of a planet with a major axis equivalent to Mercury's modulus, and eccentricity equivalent to the mean of the eccentricities of the other interior planets, Mercury and Mars may have condensed simultaneously from an intra-asteroidal ring, of a thickness corresponding to the difference between their rotation-moduli. $\triangle^4$ would then indicate the primary nucleus of the first intra-asteroidal nebulous ring, or the mean distance of Mars; $\triangle^3$, the perihelion of Mars; $\triangle^2$, $\triangle^1$, $\triangle^0$, the moduli of rotation of Mars, Venus, and Earth.

PLANETARY RELATIONS TO THE SUN-SPOT PERIOD.

By Pliny Earle Chase.

(*Read before the American Philosophical Society, March 7th*, 1873.)

Stockwell's discussion of Secular Variations has furnished an unexpected confirmation of my suggested accordance between Jupiter's mean perihelion distance, the planetary centre of gyration, and the radius vector of the disturbing force which occasions the mean sun-spot cycle of 11.07 ± years.

In my previous paper (*ante*, xii, 410) I made the comparisons with the present eccentricity of Jupiter. If we take the *mean* eccentricity (.04316), Jupiter's mean perihelion is in the precise orbit of the disturbing force, provided the disturbance-period is 11.11 years. The factor of Jupiter's variation from Bode's Law $[(1.079)^{\frac{1}{3}}]$ is also the factor of the perturbation variation from the centre of planetary gyration (5.101 ÷ 1.0257 = 4 973).

Kirkwood has shown the approximate commensurability of the Wolfian cycle with 46 years of Mercury, 18 years of Venus, 11 of Earth, 6 of Mars, and 1 of Jupiter. I have introduced these five periods in the following table, together with (6) $\frac{3}{8}$ of Saturn, (7) $\frac{2}{15}$ of Uranus; (8) $\frac{1}{15}$ of Neptune; (9) $\frac{2}{3}$ year of the mean centre of inertia of Jupiter's aphelion and Saturn's perihelion; (10) $\frac{2}{3}$ do. Jupiter's perihelion and the aphelion of Uranus; (11) $\frac{2}{7}$ do. Saturn's aphelion and Uranus' perihelion; (12) $\frac{1}{5}$ do. Saturn's perihelion and Neptune's aphelion; (13) $\frac{1}{12}$ do. Uranus' aphelion and Neptune's perihelion.

Approximations to the Wolfian Cycle.

1.	46	years of Mercury	4046.63
2.	18	" Venus	4044.60
3.	11	" Earth	4017.86
4,	6	" Mars	4121.86
5.	1	" Jupiter	4332.58
6.	$\frac{3}{8}$*	" Saturn	4034.71
7.	$\frac{2}{15}$	" Uranus	4091.78
8.	$\frac{1}{15}$	" Neptune	4008.45

* Earth's radius vector, divided by $\frac{3}{8}$ = Mercury's modulus of rotation.

9.	$\frac{2}{3}$	inertia period of	Jupiter and Saturn	4038.49
10.	$\frac{2}{3}$	" "	" Uranus	4060.86
11.	$\frac{2}{7}$	" "	Saturn and "	4046.08
12.	$\frac{1}{5}$	" "	" Neptune	4071.89
13.	$\frac{1}{12}$	" "	Uranus and "	4027.52
14.	Kirkwood's period			4043.43
15.	Mean			4070.48

If we substitute $\frac{14}{15}$ of Jupiter's year (4043.74) for the fifth number in the above table, the mean will become 4049.85, the time of planetary revolution at Jupiter's mean perihelion being 4057.65 days. The fractional coefficients of the exterior planetary years will also be nearly commensurable, $2 \times \frac{14}{15}$ being nearly equivalent to $5 \times \frac{3}{8}$, $14 \times \frac{2}{15}$, and $28 \times \frac{1}{15}$.

The relations of Uranus to the centre of oscillation of Neptune's radius vector and to the synchronous vibrations of light and gravity, lend interest to the following table. The elements introduced are the mean aphelia of the three outer planets, the mean perihelion of Jupiter, and the mean distances of the inner planets.

Approximate Commensurability of Planetary Distances.

$\frac{2}{3}$ Neptune's mean aphelion	20.226
Uranus' " "	20.043
$2 \times$ Saturn's " "	20.
$4 \times$ Jupiter's mean perihelion	19.913
$13 \times$ Mars	19.808
$20 \times$ Earth	20.
$28 \times$ Venus	20.253
$52 \times$ Mercury	20.129
Average	20.046

The almost precise accordance of the general mean with the aphelion of Uranus, the diminution of values towards the centre, and the grouping by pairs, are all indicative of harmonic laws which may serve not only to explain the sun-spot cycles, but also many of the other phenomena of our system.

RELATIVE VELOCITIES OF LIGHT AND GRAVITY.

By Pliny Earle Chase.

(*Read before the American Philosophical Society, March 7th,* 1873.)

The only approximate estimate of the velocity of gravity that has ever been made, appears to be that of La Place, who showed that it must be at least six million times as great as that of light. The mutual action and reaction of centrifugal and centripetal forces may, perhaps, furnish means for its ultimate satisfactory determination, to which end the following considerations may be regarded as preliminary.