## LAW OF PLANETARY ROTATION,

### DISCOVERED BY PROFESSOR ORSON PRATT.

TO THE EDITOR OF THE DESERET NEWS:—

Dear Sir:—Permit me to announce to the world, through your valuable paper, an astronomical discovery, made by me on the eleventh day of November, 1854. I allude to a law governing planetary rotation. Telescopic observation reveals to us the fact that many of the bodies of the solar system, not only have a progressive velocity in their orbits, but a rotative motion upon their axes. Heretofore, the only means known to astronomers, by which to determine the exact period of a planet's rotation, has been a careful observation of the movements of spots upon its surface. For instance, spots are discerned on the eastern limb of a planet's disc, which, instead of remaining stationary, gradually move across the disc in a westerly direction, disappear for a few hours at the western limb, and again re-appear in their former position on the eastern limb. These spots are believed to be portions of the surface of a planet darker than the adjacent parts, and carried around by a rotation of the planet on its own axis from west to east.

By such observation, the period of the rotation of the planet Mars has been determined to be 24h. 37m. 23s. mean solar time; Jupiter's period, 9h. 54m. 12s.; and Saturn's period, 10h. 29m. 17s. Mercury and Venus are situated so near the sun that it is extremely difficult to distinctly discern spots upon their surfaces. It is believed, however, by some astronomers that their observations are sufficiently exact to assign to Mercury a rotative period of about 24h. 5m., and to Venus a period of 23h. 21m. 21s. It is still maintained by some eminent observers that there is a small degree of uncertainty remaining as to the rotative periods of Mercury and Venus. Uranus is supposed by some observers to rotate on its axis in 9h. 30m.; but this planet is so far distant from us that it is generally believed that the present powers of the telescope are incapable of revealing any spots upon its surface sufficiently distinct to determine whether it has a rotation or not. Whether the asteroids and the planet Neptune rotate, the astronomical instruments of the present day are utterly inadequate to determine.

Do all the planets of the solar system rotate? Observation has, as yet, been entirely unable to answer this question. It is supposed from analogy that rotation is as extended in its operations as the progressive motions of planets in their orbits—that every planet turns upon its axis, producing the agreeable alternations of light and darkness, day and night. But how to demonstrate this analogical supposition—how to ascertain the periods of rotation of such planets as are beyond the reach of observation, has been a problem unsolved by the astronomical world.

Many eminent and distinguished astronomers have eagerly sought after some law, connecting the rotative periods of the planets with some known data of the solar system, such as their distances from the sun—their orbitual velocities—their masses, &c.; but all their laborious researches to develope such law have not been crowned with success—the law of planetary rotation has eluded their grasp.

Firmly believing, from my early youth, that the diurnal periods of the planets were the results of some hidden law, I have endeavored, at different times, to discover the same, so as to determine the periods of rotation by calculation instead of observation. After many fruitless researches in regard to the original causes of planetary motion, I was led by the indications of certain hypotheses to seek for the law of rotation connected with the masses and diameters of the planets, or, in other words, with their densities. These investigations resulted in the development of the following beautiful law:—

THE CUBE ROOTS OF THE DENSITIES OF THE PLANETS ARE AS THE SQUARE ROOTS OF THEIR PERIODS OF ROTATION;

Or, which amounts to the same thing—THE SQUARES OF THE CUBE ROOTS OF THE DENSITIES OF THE PLANETS ARE AS THEIR PERIODS OF ROTATION.

But as the densities of globes are proportional to their masses or quantities of matter, divided by their volumes or by the cubes of their diameters, it follows that the rotation of the planets, considered as spheres, is proportional to their masses and diameters. The law, therefore, may be expressed in terms of the masses and diameters, as follows:—

THE SQUARES OF THE CUBE ROOTS OF THE MASSES OF THE PLANETS DIVIDED BY THE SQUARES OF THEIR DIAMETERS ARE AS THEIR PERIODS OF ROTATION.

