List of Papers Communicated to the American Philosophical Society.
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(*Read before the American Philosophical Society, November* 5, 1880.)

1. Sanscrit and English Roots and Analogues. Sept. 17, 1858, *P.** vii, 177–91.
2. Chinese and Indo-European Roots and Analogues. Jan. 18, 1861, *P.* viii, 5–48.
3. Intellectual Symbolism. Oct. 3, 1862, *T.** xii, 463–594.
4. Chinese Seal Inscriptions. Feb. 6, 1863, *P.* ix, 139.
5. Chinese Analogues in other languages. Feb. 20 to May 15, 1863, *P.* ix, 145, 172, 231.
6. Catalogue of Trade Tokens circulating during the war of the Rebellion. Sept. 18, 1863, *P.* ix, 242–58.
7. Mathematical Probability of Accidental Linguistic Resemblances. Sept. 18, 1863, *T.* xiii, 25–33.
8. Comparative Etymology of the Yoruba Language. Sept. 18, 1863, *T.* xiii, 35–68.
9. Note on Possible Vowel Sounds not used in any Language. Oct. 2, 1863, *P.* ix, 271.
10. On the Diurnal Variations of the Barometer; elastic actions and reactions proportioned to mass; cyclical motions in a resisting medium, furnishing *harmonic indications of Sun's mass and distance;* anticipation of astronomical verifications or rectifications by means of varying pressures; *importance of the fundamental equations,* $v = \frac{gt}{2}$; $h = \frac{gt^2}{4}$; in which t represents the time of cosmical, molecular, or atomic rotation, and g represents the acceleration of a central force. Dec. 18, 1863, *P.* ix, 283–8 (Maxwell, Edlund, Crookes, Lockyer).†

The above was the first of a series of physical papers in confirmation of the following *General Postulate. All physical phenomena are due to an Omnipresent Power, acting in ways which may be represented by harmonic or cyclical undulations in an elastic medium.*

11. On the Height of the Tides; principles of (10) applied to the explanation of some tidal anomalies. Jan. 1, 1864, *P.* ix, 291–4.
12. Daily Distribution of Heat; coördinate thermodynamic influences of solar radiation, cyclical elasticity, and barometric pressure. March 4, 1864., *P.* ix, 345–9.
13. Mechanical modification of electric and other elastic currents; gravity, electricity and terrestrial magnetism regarded as "modes of motion" (Gray, Edison, Bell, Channing, Crookes); illustrations of the

**P.*, *Proceedings*; *T.*, *Transactions.*

† The names in parentheses are those of subsequent investigators, whose researches have confirmed the conclusions of the papers.

hypothesis that electricity consists simply of æthereal vibrations (Maxwell, Edlund). April 1, 1864, *P.* ix, 355–60.

