THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

Morehouse's comet, for the last two months the most noteworthy object calling for our attention, is by this time so low in the west at sunset that it can no longer be well observed.

We may turn our attention in another direction, and consider some results recently published by Prof. Lowell, concerning the atmospheres of the major planets.

No substance is perfectly transparent; but all known bodies absorb the light which passes through them, to a greater and greater extent as their thickness increases. For most transparent materials, this absorption is general; i. e., it affects light of different colors (or wave lengths) very much in the same way. But some substances show a selective absorption for light of particular wave lengths; that is, they absorb this light strongly, while letting through that of closely neighboring wave length almost undiminished.

All hot gases act in this way; for example, the sun's atmosphere absorbs light of the same wave lengths it emits, producing the familiar Fraunhofer lines of the spectrum. But some cold gases, though emitting no light, show a similar absorption. Among these are oxygen and water vapor, which are responsible for many lines in the solar spectrum as we see it.

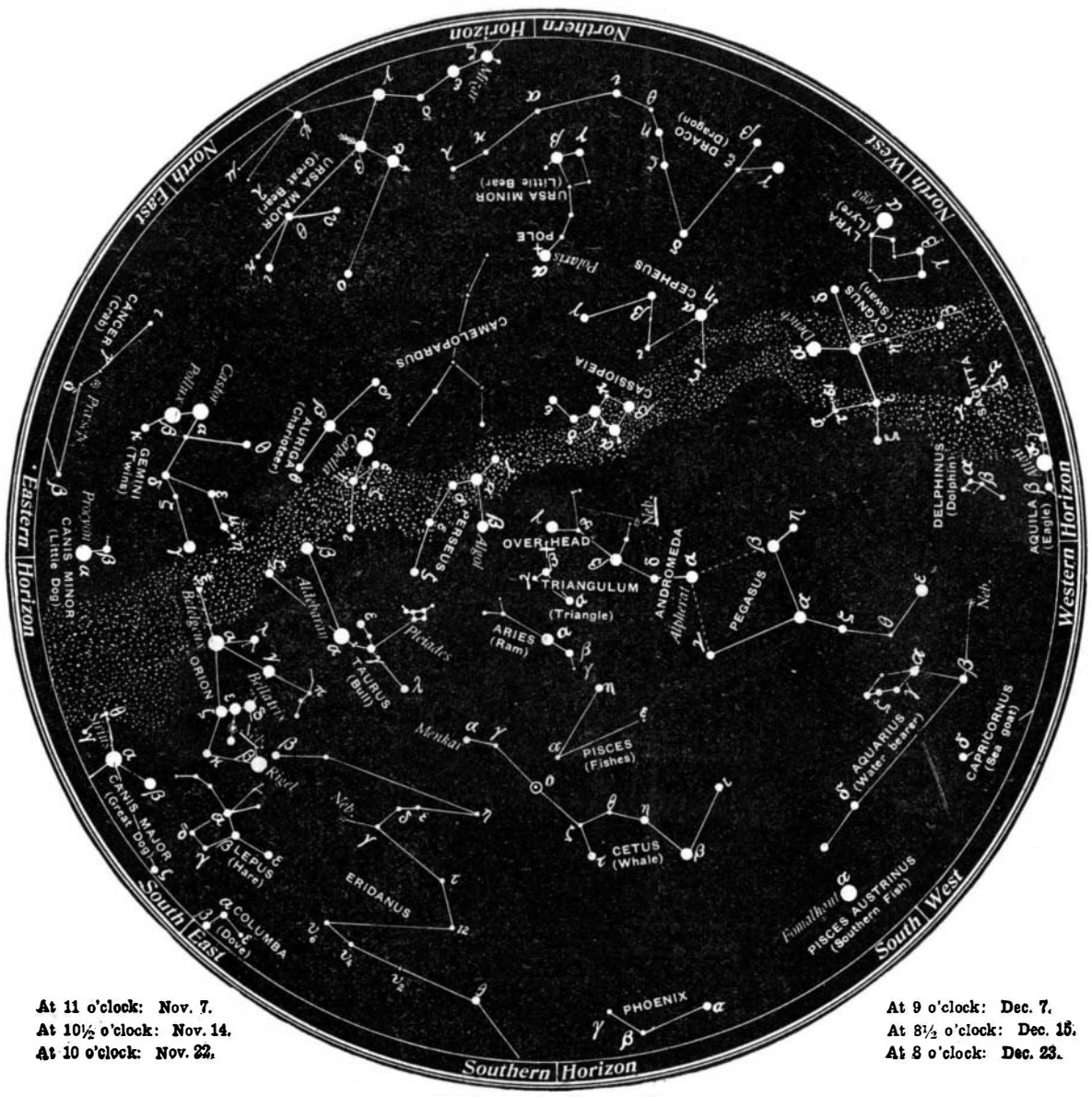
That the absorbing medium is in *our* atmosphere and not in the sun's, is proved by the fact that these lines increase in strength as the sun sinks lower toward setting; that is, as the thickness of air through which we look increases. The water-vapor lines, too, change with the varying humidity of the air.