To illustrate the correctness of this law, I will give the following examples:—

Example 1. Given the mass of the earth equal to 1; its equatorial diameter, 7925.5 miles; its period of rotation, 23h. 56m. 4.090475s. mean solar time, which is equal to one absolute sidereal day: also the mass of the planet Mercury equal to 0.0627694; and its diameter 3140 miles; it is required to find the period of Mercury's rotation.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(0.0627694)^{\frac{2}{3}}}{(3140)^{\frac{2}{3}}} :: 23h.\ 56m.\ 4.090475s. : 24h.\ 5m.$$

Example 2. Given the mass of Venus equal to 0.9043346; its diameter 7809 miles; and the mass, diameter, and rotative period of the earth, as in the first example. Required the period of the rotation of Venus.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(0.9043346)^{\frac{2}{3}}}{(7800)^{\frac{2}{3}}} :: 23h.56m.4.090475s. : 23h.21m.21s.$$

Example 3. Given the mass of Mars equal to 0.145337; its diameter, 4108.26 miles; and the mass, diameter, and rotation of the earth, as in the first example. Required the period of the rotation of Mars.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(0.145337)^{\frac{2}{3}}}{(4108.26)^{\frac{2}{3}}} :: 23h.56m.4.090475s. : 24h.37m.23s.$$

Example 4. Given the mass of Jupiter equal to 371.7547; its diameter, 88592.7 miles; those of the earth as in the former examples. Required the period of the rotation of Jupiter.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(371.7547)^{\frac{2}{3}}}{(88592.7)^{\frac{2}{3}}} :: 23h.56m.4.090475s. : 9h.54m.12s.$$

Example 5. Given the mass of Saturn and its rings equal to 289.0281; its diameter, 79160 miles; those of the earth as in the former examples. Required the period of the rotation of Saturn.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(289.0281)^{\frac{2}{3}}}{(79160)^{\frac{2}{3}}} :: 23h.56m.4.090475s. : 10h.29m.17s.$$

Example 6. Given the mass of Uranus equal to 20.625488; its diameter, 34500 miles; those of the earth as in the former examples. Required the period of the rotation of Uranus.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(20.625488)^{\frac{2}{3}}}{(34500)^{\frac{2}{3}}} :: 23h.\ 56m.\ 4.090475s. : 9h.\ 30m.$$

Example 7. Given the mass of Neptune equal to 26.87671; its diameter, 41500 miles; those of the earth as in the former examples. Required the period of the rotation of Neptune.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(26.87671)^{\frac{2}{3}}}{(41500)^{\frac{2}{3}}} :: 23h.56m.4.090475s. : 7h.\ 49m.57s.$$

Example 8. Given the mass of Neptune equal to 26.87671; its diameter, 37500 miles; those of the earth remaining as in the former examples. Required the period of the rotation of Neptune.

$$\frac{(1)^{\frac{2}{3}}}{(7925.5)^{\frac{2}{3}}} : \frac{(26.87671)^{\frac{2}{3}}}{(37500)^{\frac{2}{3}}} :: 23h.56m.\ 4.090475s. : 9h.35m.32s.$$

If in any of these examples the mass be divided by the cube of the diameter, the quotient will be the density of the planet. And if the density of the earth be taken as unity or 1, the densities of the other planets, deduced from the data given in the foregoing examples, will be as in the second column of the following table:—

| Name of Planet. | Densities (the earth's being 1. | Masses (the earth's being 1.) | Diameters in miles. | Diameters (the earth's being 1.) | Periods of rotation in absolute sidereal days (the earth's being 1.) |
|---|---|---|---|---|---|
| Mercury | 1.00934 | 0.0627694 | 3140 | 0.3961895 | 1.00622 |
| Venus | 0.96395629 | 0.9043346 | 7800 | 0.984165 | 0.975824 |
| Earth | 1.000000 | 1.0000000 | 7925.5 | 1.000000 | 1.000000 |
| Mars | 1.04346 | 0.145337 | 4108.26 | 0.51836 | 1.02877 |
| Jupiter | 0.26616 | 371.7547 | 88592.7 | 11.17818 | 0.41377 |
| Saturn & rings | 0.29007 | 289.0281 | 79160 | 9.988013 | 0.43820 |
| Uranus | 0.25005 | 20.625488 | 34500 | 4.353038 | 0.39692 |
| Neptune | 0.1872026 | 26.87671 | 41500 | 5.2362627 | 0.327246 |
| Neptune | 0.253715 | 26.87671 | 37500 | 4.7315627 | 0.400771 |

If in the examples, given above, the densities in the second column of the table be substituted for the masses and diameters, and the absolute sidereal period of the earth's rotation be considered as unity or 1, the calculations will be greatly shortened, for then the squares of the cube roots of the densities would be equal to the periods of rotation, expressed in absolute sidereal days, as in the last column of the above table.

Example. If the density of Mars be 1.04346, what will be its period of rotation?

