THE HEAVENS IN MARCH.

BY HENRY NORRIS RUSSELL, PH.D.

The very clear evenings which sometimes occur at this season of the year give us our best chance to see what is really the largest, though one of the least known, parts of the solar system—the zodiacal light. Anyone who looks westward on a clear, moonless evening, as soon as it has become really dark, and the twilight has faded from the west, will see that the background of the sky is brighter in some places than in others. By glancing rapidly across from southwest to northwest, he can easily satisfy himself that this brighter region has the shape of a slowly tapering cone, with its base on the western horizon, above the sunken sun, and its apex lost in the Milky Way, beyond the Pleiades. This light is fully as bright, in its lower portions, as the Milky Way itself, but differs from it in character, being quite soft and uniform, while the Milky Way, even to the naked eye, is patchy and full of faint specks of light.

That this light has its origin in our own system, and not among the stars, is fully proved by its characteristics. In the first place, it lies along the plane of the earth's orbit (which nearly coincides with those of the other planets), and this alone would lead us to suspect a solar origin. But the conclusive proof is that it moves with the sun, appearing always in those constellations that lie near the horizon after sunset. Since it lies in the plane of the ecliptic, these constellations are always members of the signs of the zodiac—whence its name.

In the tropics, the zodiacal light is visible at all seasons of the year, after sunset and before sunrise. But in our latitude it is only well visible when its central line rises most steeply from the horizon, and this happens in spring for the evening light, and in autumn for the morning.

In very clear skies, it is possible to see that the cone of light does not run out to a point at all, but extends quite across the sky as a faint, narrow band, which connects the brighter portions visible in the evening and the morning.

A very satisfactory explanation of these facts is given by the hypothesis that the sun is surrounded by a great swarm of meteorites, shaped something like a convex lens, which lies about in the plane of the earth's orbit, and whose thin edge extends somewhat beyond the earth. It is the light reflected by these meteorites that we see.

This accounts for everything. The light grows wider and brighter toward the sun, because there are more meteors there, and we look through a greater thickness of the swarm. The thin edge, projecting beyond the earth's orbit, gives us the faint zodiacal band which connects the brighter portions of the light, and the whole affair must obviously follow the sun in its apparent motion through the heavens. A further confirmation of this theory has recently been provided by Prof. Newcomb, who, observing from a high mountain in Switzerland, has seen the zodiacal light at midnight in the north, and so determined that the widest part of the region of meteorites extends about 30 deg. from the sun.

How big these meteorites are we cannot say. They cannot be large bodies, astronomically speaking, for if they were more than a few miles in diameter, they would be visible separately in our telescopes.

But beyond this we cannot go. It is probable that, like the meteorites which strike the earth from time to time, they are of all sizes, from many tons weight to grains of sand.

THE HEAVENS.

The evening skies in March are very fine. Starting in the west, we see Taurus, still at a good altitude, which, besides Aldebaran and the Pleiades, now contains Jupiter, the brightest object in the sky. To the left of it is the splendid Orion, and farther on, in the southwest, is Canis Major, marked by the superb Sirius, and an irregular cross of bright stars further south. Higher up is the isolated bright star Procyon, in Canis Minor, and above this is Gemini, with the two bright stars Castor and Pollux, from each of which a row of fainter ones extends toward Orion.

North of Gemini, in the Milky Way, is Auriga, with the very bright yellow star Capella. Below this, still in the Milky Way, is the bright group of Perseus, and the zig-zag line of Cassiopeia.

Returning to the south, we see below Sirius, and to the left of it, a part of the great southern constellation Argo. The sky to the east of the meridian is less brilliant. The most prominent group in the east is Leo, marked by the "Sickle"—which cannot be mistaken, even by a novice—and by a triangle of bright stars below. Between Leo and Gemini is Cancer, notable only for the star cluster Praesepe—a fuzzy patch to the naked eye, but a group of small stars to a field glass. Below this is a small but rather conspicuous group which marks the head of Hydra—a huge constellation which extends southeastward to the horizon, but contains only one bright star.

