THE DEATH OF PROF. R. H. THURSTON.

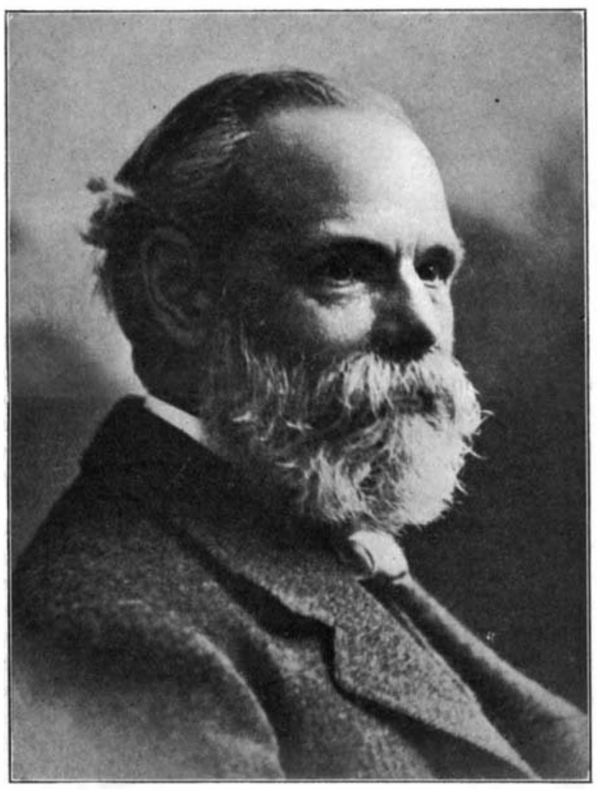
Prof. Robert H. Thurston died suddenly on October 25, at the age of sixty-four. Cornell University has lost one of the most distinguished members of its faculty, and the country one of its foremost mechanical engineers.

Even in early childhood he exhibited those tastes for applied sciences which later he developed to so remarkable a degree. He may be said to have been born an engineer. His father was a steam-engine builder of some note; and from him Dr. Thurston received his early training in steam engineering. He graduated from Brown University in 1859 with the degree of Bachelor of Philosophy. When the war broke out in 1861, he joined the Engineer Corps of the United States Navy, and served with distinction throughout the entire conflict. From 1866 to 1871 he occupied the chair of Natural Philosophy at the United States Naval Academy. Subsequently he became Professor of Engineering at Stevens Institute, where he remained until he received a call to Cornell in 1885.

Sibley College of Cornell University, as we know it to-day, is peculiarly the work of Dr. Thurston. In 1886 the number of its graduates was but eight; in 1903 it was about one hundred and twenty. For a foundation and main cornerstone he found the admirable work which had been done up to that time, chiefly under the direction of Prof. J. L. Morris. There remained, however, the superstructure of professional and graduate courses in the main lines of mechanical engineering and in its important specially differentiated branches. To the great work of planning and constantly elevating and improving these curricula he devoted his best thought and effort for the last 18 years, the period of his life richest and best in mature thought and judgment, and without abatement in vigor and freshness of mind. In a real sense, the college may be regarded as a monument to the organizing skill of Dr. Thurston, and a realization of his high ideals of engineering training. He found Sibley College in difficulties of various sorts; he left it one of the foremost engineering schools in the country.

Readers of this journal will remember him as a writer whose limpid style lent a peculiar charm to his papers. He had a happy faculty of expressing himself with a lucidity that is only too rarely found in present-day technical writing. Of the twenty volumes which he wrote, the more important are his "Manual of the Steam Engine," "Manual of Steam Boilers," "Engine and Boiler Trials," "History of the Steam Engine," and "Materials of Engineering." His published professional and scientific papers number nearly three hundred. As an inventor Dr. Thurston was known for his magnesium burning lamps, army and navy signal apparatus, various forms of testing machines for iron and other metals, some improvements on the steam engine, and various scientific and engineering apparatus. In scientific research his most noteworthy work was done in investigating the commercial economy of the steam engine, and in determining the useful qualities of various alloys.

The Editors of the Scientific American recall him as a friend whose sympathetic and kindly personality and whose vast fund of technical knowledge made him a more than welcome visitor.