$(1.04346)^{\frac{2}{3}} = 1.02877$ sidereal days, which is the answer.

The ratio of one mean solar day to one absolute sidereal day is as 1.00273791 to 1. Therefore, by dividing the sidereal days in the last column of the table by this ratio, the quotient will be solar days, which may be easily reduced to hours, minutes, and seconds, mean solar time.

To express the law of planetary rotation in general algebraical formula, applicable to the periods of the rotation of all the primary planets, let M, D, P, represent respectively the mass, diameter, and rotative period of the earth; and let m, d, p, represent the mass, diameter, and rotative period of any planet, then we will have—

$$\frac{P^2 . D^{\frac{2}{3}} . m^{\frac{2}{3}}}{d^2 . M^{\frac{2}{3}}} = p;$$ or in terms of the densities and periods, thus—

$$\frac{(\text{Planet's den.})^{\frac{2}{3}} . P^2}{(\text{Earth's den.})^{\frac{2}{3}}} = p;$$ or, if the earth's rotative period and density be each taken as unity or 1, then,

$$(\text{Planet's density})^{\frac{2}{3}} = \text{rotative period.}$$

As the rotative periods depend upon the masses and diameters of the planets, any errors entering into these elements by the imperfections of observation will necessarily affect the calculated periods of rotation in a proportionate degree. This will be more manifest by referring to the 7th and 8th examples in regard to the mass and diameter of Neptune. The mass which I have adopted in these two examples is that calculated by Professor Struve, from his own observations of the satellite attending the primary. The diameter, 41500 miles, is that given by Sir John Herschel in his 'Outlines of Astronomy.' The assumed diameter, 37500 miles, in conjunction with the same mass, gives a difference of 1h. 45m. 35s. in the calculated periods of rotation. Many astronomers have adopted 35000 miles for the diameter.

The diameter of Neptune is probably not yet known within several thousand miles, for an error of observation of three-tenths of a second of an arc, would at that great distance produce an error of over 4000 miles in the calculated diameter of the planet The same statement is equally applicable to the determination of the mass. An error of observation on the dimensions of the orbit of Neptune's satellite, though it might be only a small fraction of a second of an arc, yet it would produce a great difference in the calculated mass. We can, therefore, in our calculations, only approximate the true periods of rotation in proportion as observation approximates the true ratio of the masses and diameters of the planets.

There is a great difference in the observations of astronomers from which the mass and diameter of Saturn are computed. Some have adopted 67,000 miles as the diameter; others, 73,000; and others again, 79160. Some have adopted the mass much less than we have assigned in the foregoing table. If we take the diameter at 67000 miles, and the mass at 175.245657, the ratio and the period of rotation will remain the same as in the table.

The renowned French mathematician—Le Verrier, to whose calculations the world are indebted for the discovery of Neptune, has revised the tables containing the elements of the planet Mercury, and has computed its mass much less than formerly received: hence, I have adopted Mercury's mass less than stated in the old tables.

It will be seen by the formula which I have given, that if the rotation is known by observation, the ratio of the mass and diameter can be calculated; and that if any two of the elements are known, the third can be calculated.

The periods of the rotations of the ultra-zodiacal planets or asteroids cannot be calculated until observation shall determine their masses and diameters.

Whether the law of planetary rotation can be extended to the rotative periods of the satellites, attending the four exterior planets of the solar system, is not known. It is supposed by some, from observation, that the periods of the rotation of the satellites are equal to their periods of revolution around their primaries: but this needs confirmation by further observation of greater perfection and accuracy than what the present powers of the telescope seem capable of affording.

From the masses and diameters of the four satellites of Jupiter, as given in Herschel's "Outlines of Astronomy," I find by the application of the law of rotation, the following relative or proportional periods. (Assuming the period of the rotation of the 1st satellite, nearest to the planet, to be equal to unity or 1.)

| Jupiter's satellites. | Proportional periods of rotation, as calculated. |
|---|---|
| 1st. | 1.000000000 |
| 2nd. | 1.788478493 |
| 3rd. | 1·635488852 |
| 4th. | 1.375555069 |

