THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

IN the present month the event of the greatest astronomical interest is the very favorable opposition of Mars, which occurs on the 24th. All through September the planet is very near us—from 36 to 37 million miles, and is better placed for telescopic study than it has been for us since 1892.

Oppositions of Mars are frequent enough—about once every two years and two months; but as its orbit is by no means circular, its distance from the sun may vary from 128 to 154 millions of miles. Taking the earth's distance from the sun as 93 millions, the distance between the two planets, when in line with the sun, may vary all the way from 35 to 61 millions of miles.

At the present time conditions are almost ideally favorable. Two years ago, it is true, Mars was almost as near us as he is now; but then he appeared so far south in the heavens that he could hardly be observed in our latitude, while in England, as one of the Greenwich observers aptly said, "he hardly rose above the tree tops." This year he is almost on the equator, and it will not be necessary, as it was then, to go far south to observe him at a proper altitude.

Being so near us, he appears unusually large in the telescope, and very bright to the naked eye, fairly rivaling Jupiter, and surpassing all else in sight, so that one has but to look at the sky to find him.

Of course this good opportunity will not be lost by those astronomers who make a study of planetary detail. What they may discover we will know later; at present it may be worth while to speak a little of the conditions under which the work must be done.

Mars at his best looks only about 1/75 as big as the moon (with the same magnifying power). On account of the unsteadiness of our atmosphere (which makes everything seen through it appear to dance about and be more or less blurred) it is only under very favorable circumstances that a magnifying power much greater than 1,000 diameters can be used. That is, it is only on these rare occasions that we can see Mars as well with a great telescope as we can see the moon with a good binocular or spy-glass, magnifying 13 times. Under ordinary conditions the "bad seeing" would make it impossible to see anything like as much on Mars with the big instrument as can be seen on the moon with the small one.

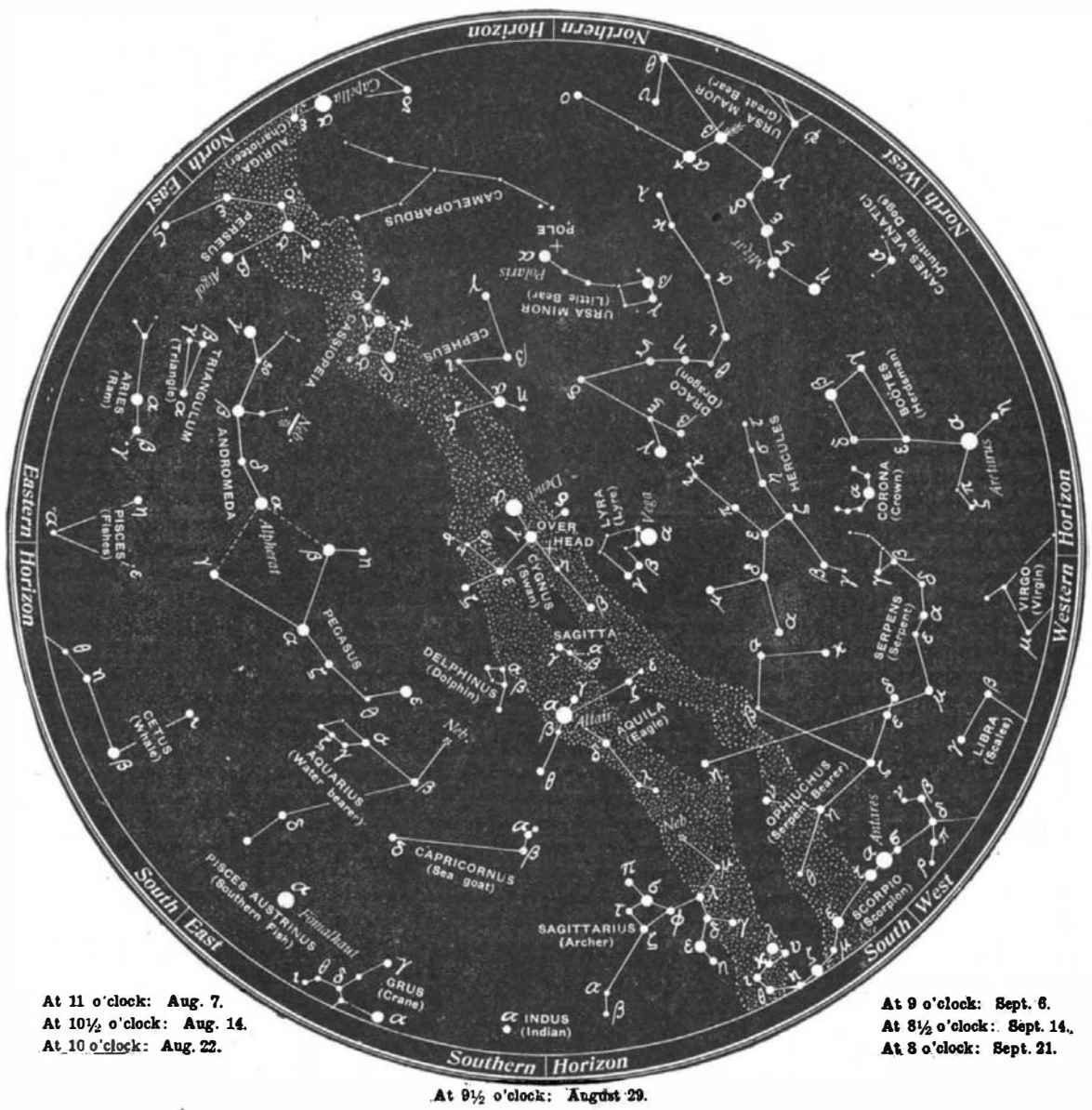
The same difficulty affects photography. The image of Mars, with the same telescope, is only 1/75 as big as the moon's; but the grain of the plate is of the same size. If we try to enlarge the planet's image by auxiliary lenses, we lengthen the exposure time, so that the image is blurred by bad seeing. The remarkable results obtained at the Lowell Observatory were gained by a judicious choice of enlarging power, combined with a very favorable climate and great manipulative skill.

