

Less than a tenth of a degree to the north of Mars you will find at the same time another fifth magnitude star, 22 Scorpii.

Before the end of August Mars will have passed out of the region represented on our map. On the 26th of that month he will be just three degrees south of where he was on April 22nd, when he began retrograding. By that time his opposition season will be well over, but we shall have him as evening star until the end of July 1891, and may easily see him any clear evening until about the beginning of next June. Between the time of his leaving Scorpius in August, next, and the time when we shall be getting our last look at him as evening star, next May or June, he will travel through the constellations Ophiuchus, Sagittarius, Capricornus, Aquarius, Pisces, Aries, Taurus.

In the middle of June 1890 he is about a degree from Delta Scorpii, in the middle of June 1891 he will be about a degree from Epsilon Geminorum. That is quite a lot of travelling in a year for even a planet. Round the shortest way it is a matter of 140 degrees, but the planets are not allowed to go that far that way. Round the way they have to go, this is a distance of 220 degrees. Uranus is a planet as Mars is, but it takes him fifty years to travel over that much of the sky. A star is not a planet, but even the "fixed" stars are in motion—"proper motion" it is called. There is one of them, up near the Big Dipper, which has so much of this motion that it has been named the Runaway Star. With such a name we might expect something extraordinary in the travelling line, but it would take the Runaway Star more than 100,000 years to change its position in the heavens as much as Mars will do between this June and next.

While on his travels Mars meets with all the usual adventures. He passes the stars along his route, sometimes very near them and sometimes right over them. Last March he came very near running over Beta Scorpii. He also passes planets that are slower than himself, and is passed by those that are faster. In the middle of November next he will pass Jupiter, at the distance of a degree. The two planets will then be in Capricornus and for some days the pair will be the most conspicuous object in the evening sky.

The moon moves faster in the heavens than Mars and therefore passes him. She is nearer than he is and sometimes passes between him and us and occults him. It would be a fine sight to have an occultation of Mars when he is as big and bright as he is now.

There has been one occultation of him already this year—on April 9th—but it was chiefly for the benefit of the Sandwich Islands and thereabouts. There will be another on October 20th, but to see it well one ought to be out in the Indian Ocean near Kerguelen Island. Next year Mars will again be occulted twice, but neither of them will be visible here. But on July 11th, 1892, there will be one which will be visible here, and Mars will then be bigger and brighter than he has been this year even when at his best. If we happen to live until then and can manage to have a clear sky, we shall see the best occultation provided for this part of the earth since that of Jupiter last September—and that was spoiled to us by fog, or clouds, or smoke.

The wanderings of Mars among the stars and his meetings with the moon, the other planets, and the stars, during these

wanderings—these are matters that the star gazer can see for himself, and need not take merely at second hand from his books. That is why these matters are chiefly dwelt on here. For information on other matters of interest connected with Mars—his real motion, his orbit, his distance, his size, his moons, his physics, and his chemistry, and his geology; his continents, and ice caps, and seas, and canals; his days and months, and seasons, and years; his astronomers, and engineers, and farmers, and all the rest of the Marticoli, those who cut the canals and planted the trees along them, and those who have been so long vainly signalling to us stupid terrestrials by means of huge beacon-lights which at this distance and in our best telescopes look like mere luminous points—for all these things the star gazer must go to books and magazine articles, and must take whatsoever he does take of them at second-hand.

Another fact that any one may learn by merely using his eyes, is that Mars varies in brightness.

Just now he is unusually bright. This is because he is unusually near. At present he is the nearest of all the heavenly bodies, except our moon. He has not been so near since November 1879, and will not be as near again until June 1892. In July and August 1892, he will be nearer and brighter than he is now.

If the orbit of Mars was a circle instead of an ellipse we would have him at his brightest once in every period of two years and two months; and at his brightest he would always be equally bright, and that would be as bright as he was in the middle of May this year. He would be brightest when in "opposition"—that is, when seen by us in the part of the sky *opposite* to the part where the sun is. When so situated, the earth is between him and the sun, and his distance from us is only the *difference* between his distance from the sun and ours. When not in "opposition," his distance from the earth is of course greater than this and he is then less bright.

All this is true of what really happens, except that when in opposition and brightest for the current season, he is not always equally bright. His orbit is an ellipse not a circle, therefore his distance from the sun is not always the same. Neither is the distance of the earth from the sun always the same. Therefore the difference of these distances is not always the same. And this difference is the distance between the earth and Mars at opposition when he is brightest. Therefore his brightest is not always equally bright. His mean opposition brightness is what he showed in the middle of May. Let us use this as his standard brightness, and call it 100. If his orbit was circular his brightness at opposition would always be this 100. But, as things are, his opposition brightness may be as low as 50, and as high as 240. When at the best this year—June 7th,—it was 120. At the last opposition in April 1888, it was less than 70. At the next one in August 1892, it will be 230. On this same scale, his brightness in the middle of each month of the present year is as follows:—January 9, February 9, March 25, April 50, May 100, June 117, July 80, August 50, September 33, October 23, November 17, December 13. Last summer and Autumn, when Mars was on the farther side of the sun, his brightness was less than 4. And so between August 1889 and August 1892 his brightness varies from 4 to 230.

Expressed in terms of star-"Magnitude," the brightness of Mars varies from that of a second magnitude star, like the Pole star, to that of one whose magnitude is *minus* 2, that is, one which is three "magnitudes" brighter than a standard star of the first magnitude like Altair, or Aldebaran, or Antares. There is no star as bright as that (Sirius is about *minus* 1½) but it is about the brightness of Jupiter at mean opposition.

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