If it be true, that the rotative periods of these satellites are equal to the periods of their revolutions around their primaries, then the law does not apparently hold good for these secondary systems, unless the diameters and masses are affected with considerable errors: for instance, if the apparent angular diameter of the 2nd satellite be reduced the one-twentieth of a second of an arc, it would reduce the real diameter 116 miles, which would give a calculated period of rotation, such as should exist in order to correspond precisely with the ratio of the periods of revolution in their orbits. In the cases of the 3rd and 4th satellites, there would have to be a greater correction in order to make the rotative and orbitual periods of the same length. A mistake of a small fraction of a second of an arc, might easily be made in the apparent angular diameters. Likewise, as the masses are deduced from observations of the minute perturbations which the satellites exercise upon each other, it is evident that a minute error in such observations, would give a much greater error in the calculated masses. Therefore, masses and diameters might be assumed, within the limits of unavoidable errors, which would give calculated periods of rotation for the four satellites of the same length as their orbitual periods.

This remarkable law, connecting the periods of rotation with the masses and diameters of the planets, appears to point to some more original law of a higher order of generalization. Such was the case in regard to Kepler's law, connecting the orbitual periods of the heavenly bodies with their distances from their respective centres of motion. Newton demonstrated Kepler's law to be a necessary result of the more general law of universal gravitation.

Providence may raise up a Newton in our day who shall disclose to us the reason why, the cube roots of the densities of the planets are as the square roots of their periods of rotation.

I intend in some future communication, to present a hypothesis which will, if I am not mistaken, account for this curious law obtaining in the solar system.

With the most sincere desire for the development and diffusion of useful knowledge, I subscribe myself your most humble servant,

ORSON PRATT, senior.

G. S. L. City, Utah Ter., Aug. 4, 1855.

## Our Immigration.

[From the St. Louis Luminary.

VISIT OF THE EDITOR TO THE CAMPS AT ATCHISON.—We have just returned from a three weeks' tour in the upper country, and too late to furnish our readers this week with more than a bird's-eye glance at the position of affairs on the frontiers, and the events of our tour.

The fine steamer F. X. Aubry landed us on the levee at Atchison, at two o'clock on the morning of the 29th ult., where we found Elder Glover, with part of his company, still on the levee, who had landed from the Equinox the previous day.

After taking a morning nap, and breakfasting with Elder McGaw, we surveyed the town, and the few tents and detachments of companies still remaining on the old camp ground just back of town, and later in the day visited the general encampment at Mormon Grove—four miles west—which presented the appearance of a city of tents and wagons beautifully arranged in the open woodland, and covering several undulations. Our visit was emphatically one of business; but it proved equally one of pleasure.

The lowing of cattle—the din and bustle of camp—and the joyful greetings, were to us what martial music is to the soldier. Altho' we had allotted ourselves only three or four days in camp, the great amount of business relating to the P. E. Fund emigration, as well as the Danish and other independent companies, which required our personal attention, detained us until the 10th inst., and then it was with reluctance that we bid them adieu, to return to our duties in the city.

During our stay, we organized four companies for the plains, consisting of about fifty wagons each.

The first under Capt. Kinley consisted chiefly of the emigrants from St. Louis, and other parts of the States.

The second under Capt. Jacob F. Secrist, embraced the Danish and part of the British independent company.

The third under Capt. S. M. Blair, embraced the Texas camp, and portions of the Saints from other parts of the States and adjacent provinces; and

The fourth under Capt. Richard Ballantyne, embraced a part only of the Perpetual Emigrating Fund emigration.

The first drew out and formed a separate encampment on the 1st inst., and soon were on their march for the mountains. The 2d were also moved out, and the 3d was moving out when we left, and the 4th were preparing to follow soon as their outfits could be completed.

The general health of the camps was good, altho' several deaths have occurred in the Danish camp and among the passengers ex-ship 'Juventa,' who had almost entirely escaped until they reached Atchison.

Among the lamented dead of this company, we have to mention Elder Simpson, long and favorably known among the British saints, and Elder Bell, late President of the Malta mission, and his wife.

The saints who remain in camp are busily engaged plowing and planting, and thus laying a foundation for the sustenance of the poor that may be left.

The merchant train of Messrs. Livingston, Kinkead & Co., of Salt Lake, passed near Mormon Grove, on the 2d inst., being the first of the season, and one month later than previous years.

Several other merchant trains were being fitted out at Atchison and Leavenworth City.

Our business called us by the way of Weston, Kansas and Independence, where on the 12th, we took passage on the 'Polar Star,' the universal favorite in the Missouri trade.