14. Polarizing influences of thermal convection and radiation ; correspondence between Challis's laws of molecular action and the laws of attraction and rotation (Baumhauer, Meyer, Mendelejeff, Zaengerle). April 15, 1864, *P.* ix, 367–71.
15. Lunar-monthly barometric variations ; resemblances to daily barometric fluctuations. June 17, 1864, *P.* ix, 395–9. Also, Proc. Roy. Soc. June 16, 1864, xiii, 329–333.
16. Component elements of normal barometric tides ; influence of oscillations moving with the velocity of light. July 15, 1864, *P.* ix, 405–11.
17. Comparative fitness of languages for musical expression. Sept. 16, 1864, *P.* ix, 419–20.
18. Primitive names of the Supreme Being. Sept. 16, 1864, *P.* ix 420–4.
19. Numerical Relations of Gravity and Magnetism ; Formulation of Hypothesis of Unity of Elastic Force ; Kinetic Ratio of Sound Waves to Light Waves (Edlund, Mendelejeff, Crookes, Lockyer, Edison). Oct. 21, 1864, *P.* ix, 425–40 ; *T.* xiii, 117–36.
20. Comparison of Solar and Lunar Magnetic and Aerial Tides ; Magellanic medal awarded Dec. 16, 1864 (Maxwell, 1873). *P.* ix, 487–95.
21. Radical Significance of Numerals. Feb. 17, 1865, *P.* x, 19–23.
22. Copto-Egyptian Vocabulary. April 7, 1865, *P.* x, 69–94.
23. Relations of Magnetic Declination to Gravity ; Heat and Attraction ; Different manifestations of the Force which controls Stellar-Systems as well as Molecular Motions. April 21, 1865, *P.* x, 97–104.
24. Relations of Magnetic Inclination to Gravity ; Accomplishment of Faraday's Desideratum. May 19, 1865, *P.* x, 111–8.
25. Experiments in Mechanical Polarization of magnetic needles by vibrations resembling those of Terrestrial convection and atmospheric currents ; mechanical polarization of Sky Light. Oct. 6, 1865, *P.* x, 151–66.
26. Observations on Skylight polarization at Philadelphia ; Remarkable visibility of all the neutral Points. Jan. 5, 1866, *P.* x, 196–7.
27. Comparative visibility of Arago's, Babinet's, and Brewster's Neutral Points, in Philadelphia and its neighborhood. April 6, 1866, *P.* x, 223.
28. Relations of Temperature to Gravity and Density ; General Equation of Oscillation and Parabolic motion ; Thermodynamic *vis viva;* Comparative Energy of action and reaction at the source of Solar Radiation and at Earth's Orbit : simple harmonic relation between terrestrial gravity and the velocity of light. Sept. 21, 1866, *P.* x, 261–9.
29. Laws regulating the distribution and transmission of Solar heat. Feb. 1, 1867, *P.* x, 309–15.
30. Probabilities in etymology ; a reply to criticism. Sept. 20, 1867, *P.* x, 345–9.

31. Meteor seen at Haverford College. Oct. 4, 1867, *P.* x, 353.
32. Meteors of Nov. 13, 14, 1867. Nov. 15, 1867, *P.* x, 357.
33. Specific Magnetism of iron; cosmical and molecular comparisons. Nov, 15, 1867, *P.* x, 358.
34. General connotations of magnetism; accordance between barometric and astronomical estimates of Sun's distance. Feb. 21, 1868, *P.* x, 368–79.
35. Evidences of Lunar influence on rainfall. June 19, 1868, *P.* x, 436–9.
36. Tidal Rainfall of Philadelphia; similarity of influence in different independent periods. Dec. 4, 1868, *P.* x, 523–37.
37. Meteors of Nov. 13, 14, 1868. Dec. 4, 1868, *P.* x, 539.
38. Philadelphia Life Tables. Feb. 5, 1869, *P.* xi, 17–22.
39. Cosmical relations of light to gravity; influence of the *modulus* of light, velocity, mass, distance, centres of gyration, orbital eccentricity, inertia, and ratio of circumference to diameter on cosmical and molecular phenomena (Alexander, 1877); solar centripetal reaction against the action of gravity towards the centre of the solar system gives *the velocity of light* in the fundamental equation $v = \frac{gt}{2}$. April 2, 1869, *P.* xi, 103–7.
40. Comparison of rainfall at Greenwich and Philadelphia; cosmical and local influences upon meteorology. May 7, 1869, *P.* xi, 113.
41. Tidal Rainfall; comparison of lunar influences at Providence, Chiswick and Toronto. Oct. 1, 1869, *P.* xi, 203.
42. Comparison of mechanical Equivalents. Jan. 7, 1870, *P.* xi, 313.
43. Monthly variations of rainfall at Philadelphia. Feb. 4, 1870, *P.* xi, 314–5.
44. European and American rainfall; comparison of quarterly rains at Philadelphia and Lisbon. March 3, 1871, *P.* xii, 38–9.
45. American Weather Notes; local influences; importance of gradients; frequency of anticyclonic storms; local cyclones in general anticyclones (Signal Service). March 3, 1871, *P.* xii, 40.
46. Winds of the United States; General anticyclonism; storm centres at normal intersections of prevailing currents. March 17, 1871, *P.* xii, 65–7.
47. Resemblance of atmospheric, magnetic and oceanic currents; primary coördinate great circles; uniform evidences of gravitating influence. April 7, 1871, *P.* xii, 68–70.
48. Relation of Auroras to gravitating currents. May 5, 1871, *P.* xii, 121–2.
49. Winds of Europe. June 16, 1871, *P.* xii, 123.
50. Normal position of the tidal ellipsoid. June 16, 1871, *P.* xii, 123–4.
51. Cyclical Rainfalls at Lisbon; solar and lunar influences compared at different independent periods; blending tidal currents of different temperatures and different degrees of humidity. Aug. 18, 1871, *P.* xii, 178–90.
52. Correlations of cosmical and molecular force; harmonic estimates of solar mass and distance from the explosive energy of oxygen and hy-

