Thermo-electro-photo-baric Unit. By Pliny Earle Chase, LL.D.

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The earliest attempt at measurement, with a view to demonstrate the correlation of thermal and electric energies, appears to have been that of Principal Forbes, who found, in 1832 (*P. Mag.*, iv, 27), that the conductivity of metals for heat and electricity, is nearly the same. The dimensions of absolute measure involved were *M, L.*

In 1843, Joule published his discussion of the calorific effects of magneto-electricity, and his determination of the mechanical equivalent of heat (*P. Mag.*, xxiii, 263, 347, 435), using the same dimensions, *M, L.*

In 1856, Weber extended the correlation of Forbes (*Pogg. Ann.*, xcix), by showing the approximate equality of the electro-magnetic ratio to the velocity of light ($L\ T^{-1}$).

Wolf's discovery of the sun-spot period was followed, in 1857, by the investigations of Lamont and Sabine, showing the identity of the sun-spot periods with the periods of magnetic perturbation (*Mag. and Meteorol. Obs., Toronto*, III, lxviii; *St. Helena*, II, cxxi–cxxxvi).

In 1860, Henshall showed the influence upon sun-spots which is produced by Mercury, Venus and Jupiter, when in conjunction with the same face of the Sun (*Cosmos*, xvii, 573).

In 1863, Chase showed (*Proc. Amer. Phil. Soc.*, ix, 283–8; *P. Mag.*, xxviii, 55–9) that the mass of the Sun can be approximately estimated from the influence upon the barometer of the constrained "relative motions" of the Earth and Sun. In 1864, he showed, by the investigation which received the Magellanic medal (*Trans. Amer. Phil. Soc.*, xiii, 117–36; *Proc. Amer. Phil. Soc.*, ix, 425–40; *P. Mag.*, xxx, 52–7), that the magnetic disturbances of the Sun and Moon are many times greater than simple tidal disturbances, and that they can be very closely represented by the disturbances of gravitating pressure, under constrained and "coercitive" relative motion. In 1869, he further showed (*Proc. Amer. Phil. Soc.*, xi, 103–7), that the constrained relative motion at Sun's surface represents a cyclical gravitating and electric disturbance which acts with the velocity of light.

In 1873, Maxwell (*Electricity and Magnetism*), published his theory that light consists of a disturbance in a medium susceptible of dielectric polarization.

In 1884, Langley (*Researches on Solar Heat*), confirmed the identity of thermal, electric, and luminous radiation, for which Chase had suggested probable reasons in 1864 (*Proc. Am. Ph. Soc.*, ix, 408), and Draper in 1872 (*P. Mag.*, xlvi, 104–17).

All of the foregoing investigations can be coördinated, in the region of greatest known energy, by means of the kinetic unit $\frac{\mu v_0^2}{2}$, in which μ represents an infinitesimal particle, and v_0 is the velocity of light, the electric ratio, the projectile velocity which represents thermo-dynamic energy at Sun's surface, and the projectile velocity which represents the maximum energy both of constrained rotation and of free revolution in the solar system.

The greatest constant energy of free revolution, which can be given to μ by solar attraction, is $\frac{\mu v_k^2}{2}$, v_k being the velocity of circular orbital revolution at the Kantian radius r_k, where solar rotation and orbital revolution are synchronous. The same energy would give synchronous radial or elliptic revolution through or about a major axis $2r_k$, under gravitating acceleration varying inversely as r^2.

The energy which would be required to produce synchronous radial oscillation, under the constant gravitating acceleration, g_k, would be π^2 times as great, or $\frac{\mu\pi^2 v_k^2}{2}$.

The energy which would be required to produce constant radial oscillation in the region of maximum solar gravitation and coercitive force (at Sun's surface) would be k^4 times as great, or $\frac{\mu\pi^2 k^4 v_k^2}{2} = \frac{\mu\, v_0^2}{2}$, k being the ratio of the Kantian radius to the solar radius.

The time which would be required to communicate this maximum energy is t_k, the time of virtual projection against uniform resistance, in the region of greatest solar energy, which is also the time of solar half rotation, as well as the minimum time of synchronous elliptic, circular and radial oscillation in the solar system.

The ordinary thermal and gravitating units may be deduced from the general unit by means of the equations

$$g_n = \frac{m_n\, r_0^2\, v_0}{m_0\, r_n^2\, t_k}$$

$$T = \frac{v_0^2}{2 g_3\, h}$$

In the second of these equations T represents the mass of water which could be heated one degree by μ of oscillating luminiferous æther, or the number of degrees to which μ of water could be heated ; g_3, gravitating acceleration at Earth's equator ; h, the linear dimension of the mechanical unit of heat.

The harmonic values are as follows :

$m_0 = 329414\, m_3$
$r_0 = 108.923\, r_3$
$g_0 = 27.765\, g_3$
$v_0 = 185500$ miles per second.
$g_3 = 32.033$ feet per second.
$T = 10,775,492,000,000°C$.