Up to the time of our leaving Independence, no tidings had been heard from the Salt Lake Mail, due on the 30th ult. It was reported that the party with the April mail, outward bound, had been robbed of every animal at Devil's Gate, and fearful apprehensions were entertained for the safety of the party. Some early trains of Californians are also reported to be stripped of all their animals.

Capt. Heath of the U. S. Army, direct from Fort Kearney, who was a fellow passenger down the river, informed us that the May mail, outward bound, with which was Hon. J. M. Bernhisel, had been safely escorted by a part of his command as far as Ash Hollow, and safely delivered to a like escort from Laramie. Dragoons have started from Fort Leavenworth to patrol the line, and keep Indians off the road.

The 'Ben Bolt' with a company of saints, was just landing at Atchison, as the Polar Star left there, on the 11th.

DEPARTURE FOR THE PLAINS.—We shipped on Tuesday the 19th inst. on the Ben Bolt, upwards of 200 P. E. Fund passengers, under the presidency of Elder Francis St. George, Louis A. Bertrand, Secretary.

This company had been encamped near this city about 14 days, and had enjoyed general good health, and have left this city with light hearts and buoyant spirits.

It was uncertain for some time whether this company would be sent thro' this season, therefore when it was announced that they could embark, they were perfectly delighted, and ready to shout hosannah to God and the Lamb.

This is the company that was said to be disaffected and determined not to proceed further on their journey—but we will say to their credit that they felt well notwithstanding their temporary disappointment, and as a general thing were fully resigned to their lot, and had pretty generally made up their minds to remain another year. They are consequently rejoicing in the Lord and praising Him for their deliverance.

Elder John S. Fulmer left this city on Thursday the 21st inst., by the F. X. Aubry. We purpose to ship one more company this season, which will be mostly of the passengers of the ship Germanicus, which arrived here about 18 months since.

With this company we shall roll off the entire emigration of this season from this city, and in a few weeks we hope to roll off the entire emigration not only from this city but also from Atchison; our hands will then be measurably free, and our mind considerably relieved, and we shall feel better prepared for the performance of other duties and engagements.—[St. Louis Luminary, June 23.

## OUR CORRESPONDENCE.

### NEW KIND OF SUGAR.

[From a letter from Elder L. N. Scovil to Br. Joseph Cain.]

PROVO CITY, July 31, 1855.

Last week a sweet substance was discovered on the leaves of the trees. A few began to gather it by stripping off the leaves and soaking them in water; in this way Br. A. Daniels made 11 lbs of sugar in one day; it looks and tastes like maple sugar. Many scores of men, women, and children are now engaged in gathering it.

Br. Aaron Daniels has just brought in three specimens which he sends to your care, and which you will please to deliver as follows, viz: one cake to Prest. B. Young, one to Br. Geo. A. Smith, and the other to Br. A. Carrington. Br. Daniels says he made 20 lbs yesterday, and he thinks it is getting better every day.

When it was first discovered some said that it was honey dew, others said it proceeded from the Cotton wood leaves, but it is found on all kinds of leaves and on the rocks. My children have gathered and brought in a quantity of it, which they had taken from the leave, as it is deposited, many of the leaves have scales of this sweet substance as thick as window glass, and some a great deal thicker.

Br. Daniels tells me that his process is to cut the twigs from the trees and after soaking in water strain and boil, similar to making maple sugar. I have tasted some excellent metheglin made from the same substance.

[The cakes of sugar above mentioned came safe to hand, the grain and color very closely resembling maple sugar when it is run into cups or moulds. The color and slightly bitter taste were doubtless due to the leaves, and probably arose from their being soaked rather too long.—Ed.]

TORNADO IN GEORGIA.—A letter from Cedar Town, Ga., dated May 21, says:—

On the evening of the 18th, a severe storm of wind, rain and hail swept across the central portion of our county, from northwest to southeast, doing immense injury to the plantations over which it passed. Wheat crops in particular, now too far advanced to recover, have been almost entirely ruined, at a time when, on account of the scarcity of grain, they were held in more than ordinary estimation. Forests have been denuded of their foliage, fowls in abundance destroyed, and millions of noisy locusts forevere silenced. Reliable persons residing in the track of the storm say that the hail covered the ground to the depth of a foot, and that there were drifts of hail three feet deep in some places. The damage done to some fields by washing has been estimated—probably with a shade of extravagance—as equal to the ordinary washing of a century. Several of the families most seriously affected by this storm were also principal sufferers by the terrible tornado which visited our county on the 12th of March last.