a bark and was considered a good sailer. Her crew consisted of eighteen seamen of the Swedish navy and three Norwegian walrus hunters. She was provisioned for two years. After passing East Cape, Behring Strait, July 20, 1879, the "Vega," on September 2, arrived at Yokohama and returned to Sweden after circumnavigating the globe.

THE HEAVENS IN AUGUST, 1903.

BY HENRY NORRIS RUSSELL, PH.D.

We are abundantly favored with evening views of the planets at present. Venus and Mars light up the west after sunset, and, as they disappear, Saturn and Jupiter arise to take their places. Uranus is also in sight, but is not conspicuous.

At 9 P. M. on the 15th, Venus has not long set. Mars will soon follow her, but he is still a few degrees above the western horizon. The most conspicuous star in the western sky is Arcturus, which is about half-way down from the zenith.

Far to the southward, beyond Ophiuchus and Serpens, is Scorpio, still well visible just past the meridian, while Sagittarius is farther east.

Following up the Milky Way from these constellations, we first reach Aquila, after a vacant region. Then come Cygnus and Lyra, the latter almost directly overhead.

The great square of Pegasus is the most conspicuous configuration in the eastern sky. To the north of it are Andromeda and Perseus, just rising, and to the south are Aquarius and Capricornus, themselves inconspicuous, but now rendered bright by the presence of Jupiter and Saturn.

Cassiopeia is on the right of the pole, Draco almost above it, and Ursa Major on the left.

Hercules and Corona, which lie between Vega and Arcturus, complete the list of conspicuous constellations now visible.

THE PLANETS.

Mercury is evening star throughout August, but will not be easy to see, as he is too far south of the sun. Even at the end of the month, when he is farthest from the sun, he sets but 40 minutes later. On the 28th he is in conjunction with Venus, but the two planets are far apart—more than six degrees—and too near the sun to be well seen.

Venus is also evening star, and is conspicuous during the earlier part of the month, reaching her greatest brilliancy on the 12th. But as she is now rapidly swinging into line between the earth and the sun, she sets earlier and earlier from night to night, and by the end of the month she will be hard to see. Her apparent motion among the stars is small, and she remains in Virgo, about midway between Spica and Regulus, throughout the month. On the 1st she sets at about 9 o'clock, but on the 31st she disappears before seven.

Viewed with the telescope, she appears as a crescent, which steadily narrows as the month advances, the illuminated portion of her disk varying from one-third on the first to one-tenth on the 31st. In her present position, Venus appears larger with the same magnifying power than any other planet ever does, and it is easy to see the crescent phase with any powerful field-glass, that is, one which magnifies six or eight diameters. Even with an instrument of half this power, the crescent phase can be detected by a trained eye.

Mars is evening star in Virgo and Libra. On the 1st he is not far from Spica, and sets at about 10:10 P. M., but at the end of the month he vanishes an hour later.

On the 29th he passes south of the third-magnitude star Alpha Libræ, at a distance of about 1½ deg. The two objects will afford a pretty field for a low-power glass, as the star in question is a wide double, whose companion is just too faint, and too near its primary, to be seen with the naked eye.

Jupiter is on the borders of Aquarius and Pisces, and is rapidly becoming conspicuous in the evening. At the beginning of August he rises at about 9:15, and a month later at 7:15. He can be instantly recognized by his brightness, which far exceeds that of any of the fixed stars.

Transits of his satellites, interesting to watch with good telescopes, occur before midnight on the evenings of the 7th, 14th, 16th, 23d, and 30th. The 16th is a particularly interesting night, as all four satellites take part in the performance, though not all at the same time.

Saturn is in Capricornus, and is visible all night long, passing the meridian at a little before 11 P. M. on the 15th. Though very far south, he is a fine telescopic object.

Those who have been following his aspect for the last few years will notice a change in the appearance of his rings. Two or three years ago, the elliptical outline of the rings was unbroken by the planet, but now the ellipse has narrowed so much that the ball of the planet projects beyond it on both sides.