THE LATE PROF. R. H. THURSTON.

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

It is obvious that, when a planet has well-defined permanent markings on its surface, its period of rotation can best be determined by observation of these. But Mars and the Moon are the only bodies in the solar system which have easily-visible markings of this sort. It is for this reason that they are the only bodies in our system (besides the Earth itself) whose periods of rotation are known to a high degree of precision.

Jupiter and the Sun show conspicuous markings, but they are not permanent—though the "great red spot" on Jupiter has lasted a good many years. Different spots, however, both on Jupiter and on the Sun, are found to have different periods of rotation. In fact, the sunspots show a steady increase in their period as we go from the solar equator toward the poles, while each of the principal "belts" of Jupiter has its own peculiar time of rotation, the equatorial belt moving most swiftly. In these cases we cannot be sure which of the markings that we see, if any, represent the true rotation period of the main mass of the interior.

The other planets are much more untractable. Mercury, to be sure, has shown to the keen eye of Schiaparelli a few faint but permanent markings, which seem to show conclusively that he keeps always the same face to the Sun, and consequently rotates once in 88 days. But Venus, Uranus, and Neptune show no markings at all, and Saturn rarely has any that can be used to determine his rotation. On rare occasions, however, a mark appears.

The first notable instance of the sort was in December, 1876, when Prof. Asaph Hall observed a bright spot near Saturn's equator. It was found to have the rotation period of 10h. 14m.

A conspicuous white spot appeared on the planet this year, in the "north temperate zone," to use a term of ordinary geography.

It was discovered by Prof. Barnard at the Yerkes Observatory on June 15, and has since been followed by many observers. It is oval in form, some fifteen or twenty thousand miles long by about two-thirds as broad, and has gradually been fading away. Its period of rotation is about 10h. 38m.

The difference between the rotation period of this spot and that of the one seen by Prof. Hall is rather surprising. Both were too well observed to admit any doubt as to the facts, and it seems clear that on the surface of Saturn, as well as of Jupiter, there must be currents of matter moving with different velocities. But as the diameter of Saturn is over 70,000 miles, a simple calculation shows that the two spots, if they both existed at once, would move past one another on the planet's surface at the rate of 1,600 miles an hour. How the currents on the planet's surface can have such great speed is rather puzzling. No satisfactory explanation has yet been offered, at least so far as the writer is aware. But what shall we do in the case of the remaining planets, which show no markings at all? How can we get any idea how rapid their rotation is?

One answer is afforded us by the spectroscope, by taking advantage of the well-known principle that the lines in the spectrum of a body which is approaching us are shifted toward the violet, while if it is receding, the lines are displaced toward the red. (Though the planets do not shine by their own light, the same principle applies to the light which they reflect.)

Now suppose that we take a photograph of a planet's spectrum, arranging the slit of our instrument parallel to the planet's equator. Then, if the planet is in rotation, the light at one end of the slit will come from one edge of the planet, say the one that is moving toward us, while the other end of the slit will get light from a part of the surface that is receding from us. It follows that the lines in the photographed spectrum will be shifted toward the violet at one end and toward the red at the other; in other words, they will cross the band of spectrum obliquely instead of at right angles. Other things being equal, the amount of tilt of the lines is proportional to the speed of the planet's rotation.

By this method the rotation period of Saturn could be obtained at any time independent of the infrequent markings on his disk, and, in fact, its first use was to investigate the rotation of Saturn's rings, as has already been told in these columns.

Recently the same thing has been done for Venus. Some results published a couple of years ago by Dr. Bilopolsky, of Pulkowa, seemed to indicate that Venus rotated in about a day. But this summer there has appeared an account of a long and very careful series of observations made at the Lowell Observatory, in Arizona, with a very powerful instrument, which show no sensible evidence of any rotation, and demand for their explanation a period of rotation at least some weeks in length. So the evidence is at present in favor of a long rotation period for Venus. The theory that she always turns the same face toward the Sun, and so rotates once in 225 days, seems as likely as any.

