### THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

Details concerning the orbit of the eighth satellite of Jupiter, discovered at Greenwich last January, are at last at hand. It is hard to tell which to admire more—the skill of the observers who detected this exceedingly faint speck upon their photographs, and followed its motion for more than four months, or that of the mathematicians who solved the very difficult problems which this motion presented.

Since the discovery of the satellite by Melotte at Greenwich it has been photographed on twelve nights there and also twice at Heidelberg, and three times at the Lick Observatory.

In any ordinary case it would be very easy for an astronomer to determine its orbit from this material; but this is far from an ordinary case.

If Jupiter and the satellite alone came into the problem, it would present no difficulties, for we know that in that case, the latter would move about the planet in an elliptical orbit, fixed in size and position in space, and that its motion in this orbit would take place at a definite rate, depending only on the mass of Jupiter.

It would then be easy enough, by well-known methods, to find from the observations what was the size and shape of this orbit, and the satellite's time of revolution about its primary.

But as a matter of fact, the sun as well as the planet attracts the satellite. If the force which it exerted on the latter were equal in amount and parallel in direction to that which it exerts on Jupiter, it is clear that they would both be influenced by the sun in exactly the same way, and their motion *about one another* would not be changed at all. But since the two bodies are at different distances from the sun, and in different directions, this is not so, and the difference of its attraction on the two tends to alter, or in technical phrase, to "disturb," their relative motion.

When this "disturbing force" is only a small fraction of the attraction of the primary (say one per cent or less) we can take account of its effects by supposing that the elliptical orbit of the satellite shifts about, changing its shape and position, while the satellite itself is set alternately forward or back along this displaced orbit (compared with the position which it would otherwise have accepted). All these changes can be accurately calculated and predicted, though the work involves great mathematical complexity and almost interminable calculations; and this method suffices for the moon and for all previously known satellites. But in the present case the disturbing force is relatively so great that even these methods are not sufficient to handle the problem, and Messrs. Cowell and Crommelin (of the Greenwich staff) have been obliged to invent a new way of attack.

If we know where the satellite was at any time, and how it was then moving, we can calculate the forces acting on it, and then its position at a given time, say a week later. Then, finding what forces act on it in its new position, we can go on for another week, and so, step by step, can extend our calculations as long as we please.