This is an effect of perspective, due to the fact that we now see the rings more nearly edgewise than we did in 1900. The rings will appear to narrow with increasing rapidity until 1907, when they will actually present their edges to us, and vanish from view except in the most powerful telescopes. Then they will open out again, but we will see the southern face of the rings, instead of the northern one, as at present. This disappearance of the rings was a great puzzle to the earlier astronomers, and it was a long time before the true explanation of the apparently discordant observations made at different epochs was discovered. But this discovery opened the way for an even more perplexing question. How did the rings get there, and how do they continue to stay there, consistently with the law of gravitation? The subject has occupied the attention of many distinguished mathematicians, and one theory after another had to be abandoned, till at last a fairly satisfactory one was found.

If the rings were solid, calculation shows that if they were not enormously stronger than any known substance, they would be torn to pieces by the enormous forces set up by the attraction of Saturn itself. Moreover, it has been further shown that, even if a sufficiently strong substance could be found, the motion of a solid ring would not be stable. It would resemble the condition of an egg balanced on its small end. So long as the egg is left alone, it will continue to stand in this position; but the slightest jar will cause it to fall over. Similarly, a solid ring of Saturn, if it was started right, might go on indefinitely; but at the slightest disturbance by any outside force, it would deviate more and more from its original position, until it finally came into collision with the other rings or the planet, and destroyed the whole system.

As the attraction of the satellites of Saturn affords just such a disturbing force, it is clear that the permanent existence of the ring proves that it cannot be solid.

It has indeed been shown by Prof. Clerk-Maxwell that the rings might be stable if they were loaded with heavy masses at certain points. But when the rings are seen edgewise, they show a smooth and even line, which grows all the more uniform as the power of the telescope and the steadiness of the air increase. So this theory must also be given up.

After proving that a liquid ring would in like manner break up into pieces, Maxwell showed that a stable system could be found. According to his theory, the rings of Saturn consist of a multitude of small particles, each of which revolves about the planet in a practically circular orbit, almost as if the others were not there. They are so close together that we cannot see them separately, and the whole mass of them is opaque (like an ordinary cloud). He proved that under these circumstances, if the particles were small enough, their motion would be stable. Such a system would behave like an egg lying on its side. A small disturbance only causes it to oscillate about its former position.

Maxwell's theory of the rings has since received several striking confirmations. To begin with, the innermost of the rings (the so-called "crape ring") is transparent, and the planet can be seen through it. This can be explained by supposing that the particles of which it is composed are so far apart that we can see through between them.

Certain peculiarities in the way in which the rings reflect varying amounts of light at different angles of incidence can also be explained satisfactorily on this theory, and on no other.

But the most striking proof of all was first obtained at the Lick Observatory by the late Prof. Keeler, who applied the spectroscope to determine the motion of the rings in the line of sight.

If the ring rotates like a solid body, its outer edge must move faster (more miles per second) than the inner. But on Maxwell's theory the reverse would be the case, as the inner particles, like the inner planets of the solar system, would move faster than the outer ones. Prof. Keeler's photographs show that this is actually the case, and are by themselves sufficient to prove that the ring is made up of innumerable pieces.

How the rings came to be formed is a still more difficult problem. But it is interesting to notice that it has been shown that a satellite of any size, revolving as near the planet as Saturn's rings are, would be torn to bits by the tidal forces due to the planet. It is therefore not unnatural to regard the rings of Saturn as representing one or more satellites spoiled in the making—broken apart by tidal forces (or prevented from ever gathering together) and spread out by the action of these same forces into the thin, flat sheet that we see.

Uranus is evening star in Ophiuchus. His position on the 15th is in right ascension 17h. 24m., declination 23 deg. 29 min. south—about 1½ deg. north and 2 deg. east of the third-magnitude star Theta Ophiuchi. He comes to the meridian a little before 8 P. M. and is just visible to the naked eye.

Neptune is in Gemini, and rises about 2 A. M. on the 15th.

THE MOON.

Full moon occurs at 4 A. M. on the 8th, last quarter at midnight on the 15th, new moon at 3 P. M. on the 22d, and first quarter at the same hour on the 29th. The moon is nearest us on the 21st, and farthest away on the 6th.