In the cases of Uranus and Neptune, it is difficult, if not impossible, to apply the spectroscopic method, on account of the faintness of their light. Besides this, Uranus is at present in a position where his pole is turned almost directly toward us, so that, if there were any markings on his surface, we would see them simply turn round and round like a wheel, scarcely approaching us or receding from us at all. The spectroscopic method therefore fails. However, there is still another method that can be used, depending upon the mathematical theory of the motion of their satellites.

If a planet is perfectly spherical, the point in the orbit of any satellite where it comes nearest to the planet will remain fixed, but if the planet is flattened at the poles, this point of nearest approach will move slowly round the orbit, at a rate depending upon the amount of flattening of the planet. Now the amount by which the planet is flattened at the poles depends on its rate of rotation. As the elevation between the two involves also the distribution of density in the interior of the planet, we cannot derive an exact value of the rotation period from the flattening; but we can get a pretty good idea of its magnitude.

In a recent paper, Prof. Bergstrand, of Upsala, has made a study of the orbit of one of the inner satellites of Uranus. He finds that the point where the satellite comes nearest the planet is actually in motion, and comes to the conclusion that it is probable that Uranus is flattened at the poles by about 1-17 (more or less) of his whole diameter, from which it would follow that the planet's rotation period is about twelve hours.

A similar investigation of the satellite of Neptune, made some three years ago by Prof. Brown, of the Naval Observatory in Washington, led to the conclusion that Neptune is also perceptibly flattened at the poles, and that its period of rotation is some fifteen hours, more or less.

THE HEAVENS.

The brilliant constellations of winter are now returning to our skies. At our usual hour—9 o'clock on the 15th—Orion, the finest of them all, has just risen in the east. Gemini is north of him, and also low down. Taurus and Auriga are above these two. Perseus and Cassiopeia lie in the Milky Way above Auriga, and Andromeda and Pegasus extend toward and beyond the zenith. Cygnus, Aquila, and Lyra brighten the western sky.

The southern constellations are dull—Eridanus in the southeast, Cetus due south, and Aquarius and Capricornus west of it; but the bright star Fomalhaut, and the still brighter planets Jupiter and Saturn, diversify the southwestern sky.

The Great Bear and Draco are below the pole, and not very conspicuous.

THE PLANETS.

Mercury is morning star until the 21st, when he passes through superior conjunction—almost literally behind the sun—and becomes an evening star. He is visible for the first few mornings of the month, rising more than an hour before the sun, but he does not remain in sight for more than about a week.

Venus is morning star in Leo and Virgo, and is exceedingly conspicuous. On the 28th she reaches her greatest elongation west of the Sun, 46¾ degrees. All through the month she rises before 4 o'clock. On the morning of the 15th she is in conjunction with the Moon. At 10 o'clock she will be almost above the Moon, at a distance of about two degrees—four times the Moon's diameter. This is a very good time to look for her by daylight.

Mars is still an evening star, but, being very far south in Sagittarius, he is far from prominent. He sets at about 7:30 P. M. in the middle of the month.

Jupiter is conspicuous in the early evening. He is in Aquarius, and comes to the meridian at about 7:30 on the 15th. Those who have telescopes of any size can see an interesting sight on the evening of the 24th, when his first and fourth satellites are eclipsed or occulted behind the planet, and the third satellite transits in front of it.

Saturn is evening star in Capricornus. He sets at about 11 P. M. on the 1st, and 9 P. M. on the 30th. Uranus is in Ophiuchus, too near the Sun to be seen. Neptune is in Gemini, and comes to the meridian at 3 o'clock in the morning on the 15th, too late for convenient observation by amateurs.

THE MOON.

Full moon occurs at midnight on the 4th, last quarter at 10 P. M. on the 11th, new moon at midnight on the 18th, and first quarter at 1 A. M. on the 27th.

The Moon is nearest the Earth on the 10th, and farthest away on the 25th. She is in conjunction with Neptune on the 8th, Venus on the 15th, Mercury on the 18th, Uranus on the 21st, Mars on the 22d, Saturn on the 24th, and Jupiter on the 27th. None of these conjunctions is remarkably close.

About 11 o'clock in the evening on November 6 the Moon passes close to the bright star Aldebaran. As seen from the northern part of the United States, she will actually occult the star for a short time, but observers in the south will see her pass clear of it.

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