In the east the larger part of Virgo has risen. North of this is Boötes, with the bright red star Arcturus. Ursa Major is admirably displayed high in the northern sky. The Bear's head and fore-paws have almost reached the meridian, while the end of her tail is still on a level with the Pole star. Ursa Minor and Draco, which lie below, complete the list of the conspicuous constellations.

THE PLANETS.

Mercury is evening star in Pisces. On the 18th he is farthest from the sun, and about this date he can be best seen. This is an unusually favorable occasion for seeing him, as he is north of the sun, very bright, and does not set till about 7:30 P. M. Toward the end of the month he gets too near the sun to be well seen. On the 27th he is in conjunction with Venus, but both planets are too near the sun to be well seen.

Venus is also nominally an evening star, but she is so near the sun that, except at the end of the month, she is practically invisible.

Mars is evening star in Pisces and Aries, setting at about 8:30 P. M. in the middle of the month. Jupiter is likewise an evening star, being in Taurus, between the Pleiades and Aldebaran, and remaining in view till near midnight.

Saturn is morning star, but is too near the sun to be well seen. Uranus is in Sagittarius, and rises about 2 A. M. on the 15th. On the 29th he is in quadrature with the sun, and comes to the meridian at 6 A. M. Neptune is in Gemini. He is also in quadrature, on the 28th, and comes to the meridian at 6 P. M.

THE MOON.

First quarter occurs at 4:20 A. M. on the 3d, full moon at 3:09 P. M. on the 10th, last quarter at 6:49 A. M. on the 17th, and new moon at 6:44 P. M. on the 24th. The moon is nearest us on the 12th, and farthest away on the 28th. She is in conjunction with Jupiter on the 2d, Neptune on the 5th, Uranus on the 18th, Saturn on the 22d, Mercury and Venus on the 25th, Mars on the 27th, and Jupiter again on the 29th.

On the evening of March 2 the moon passes between us and the bright star Aldebaran, occulting it for about an hour. As seen from Washington, the star disappears behind the moon's dark limb at 10:30 P. M., and reappears at the other side of the moon at 11:30. The times will be different at other places of observation, but not greatly so for places in the Eastern States.

At 8 A. M. on the morning of March 21, the sun crosses the celestial equator, and enters the sign of Aries, and, in the phrase of the almanacs, "spring commences."

Princeton, February 19, 1906.

SIXTY MILES AN HOUR ON THE WATER.

BY ERNEST ARCHDEACON.

Builders of motor boats have realized for a long time the tremendous difficulties met with when they attempt to increase the speed of their craft even slightly, in view of the fact that the resistance of the water and, consequently, the power necessary to propel the boat increases with the usual type of hull as the cube of the speed.

During the last few years it has become possible to attain an increased speed with a motor of a given power by so shaping the hulls that their speed of translation tends to lift them partly out of the water, so that when the speed increases the resistance of the water increases much less than heretofore on account of this lifting of the hull, which, according to some constructors, reaches about thirty-three per cent of the total displacement of the boat. This is quite the *dernier cri* of motor-boat construction.

Over two years ago one of my countrymen, M. le Comte de Lambert, succeeded in constructing a boat which, in place of causing the emersion of about one-third of its hull from the water, succeeded in bringing the entire hull upon the surface. At this moment the resistance to the boat's advance became sensibly null. This boat is not a Utopia; it was built and operated over two years ago. The principles which its constructor followed were discovered a number of years ago by a Swiss scientist, M. Raoul Pictet, who carried on dynamometric experiments of the highest interest. These experiments were carried out on Lake Geneva with hulls of boats furnished with inclined planes; and they demonstrated accurately the phenomena of gliding and also the invariability of the effort of traction, at all speeds, as soon as the gliding was obtained.

Let us now return to the De Lambert hydroplane boat. (This boat was illustrated in the SCIENTIFIC AMERICAN of October 7, 1905.) The boat is constructed in a very rudimentary fashion. It is, according to its builder, too heavy and full of defects, as is generally the case with a first experimental apparatus. Nevertheless, with a 13-horse-power motor, it attained a speed of 35 kilometers (21¾ miles) an hour—a speed which was several times taken by official chronometers. It was two years ago that this boat was experimented with without any mishap or serious drawback; and the results of the experiments were given to the world.