She is in conjunction with Uranus on the 3d, Saturn on the 7th, Jupiter on the 11th, Neptune on the 19th, Mercury and Venus on the 24th, Mars on the 27th, and Uranus again on the 30th. None of the visible conjunctions is close.

BORELLY'S COMET.

Photographs of the region of Borelly's comet, 1903, G, were taken at the Harvard College observatory on May 28, 1903, at 19h. 45m. G. M. T., and May 30, at 19h. 52m. G. M. T., about three weeks before its discovery. The positions of the comet at these times were for 1855, R. A. 21h. 49m. 27s., Dec. —19 deg. 6.1m.; and R. A. 21h. 50m. 15s., Dec. —18 deg. 33.2 m., according to the observations of Fayat. Astron. Nach., 162, 291. In both cases, the position of the comet was near the edge of the plate. An object closely resembling the comet was found on the first plate in R. A. 21h. 48m. 43s., Dec. —19 deg. 16.8 min., and of about the magnitude of the stars —19 deg. 6193 and —19 deg. 6198. These stars appeared on the second plate, but no image of the comet was found in the corresponding position. Its computed brightness on these dates should have been about one-sixth of that at the time of discovery. It was therefore probably too faint to appear on these plates, but that cannot be determined with certainty until more accurate elements have been computed. Plates covering the region of the comet were also obtained at Arequipa on May 14 and May 29, and probably on May 4, 1903, but they have not yet been received in Cambridge.

EDWARD C. PICKERING.

WHITE SPOT ON SATURN.

On July 1, after observing Jupiter for some time, I directed my 10-inch reflector to Saturn, and found the details sharply defined. The dusky north polar cap was very distinct, and so was the dark belt on the north side of the equator. The belt was darkest and more strongly outlined on its southern side, probably by contrast with the bright equatorial zone. I soon noticed a large bright spot on the north side of the belt, and in a position nearing the western limb of the planet. It was followed by a diffused dusky marking. The luminous spot must have been on the planet's central meridian at about 14h. 1m., but this is only a rough estimate, as the marking was far past transit when I first saw it. It is to be hoped that this feature will prove fairly durable, in which case it may be expected to furnish an excellent means of redetermining the rotation period of Saturn.

A telegram from Kiel which has been widely published, states that Barnard, of the Yerkes Observatory, saw a white spot in Saturn's N. hemisphere central on June 23, 15h. 47.8m. Williams Bay time. Allowing for the difference of longitude, this would be 21h. 42m. G. M. T. Adding eighteen rotations of Saturn of about 10h. 14m. will bring us to the time when the spot was approximately in transit as observed at Bristol, and there seems no doubt as to the identity of the objects.

This disturbance on Saturn will recall Prof. Asaph Hall's white spot seen in the winter of 1876-7, and followed from December 7 to January 2. A number of transits of this object were observed by Hall, Eastman, Newcomb, Edgecomb, and A. G. Clark, and from the data obtained the former found the rotation period of Saturn to be 10h. 14m. 23.8s. ± 2.30s. mean time.

The spot lengthened out into a bright belt, and soon lost its distinctive character.

Should the present object remain visible, it will be on or near the central meridian of Saturn on July 10, 13h., July 13, 12½h., and July 16, 12h. 10m.—W. F. Denning, in Nature.

The problem of piercing a glacier by means of boring has at last been solved, says the New York Sun, with results of real scientific interest in experiments made last August on a glacier near Vent, in the Tyrol. At a distance of about one and a quarter miles from the tip of the glacier where its breadth is 2,130 feet and the height of its surface above sea level 8,530 feet, a boring in the middle reached rock at a depth of 500 feet. Taken along with measurements of rate of movement, surface melting and temperature the experiment enabled the following conclusions to be drawn: First—the temperature of the ice is at the melting point throughout the whole mass on the tongue of the glacier. Second—the bed of the glacier is trough-shaped. Third—the ice moves more slowly at the bottom than at the surface. The bore holes were filled up with pieces of wood, which will serve for many years to come as indexes of the rate of movement and of surface melting.