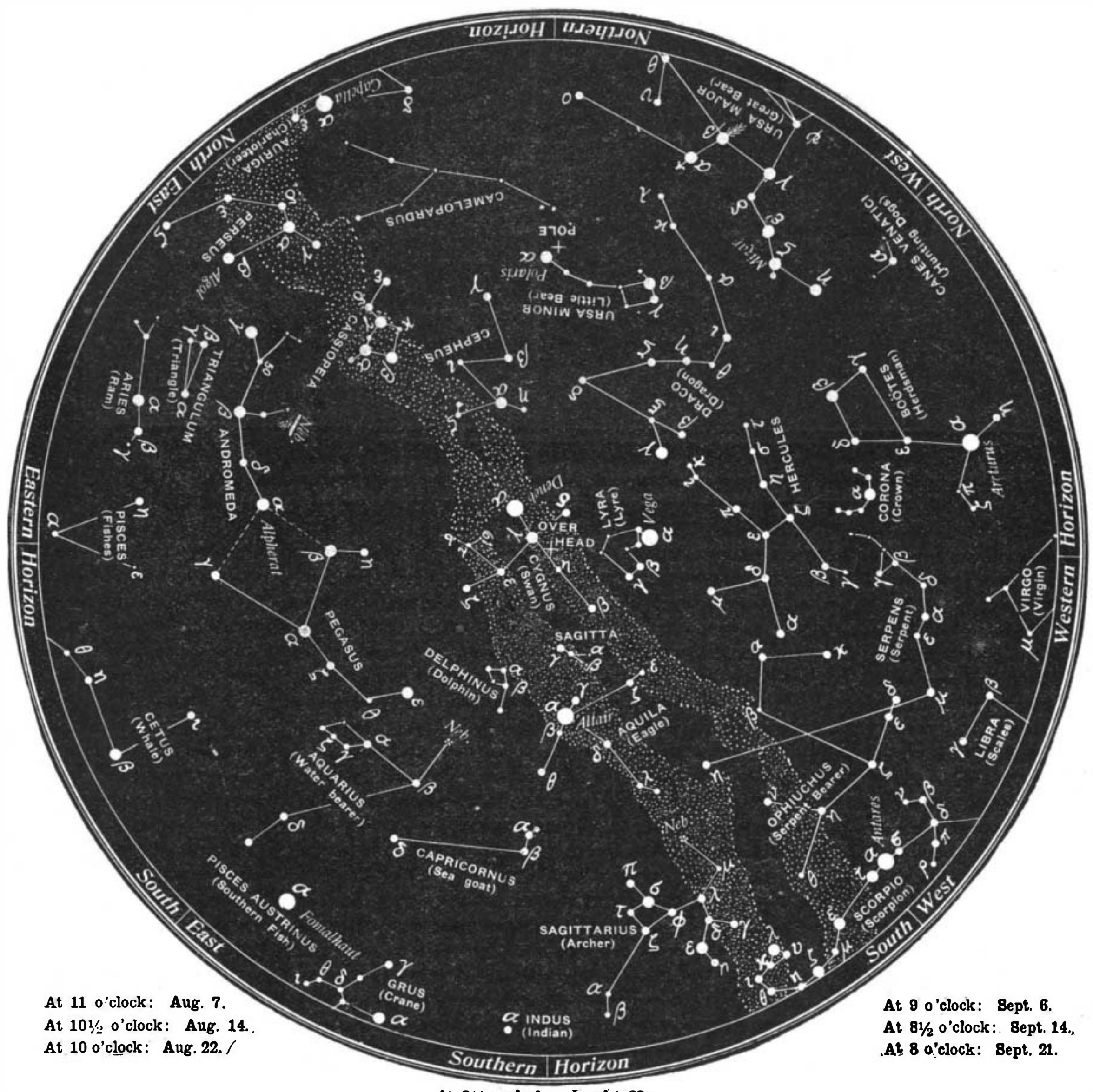
This method is an old one, familiar to astronomers; but the chief difficulty is to start it going, by finding out where the satellite was to begin with, and how fast it was moving.

By very ingenious mathematical devices the English astronomers have solved this problem and calculate a provisional orbit for the satellite, which represents its motion all through the four months of observation, with errors never exceeding 1/500 part of its distance from Jupiter; and they hope to improve their orbit so as to do still better. They find that, as previously suspected, it is revolving about the planet in the opposite direction from all its other satellites. Its distance from the planet was about 19 million miles in January, and 15 million miles at the end of April. If the sun's influence should be suddenly removed, it would continue to revolve about Jupiter in an elliptical orbit, at an average distance of some 16 million miles, with a period of two years and two months; but the solar perturbations may modify this very largely. It will, however, be possible to calculate their effects accurately by these new methods, and so to predict exactly where to look for the satellite when Jupiter becomes observable again next autumn.

THE HEAVENS.

Our map shows what constellations we may find in the evening skies. Right overhead is the great cross of Cygnus, whose arms stretch across the Milky Way. West of it is Lyra, and south is Aquila, with the smaller groups of Delphinus and Sagitta. Sagittarius is a little west of south lower down, and Scorpio is setting in the southwest. Ophiuchus and Serpens occupy the sky above it. Hercules and Corona are almost due west, with Boötes below them. The Great Bear is low in the northwest. Draco and Ursa Minor are above it. In the northwest Capella, the brightest star north of the celestial equator, has just risen.