It is hard to believe that in view of these results motor-boat builders have done nothing as yet toward the construction of a boat built on these principles—a boat which seemed destined to create a revolution in the line of speed craft.

On the contrary, however, they have been too much preoccupied with increasing indefinitely the number of horse-power possible to place in their hulls. We have actually reached the point of placing 300 horse-power in a walnut hull in order to attain a speed of 31 miles an hour at the most. We are now awaiting the 500 horse-power motor-boat engine.

How blind these builders are not to see that with 20 horse-power and a hydroplane they will attain the same speed as is possible with 100 horse-power in the regular hull; and that with 300 horse-power—I do not dare to predict the speed!

To continue the discussion in a simple manner I will say that a well-constructed hydroplane can be made to attain sensibly the same efficiency as an automobile. But, in the actual state of the science, a 100-horse-power automobile will travel 90 miles an hour! Notwithstanding the lack of energy of boatbuilders in adopting a new idea, I am willing to bet, and I am ready to stick to it, that before September 1, 1907, 55 miles an hour will be made on the water. And I am surely below the truth.

The theory of the hydroplane, which is, moreover, identical with that of the aeroplane, is the following:

Any inclined plane moving in a fluid, air or water, and which has a horizontal movement of translation, undergoes an ascending or descending reaction according as the inclination of the plane is ascendent or descendent with respect to the direction of travel.

But, the hydroplane is nothing more than a boat to which has been added a suitable series of inclined planes. Before starting, the water which the apparatus draws, as well as its displacement, will be maximum. As soon as it is under way it will commence its movement of ascension, which will only cease when it attains such a position that the draft of water becomes zero, and the displacement also.

With Count de Lambert's boat, the inventor estimates that as soon as the speed reaches 15 kilometers (9.31 miles) an hour, the emersion is already complete. Moreover, he states that as soon as this emersion is obtained, the effort of traction no longer varies whatever may be the speed. From this we reach the conclusion that the force necessary for the propulsion of an emerged hydroplane increases exactly as the speed. At very high speeds this theorem will no longer be quite exact, since the resistance of the air will not then be negligible; but with speeds up to 20 miles an hour we are altogether free to neglect this.

Let us now calculate from these figures what power Count de Lambert's hydroplane requires in order to emerge completely. We have, evidently,

$$\frac{x \text{ (power sought for)}}{13 \text{ horse-power (total power of motor)}} = \frac{15\ k}{35\ k}$$

whence

$$x = \frac{13 \times 15}{35} = 5.5 \text{ h. p.}$$

Therefore, the boat used 5½ horse-power in order to rise from the water at a speed of 9.3 miles an hour, after which the increase of speed obtained was exactly proportionate to the increase in horse-power, i. e., in the proportion of 5.5 horse-power to 13.

It will be easy to construct a boat not weighing as much as that of Count de Lambert's (which weighed 800 kilogrammes, or 1,763 pounds), when fitted with a motor of 50 horse-power. Making the calculation in the manner as above, we have

$$\frac{5.5}{50} = \frac{15}{x}$$

$$\text{whence } x = \frac{15 \times 50}{5.5} = 136 \text{ kilometers (84.45 miles)}$$

an hour.

I should add immediately that at these speeds the resistance of the air becomes quite important, and, as the calculation no longer holds exactly, the figure given above must be diminished considerably, although it would still remain quite high.

I believe that I have shown in a satisfactory manner the immense interest to be had in building and experimenting with well-constructed hydroplanes, and I repeat that I do not understand the apathy of the boat builders.

I know that the criticism will be made that the hydroplane will not work in turbulent water since the planes would strike the waves and not glide over them. This opinion is not altogether true, as I have found from my own experiments with the hydroplane that it is not stopped by the waves any more than is an ordinary boat.—Translated for the SCIENTIFIC AMERICAN from La Vie Automobile.

Casein Cement for Porcelain.—Mix 10 parts of recently prepared casein with 30 parts of soluble silicate of soda and 20 parts of similar silicate of potash.—Nouvelles Scientifiques.