Even if our air was, by a miracle, quite steady, there is a limit to what we can see on Mars. No telescope, however perfect, can make the image of a star a mere luminous point, as geometrically it ought to be. This arises not from the character of the lenses, mirrors, etc., but from the very nature of light. Knowing that light consists of wave-like vibrations, it is possible to show (by methods too technical to be briefly explained) that the image of a star seen through a round opening, like that of a telescope, will not be a sharp point, but a small disk of light, fading away gradually at the edge, and surrounded by much fainter rings of light. Similarly, the image of a straight line is not a similar line, but a streak of definite width, bordered by much fainter streaks. The larger the aperture of the telescope. the smaller will be these spurious images. By stopping down our lens to one-half its size, we make them twice as big, and so on.

Their actual size is very small. With the great Yerkes telescope the spurious disk of a star is about 1/2400 of an inch in diameter. But on the image of Mars at its nearest, this corresponds to nearly 20 miles on the planet's surface.

Nothing much smaller than this can be seen clearly with any existing telescope, even under ideal conditions. A narrower black line would seem blurred out into a gray fuzzy streak—much like a photograph out of focus, as regards appearance, though quite different optically—and a black dot into a faint gray patch.

It is of course one of the first duties of an observer to learn to recognize these spurious images, and distinguish them from real ones, and also to attempt the more difficult task of seizing the moments of good seeing, between the disturbances of the image due to our atmosphere. But the fact remains that we cannot see clearly anything less than 20 miles across upon Mars (or anything much less than 50 miles, except with a very few instruments) and that therefore any visible evidences of life or of intelligent construction on the planet would have to be on an enormous scale.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: August 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

NIGHT SKY: AUGUST AND SEPTEMBER

THE HEAVENS.

Right overhead at our hour of observation is Cygnus, one of the finest of the constellations. Our initial letter shows the figure of the Swan, flying southward along the Milky Way, with the star β marking its head, the line $\zeta\ \varepsilon\ \gamma\ \delta\ \varkappa$ (the last not on the map) its widespread wings, and with α, the brightest of all, in the midst of its body.

