

ASTRONOMY

# Full Moon Close; Tides High

## During September Moon's Closest Approach to Earth Comes at Full Phase, With Cumulative Effect on Ocean

By JAMES STOKLEY

**V**ENUS, which shone so brilliantly in the western evening sky during the spring and summer, has disappeared from view, but Saturn has appeared in the east to take its place, and this month still has three planets on the celestial stage. Jupiter and Mars are low in the southwest, close together, setting between two and three hours after the sun. Jupiter can be identified because of its brilliance, Mars is farther east and red in color; though considerably fainter than Jupiter it is brighter than most of the stars in this part of the sky. These two planets are not shown on the accompanying maps, because they have disappeared below the horizon before the time for which the charts are drawn, that is, 10:00 p. m., Sept. 1, 9:00 p. m., Sept. 15, and 8:00 p. m., Sept. 30. The third planet, Saturn, is shown in the constellation of Aquarius, where its brilliant and steady glow makes its readily apparent.

The most conspicuous constellation seen on September evenings shines directly overhead—Cygnus, the swan, sometimes called the northern cross. The swan's tail extends to the northeast, and is marked by the star Deneb, brightest in the constellation. The neck extends in the other direction, and is terminated by Albireo, which represents the beak of the swan. This is also the bottom of the cross. The stars that represent the arms of the cross are also the wings of the bird, outstretched in flight.

### Vega Now Brightest Star

West of Cygnus appears the brightest star seen in the sky these evenings, Vega, in Lyra, the lyre. To the south is Aquila, the eagle, with the brilliant Altair. Close to Altair are two of the smallest constellations in the sky, this month in their best position. Above it is Sagitta, the arrow, horizontal, and flying eastward. Farther east is Delphinus, the dolphin, in which can be seen a diamond-shaped group of stars called, for some unknown reason, "Job's coffin."

Three other first magnitude stars can be seen this month in the evenings, but they are all very low, so near the horizon, in fact, that they will be rivalled in brilliance by fainter stars, more favorably

placed higher in the sky. To the southeast, below Aquarius, the water carrier, is Piscis Austrinus, the southern fish. These two constellations are very closely connected, for the old star maps represent the former as an old, bearded man, carrying a jar from which is flowing a stream of water into the mouth of the fish. In the fish is the star Fomalhaut, about all of the constellation that can be seen easily from most parts of the United States.

### Bootes Follows the Bear

Low in the northwest is Arcturus, in Bootes, the bear-driver. This can be easily located by following the curved line made by the handle of the great dipper, which is low in the sky, farther north. During the early Summer Bootes was high in the sky, but now it is disappearing from view for a time. In the northeast can be seen Capella, in Auriga, the charioteer. This rises higher later in the evening, and during the autumn and winter will become more and more prominent.

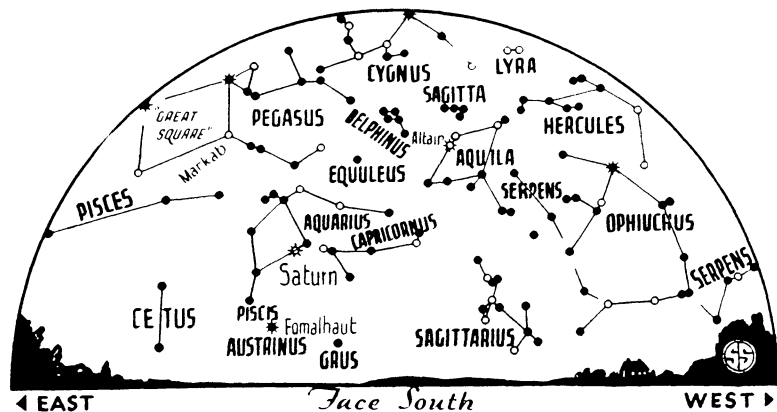
Every 29 days the moon goes through its phases in the familiar manner, appearing full when opposite the sun, for then the entire sunlit half is turned towards us. About a week later, when it is at right angles to the sun, we see but half of the bright hemisphere, or a quarter of the complete moon, and we call this last quarter. Then it is not visible in the evening, for it rises at midnight. After

about another week, it is in almost the same direction as the sun, and as the bright portion is turned completely away from us, it cannot be seen at all, then is the phase of new moon. But a couple of days after new, a narrow sliver of the bright hemisphere is turned towards us, which we see as a narrow crescent low in the west just after sunset, for then it has moved to the east, and sets a little while after the sun. Gradually, more and more of the bright side turns to us, and, about a week after new moon, we again see half of the illuminated side, which we call first quarter. After this it passes through a "gibbous" phase, until it is full again. During September, the moon will be at first quarter on the 5th, full on the 12th, at last quarter on the 19th and new on the 27th.