Almost all the lines in question are at the red end of the spectrum, and for this reason have been very difficult to observe in the spectra of other bodies than the sun; for the extreme red is very faint to the eye, and wholly without effect on ordinary photographic plates.

But the workers at the Lowell Observatory, using the new red-sensitive plates and making long exposures, have succeeded in obtaining photographs of planetary spectra, which in the case of Jupiter and Saturn at least, extend as far into the red as eye observations could possibly go under any circumstances.

The results are of great interest. For all four of the outer planets the lines due to atmospheric oxygen are stronger than for the moon (used for comparison to show the influence of our own atmosphere). We may hence conclude that their atmospheres contain oxygen. Similarly, in the case of Uranus and Neptune, there is reason to believe that hydrogen, and perhaps helium, are present in their atmospheres. But in all four cases, the strongest bands in all the spectrum are those, far out in the red, due to water vapor, which are very much heavier than those produced by one atmosphere alone. So it appears that the vapor of water is a principal constituent of their atmospheres. In our own it is present only in a small percentage; but this would be greatly increased by a moderate rise in temperature, which would increase evaporation from the ocean. If the earth's surface temperature should in any way be raised above 212 deg. F., the oceans would begin to boil, and we would soon have an atmosphere composed mainly of water vapor, which in this case we would call *steam*.

We are thus led to believe that the outer planets are hotter than the earth. This has long been suspected, in the case of Jupiter, on account of the very rapid changes of the cloud-like markings upon his surface; but this new evidence, applying to all four planets, is still stronger. How hot they are, we cannot of course estimate; but it looks very likely that these planets consist of a nucleus hot right up to its surface, veiled in dense, unbroken clouds, floating in an atmosphere largely composed of steam.



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

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9½ o'clock: November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

THE HEAVENS.

Studying our map, we see that the winter constellations are now fairly in sight. Orion is well up in the southeast, with Aldebaran above him, and Sirius flashing and twinkling below.

Due east, and to the left of these constellations, are Auriga (with the great yellow star Capella), Gemini, and lowest down Procyon in Canis Minor.

Perseus, Andromeda, and Aries are almost overhead. Pisces, Cetus, and Eridanus fill a very large and dull region in the southern sky. The bright star low in the southwest is Fomalhaut. The one above it, not shown on the map, is the planet Saturn.

The great square of Pegasus is high up, west of the zenith. Far below, just on the horizon, Altair is setting. Vega is likewise very low, almost due northwest, with Cygnus above.

Cassiopeia and Cepheus are above the Pole, Ursa Minor and Draco below, and Ursa Major lower still, east of north.

THE PLANETS.

Mercury is morning star till the 23d, and afterward evening star, but is too near the sun all through the month to be well seen.

Venus is morning star in Libra and Scorpio, and rises about 4:40 A. M. in the middle of the month.

