its apparent diameter is only about one eighth that of the sun, and only a very partial eclipse can therefore result. It might better be called a transit. These transits could only occur close to the nodes and not at every node but a year or two apart, for the whole solar eclipitc limit is less than one degree. Besides these transits of Deimos there would of course be the rare transits of Mercury and Venus, and also transits of the Earth and even of the moon.

But the apparent diameter of the sun would vary from a little less than that of Phobos to only about two-thirds of it, so that total eclipses of the sun by Phobos would occur, and at every node. That is, twice a year there would be five to seven total solar eclipses less than eight hours apart, the longest not lasting more than 20 seconds, besides the partial eclipses that would precede and follow them. At times the path of totality might not be more than ten miles wide and a good

deal of light would be diffused and reflected in from the surrounding region. At other times, especially if it were cloudy and the planet near aphelion, though the path might not be more than fifteen miles wide, points in the path would be plunged into total darkness. But there would be no annular eclipses of the sun and and total eclipses would only be seen by those who were near the equator. In this region however they would be rather common and the phenomenon would occasion as little disturbance in the life of people there as the shadow of a cloud passing over the surface of the earth.

The astronomer upon Mars would have some distinct advantages over his terrestial contemporaries in the study of these Martian attendants. His knowledge of these bodies so nearby must be very complete. Within the eclipse belt he would have more chances for studying eclipse phenomena, but the paths of totality would be so narrow that his computations must be very accurate and his stations located just right or he would find himself witnessing only a partial eclipse in the penumbra instead of a total eclipse in the small insular umbra.

A journey to Phobos, instead of being a dream of some Martian Jules Verne, might well be an engineering accomplishment if it were worth while. In fact the small superficial gravity upon Mars, and the lesser "velocity of escape" for projectiles might limit artillery operations, lest a lot of cannon balls be lost after an engagement and go to form a flock of minor satellites revolving about the planet.

Speculation upon the habitability of Mars suggests the possibilities of a remarkable mythology which a primitive people might build up about such phenomena as we have described. The gods of the Martians would be wondrous gods indeed.

MEASURING THE SUN'S HEAT

A REVIEW BY THE EDITOR

Sometimes the truths of science are more readable than fiction. This is true of Dr. C. G. Abbot's contribution to the last report of the Smithsonian Institution which is now available as a reprint of some 20 pages from the Government Printing Office. The story is entitled "Studying the Sun's Heat on Mountain Peaks in Desert Lands." It is written in his usual happy style and the scenes are made vivid with full page pictures of the stations described. Those who have read in the pages of this PUBLICATION the account of the Smithsonian expedition to Algeria will want to get this pamphlet and read the whole story.