### Phases and Distance Both Change

At the same time that it is changing its phases, the moon changes its distance, for its orbit, its path around the earth, is not a true circle, but an ellipse. On the average, its distance is 238,857 miles, but it can come as close as 221,463 miles or recede as far as 252,710 miles from the center of the earth. However, the change in distance does not keep step with the phases. When the moon is closest, it is said to be at "perigee," and after it has made a complete trip around the earth, and is back in the same direction among the stars, it is closest again. But it has not returned to the same phase. This depends upon its direction in relation to the sun, and during the period of about 27 1/3 days that it has taken to encircle the earth, our planet itself has been trav-

☼ \* ○ • SYMBOLS FOR STARS IN ORDER OF BRIGHTNESS



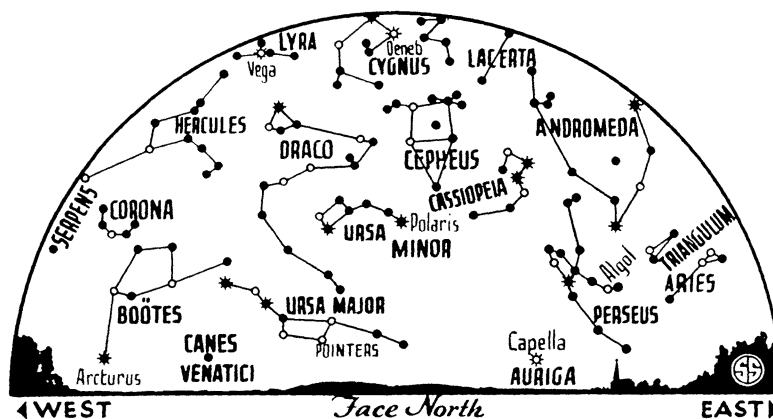
VENUS GONE; SATURN AND MARS REMAIN

eling about a thirteenth of its complete annual journey westwards around the sun. The result is that we see the sun farther east, among the stars in the background, than we did before, and the moon has to travel about two days more before it is as far ahead of the sun as it was before. The moon is full every 29½ days; this is called the synodic month; while the other period, in which the moon actually goes around the earth, is called the sidereal month. This causes the times of perigee and apogee, the point at which it is farthest from earth, to shift around at different times with relation to the phases.

**Closest of Year**

But during September it happens that perigee occurs at 1:06 p. m., Eastern Standard Time, on the 12th, 2 hours 12 minutes before full moon. Even though the moon comes to perigee each month, it is not always the same distance, and it further happens that the one during September is the closest of the year. At that time it will be only 221,750 miles away. In contrast, when it was at perigee in May, it was 229,650 miles from us. Apogee, this month, comes on the 25th, at 11:36 p. m., with 252,750 miles separating us.

All these things have an important bearing on the height of the tides. As is well known, these are caused by the gravitational pull of the sun and of the moon, particularly the latter. Even though it has so much less mass than the sun, it is so much closer that its tide-producing effect is more than twice as great. The force of the gravitational pull between two bodies varies with the square of their distance. The part of the earth nearest the moon, therefore, is attracted more than its center, and there is a tendency to pull the surface up at the point where the moon is overhead. A very slight effect of this kind on the solid ground has been detected, but it is more noticeable in the ocean, where the water can respond more readily, so there is a rather large bulge. Also, the earth itself is pulled more strongly than the water on the side of the earth opposite from the moon, and there is another bulge in that direction. These two bulges follow the moon as the earth turns on its axis, the



**THE BEAR-DRIVER GOES; THE CHARIOTEER COMES**

friction delaying them a little after the place where the moon is highest in the sky. And, of course, the water in these bulges must come from some place, so there is an area of low water half way between them. For a person on the sea-coast, high tide comes when one of the bulges is going past, low tide when the depression reaches him.

The sun's effect is about 5/11 of the moon's, and so it also produces two bulges and two low spots. When the moon is new, or full, the bulges from the attraction of the two bodies, which are then in line, coincide, and we have extra high, high tides and extra low, low tides, which are called the spring tides. At first and last quarter, the solar and lunar

tides tend to cancel each other, the range from high to low each day is much less and then we have the neap tides.

As the moon changes its distance from earth, the tide raising effect is altered. At perigee the tidal range is about a fifth greater than when the moon is most distant. Therefore, when the moon is new or full at the time it is in perigee, the difference between high and low tide is greatest of all. As that happens this month, people who live near the sea or bodies of water connected with it will probably see the highest high tides and the lowest low tides of the year, with the moon almost as close as it can possibly come.

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**ARCHAEOLOGY**

# Honey Given to Dead In Old German Burials

**D**EAD MEN ate honey, in the afterworld of the ancient Central European religion.

That at least is the inference that seems likely, from evidences dug out of ancient burials in Germany, as analyzed under the microscope of Prof. Johannes Grüss of Berlin. (*Forschungen und Fortschritte*, July 10/20). For many years, Prof. Grüss has been building a wide reputation for his painstaking researches in what might be termed "micro-archaeology"—examination under the microscope of such minutiae as starch grains, yeast cells and shreds of fibers found in ancient ruins and tombs.

His newest investigation has to do with the contents of a little pottery vessel found in a log coffin in an ancient Allemannic cemetery by archaeologists of the Stuttgart Museum. Mingled with the

fine-grained clayey debris that filled it were masses of recognizable pollen grains and a quantity of yeast cells. There were also minute bits of flower petals and wheat-grain fragments.

The wheat-grain fragments argued a funeral gift of bread, a not uncommon find with the dead of all lands. The pollen grains and petal debris indicated that honey was at one time present. This was confirmed when Prof. Grüss made a test for sugar, and found a small but quite definitely measurable quantity.

What had become of the honey itself was shown conclusively enough by the remains of the yeast cells. The burial had been in a moist place. The honey had absorbed water enough to dilute it. The yeast, already present, had fermented most of it to alcohol, which in the course of time vanished.

**Phases of the Moon**

First Quarter . . . . .	Sept. 5
Full Moon . . . . .	Sept. 12
Last Quarter . . . . .	Sept. 19
New Moon . . . . .	Sept. 27