Perseus is rising due northeast, and Cassiopeia and Cepheus are above him—all three in the Milky Way. The great square of Pegasus is due east. To the left of it extends Andromeda, below which are Aries and Triangulum. The bright object low down, almost due east, is the planet Saturn, and the one in the southeast the star Fomalhaut, in the Southern Fish. The other constellations in this part of the sky—Aquarius, Capricornus, and Cetus—have no bright stars.




At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: August 29.

**NIGHT SKY: AUGUST AND SEPTEMBER**

THE PLANETS.

Mercury is evening star throughout September, but being far south of the sun, is visible only with difficulty. At the end of the month, when conditions are most favorable, he sets only about half an hour after the sun.

Venus is morning star. She is at her greatest elongation west of the sun on the 14th, and is very conspicuous all through September, rising about 2 A. M. She can easily be seen in the daytime by watching her every few minutes during the dawn, when it will be found that she remains visible even after the sun is up. Mars is likewise a morning star, but is too near the sun to be well seen. Jupiter is also a morning star, rising at about 3:30 A. M. at the end of the month.

Saturn comes to opposition on the 30th and is visible all night long. His rings are apparently opening out again, and he presents once more the familiar telescopic appearance.

Uranus is in Sagittarius, and comes to the meridian about 7:20 P. M. on the 13th. Neptune is in Gemini, observable only in the early morning.

THE MOON.

First quarter occurs at 4 P. M. on September 3, full moon at 7 A. M. on the 10th, last quarter at 5 A. M. on the 17th, and new moon at 10 A. M. on the 24th. The moon is nearest us on the 9th, and farthest off on the 22d. As her nearest approach to us almost coincides with full moon, we may expect unusually high tides about that date, for everything cooperates to make them so. She is in conjunction with Uranus on the 5th, Saturn on the 11th, Neptune on the 19th, Venus on the 21st, Jupiter on the 22d, Mars on the 24th, and Mercury on the 27th.

At 6 A. M. on September 23 the sun crosses the celestial equator, and enters the sign of Libra, and in almanac parlance, "Autumn commences."

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### FERMENT OF EGG YOLK.

The yolk of the egg contains a ferment which is capable of converting starch into sugar. This ferment is remarkable for the slowness and the consequent long duration of its action. After placing it in contact with the starch the saccharifying action is hardly commenced after an hour, and it takes a month or more to complete it entirely. In a communication made to the Société de Biologie, M. H. Roger brings out some new facts about the ferment of egg-yolk and shows that it is remarkable from the fact that it is soluble in ether. If egg yolks are exhausted by ether and the resulting extract is evaporated at a low temperature, the residue of the process will convert starch into sugar provided it is well mixed with starch paste so as to form an emulsion. The ether extract should not, however, be heated too strongly as it becomes inactive when heated above 80 deg. C. After treating the egg yolk by ether as above mentioned, there remains a viscous mass, and if this latter is treated by distilled water, the resulting extract has also the saccharifying property, and a part of the ferment still remains in the original mass of yolk after the ether and the water treatment. It might appear that these ferments are not identical, and we might conclude that the egg yolk contains three different ferments, one of which is soluble in ether, the second in water, and a third which is insoluble in these two liquids. The author, however, is inclined to believe that there is but a single ferment, which is intimately united to the different substances which go to make up the yolk of the egg. One part of the ferment is thus united to the fatty matter and like portions which thus form a combination soluble in ether. Another and larger part adheres to albumens and other substances which are removed by water. The last portion is united to the substances which form the insoluble residue.

The Royal Automobile Club's dust trials were recently concluded at Brooklands. The vehicles had to run over a stretch of fine limestone dust 200 feet long and 10 feet wide, at the end of which a heap of dried leaves was placed. One device submitted was for sucking the dust from the wheels and depositing it on the road in granulated form. Owing to some defect in the mechanism the apparatus was not seen at its best in the first run, but some of the later runs showed an improvement. Another device was a perforated sheet steel screen underneath the car body, with forced drafts above the screen. Tests with disk wheels, different shaped tires and bodies and other fixtures were made, and a photograph of each test was officially taken.