Mars is likewise morning star, very near Venus at the beginning of December; but as his eastward motion is much slower than hers, she draws away from him, and is about 20 deg. distant at its close.

Jupiter is in quadrature with the sun on the 5th, rises about 11:30 P. M., and crosses the meridian at 6 A. M.

Saturn is also in quadrature, on the 25th, but, being east of the sun instead of west, crosses the meridian at 6 P. M. and is visible all the evening.

Uranus is approaching conjunction with the sun, and is unobservable. Neptune is nearing opposition, and can be observed after 10 P. M. or thereabout.

THE MOON.

Full moon occurs at 5 P. M. on December 7, last quarter at 4 P. M. on the 15th, new moon at 7 A. M. on the 23d, and first quarter at 1 A. M. on the 30th.

The moon is nearest us on the 26th, and farthest away on the 14th. She is in conjunction with Saturn on the 2d, Neptune on the 10th, Jupiter on the 14th, Mars on the 19th, Venus on the 20th, Mercury on the 23d, Uranus on the 24th, and with Saturn again on the 29th.

At 1 A. M. on the 22d the sun reaches its greatest southern declination, and in the language of the almanac "winter commences."

ECLIPSES.

There is an eclipse of the sun this month, and there comes very near being one of the moon.

The former, which takes place on the 23d, is visible only in the southern hemisphere. The track of central eclipse crosses South America, about 30 deg. below the equator, passing a little north of Buenos Ayres. A large partial eclipse will be visible in the morning all through Argentina, Chile, and southern Brazil. The rest of the shadow track is all over the ocean, passing about 1,000 miles south of the Cape of Good Hope, so that a partial eclipse will be visible in South Africa.

At the time of full moon on December 7, the moon just grazes the earth's shadow. If it was a few miles farther north, it would enter the shadow, and there would be a small partial eclipse. As it is, we may be interested, if we watch the moon rise that evening, in knowing that it is as nearly full as the moon can possibly be without getting into the shadow of the earth.

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Electro-acoustic Method of Measuring Distances at Sea.

Debrix has invented an ingenious method of measuring the distance of a vessel which cannot be seen, because of darkness, fog, or intervening objects. The method is based on the difference between the velocities of sound and Hertzian waves.

At the receiving station, which we may suppose to be a lighthouse or semaphore station on the coast, a train of clockwork causes a pointer to move over a divided dial at the rate of one division per second. The clockwork is started by a Hertzian wave, which is sent out by the ship simultaneously with a sound wave, produced by a gun, siren, or whistle. As the propagation of Hertzian waves is practically instantaneous, the pointer may be regarded as starting at the instant at which the sound wave leaves the ship. The observer on shore watches the pointer and notes its position at the moment the sound reaches his ears. The distance of the ship is then obtained by multiplying the number of divisions traversed by the pointer by the velocity of sound (about 1,100 feet per second).

The position of the ship can be determined with greater precision if the Hertzian and auditory signals are received by two shore stations, which can communicate with each other by telegraph. The distance of the ship from each station having been found, the ship's position on the chart will be at the intersection of two circular arcs drawn about the stations, as centers, with radii equal to the two distances. The result might be communicated to the ship by wireless telegraphy.

A still better plan would be for each of the chain of coast stations to emit, at regular intervals, simultaneous Hertzian and auditory signals (the stations being distinguished by peculiarities in the signals, as lighthouses are now differentiated). Then any ship provided with the simple receiving apparatus described above could determine its position at any time and make its way safely to port.—Cosmos.

A motor-operated revolving door has recently been installed in a Boston store, which differs materially from the ordinary type. The door is 10 feet in diameter, and is fitted with six wings, which are so arranged that if they come in contact with any person, they will swing back out of the way. The doors will swing in either direction, so that in case of a panic the crowd can pass out at either side, the doors folding before them. A quarter horse-power motor drives the door at a speed of about six revolutions per minute. After a wing has been swung out of its normal position, it returns under the action of the spring, but its motion is controlled by an air check.