Two or three stars in it deserve special attention. α is notable because the most careful measures of its parallax fail to give a sensible result. This star, though apparently one of the brightest in the heavens, is at a literally immeasurable distance. Its real magnitude must be exceedingly great.

β is a fine wide double, yellow and blue, also at a very great distance.

Most interesting of all is the small star 61 Cygni (marked on the map) which is just easily visible to the naked eye. This is the first star whose distance was measured (by Bessel in 1838). Numerous recent measures have determined its parallax and distance with an uncertainty probably less than five per cent. Its distance from us is 10½ light years, or 62 millions of millions of miles. At this distance the sun would look about as bright as the pole star now does to us. 61 Cygni appears to the eye only about 1/10 as bright as this. As it is a double star, neither of the two can be 1/10 as bright as our sun. They are in slow relative motion, which in the last century has shown very little curvature; but it is pretty certain that they are really moving in a vast orbit, whose circuit may occupy a thousand years or more.

West of the zenith, and high up, is the brilliant steel-blue Vega, and in the south is Altair, which is about one-half as bright. Above the latter are the small groups of Delphinus and Lagretta, and below are Capricornus, with its familiar double stars, and Sagittarius. Scorpio is setting in the southwest, and Ophiuchus is above it. Hercules and Corona are below Vega, and Arcturus lower still, almost due west. The Great Bear is low in the northwest, with the Little Bear and Dragon above her.

In the northeast Cepheus is high above the pole, Cassiopeia below, then Perseus, and lastly Auriga, which is just beginning to rise. In the east is the great square of Pegasus, with Andromeda on the left and Aquarius on the right.

The solitary star in the southeast is Fomalhaut. The very bright object a little south of east is Mars, and the fainter one about half way between this and Aries is Saturn.

THE PLANETS.

Mercury is evening star all through the month, and is visible in the first half of it, setting about 7:20 P. M. on the 1st, and 7 P. M. on the 15th. He is at his greatest elongation on the 17th, when he is 26 deg. east of the sun; but being also some 11 deg. south of it, he is not very favorably placed.

Venus is evening star, setting about 8 P. M. on the 1st, and is moving rapidly southward, so that on the 30th, though farther from the sun, she sets at about 7:20.

Mars is in Pisces, and comes to opposition on the 24th. He is visible all night long, and is exceedingly conspicuous. During the month he moves slowly westward among the stars, and at its end he is quite near the "first point of Aries," from which longitudes and right ascensions are measured, being about 4½ deg. south of it.

Jupiter is in conjunction with the sun on the 18th, and practically invisible all through the month.

Saturn is in Pisces, and rises about 7:30 P. M. on the 15th, so that he is observable most of the night.

Uranus is in Sagittarius and crosses the meridian at 7:37 P. M. on the 15th.

Neptune is in the constellation Gemini, and rises a little after midnight.

THE MOON.

Last quarter occurs at 3 P. M. on the 6th, new moon at 10 A. M. on the 14th, first quarter at 1 P. M. on the 22nd, and full moon at 8 A. M. on the 29th. The moon is nearest us on the 1st and again on the 29th, and remotest on the 16th.

On the evening of the 1st she is in conjunction with Mars, and as seen from the eastern United States, passes right over him, hiding him for nearly an hour. This will be a most interesting affair to watch.

As seen from Washington, Mars disappears at the eastern side of the moon at 8:42 P. M., and reappears almost at the opposite point, at 9:39. These times will be earlier for places west of Washington, and later for those east of it, *after allowance is made for the difference between standard and Washington time.*

The moon is also in conjunction with Saturn on the 2nd, Neptune on the 9th, Jupiter on the 14th, Mercury on the 16th, Venus on the 17th, Uranus on the 23rd, Mars again on the 28th, and Saturn on the 30th; but these are of less interest, though the second conjunction with Mars is close, and an occultation is visible in South America.