drogen (Young) ; *vis viva* of wave propagation = $\frac{5}{9}$ of the *vis viva* of oscillating particles (Maxwell, 1877). Feb. 16, 1872, *P.* xii, 392–4.

53. The Herschel-Stephenson Postulate ; conditions of stability in elastic atmospheres ; influences of centres of oscillation on planetary masses, distances, and times of rotation. March 1, 1872, *P.* xii, 395–7.
54. Further approximations to sun's distance ; accordant harmonies of terrestrial rotation, lunar distance, lunar revolution, explosive energy, and the velocity of light. April 5, 1872, *P.* xii, 398–400.
55. General relation of Auroras to Rainfall. April 5, 1872, *P.* xii, 400.
56. Influence of meteoric showers on Auroras. May 16, 1872, *P.* xii, 401–3.
57. Planetary Illustrations of Explosive Oscillation ; apsidal and mean positions and eccentricities (Alexander, 1877). May 16, 1872, *P.* xii, 403–5.
58. Undulatory harmonies of solar and planetary rotation, revolution, mass, gravity, and light. May 16, 1872, *P.* xii, 406–7.
59. Aethereal density and polarity ; influences on cosmical masses and relative positions. May 16, 1872, *P.* xii, 407–10.
60. The sun-spot cycle of 11.07 years ; wave-cycle of Jupiter's projectile locus (mean perihelion distance). May 16, 1872, *P.* xii, 410–1.
61. Aethereal Oscillation, the primordial material Force ; cardinal centres of wave influence ; planetary illustrations. July 5, 1872, *P.* xii, 411–7.
62. Daily auroral and meteoric means. Sept. 20, 1872, *P.* xii, 516–8.
63. Stellar and Planetary Correlations ; relations of distance to cardinal points of explosive oscillation ; rupturing velocities acquired by nebular "subsidence" from *nd* to $\frac{nd}{n+1}$; evidences of parabolic projection between *α Centauri* and sun, *the locus of the paraboloid being determined by the solar modulus of light, sun's linear centre of oscillation, and sun's gravitating reaction against luminous undulation ;* harmonic positions of loci of planetary rupturing velocities. *These are the only* POSITIVE *evidences yet discovered of gravitating influence between different stellar systems.* Sept. 20, 1872, *P.* xii, 518–22.
64. Cyclical rainfall at San Francisco ; indications of planetary as well as lunar influence. July 19, 1872, *P.* xii, 523–42.
65. Recent monthly Rainfall in the United States ; compiled from Signal Service reports ; lunar influence less disguised than solar. Nov. 1, 1872, *P.* xii, 555–7.
66. Lunar-cyclical Rainfall in the northern Temperate Zone. Nov. 1, 1872, *P.* xii, 558–9.
67. Oscillatory Forces in the Solar system ; harmonies of apsidal and mean planetary positions and moments of inertia ; influence of the ratio of the circumference to the diameter of a circle (Forbes, 1880). Feb. 7, 1873, *P.* xiii, 140–1.
68. Estimate of solar mass and distance from the equilibrium of elastic and gravitating forces. Feb. 7, 1873, *P.* xiii, 142–3.

69. Note on Planeto-Taxis; reasons for limitations of "Bode's law." March 7, 1873, *P.* xiii, 143–4.
70. Rotation of the sun and the Intra-asteroidal Planets. March 7, 1873, *P.* xiii, 145–7.
71. Planetary relations to the sun-spot period. March 7, 1873, *P.* xiii, 147–8.
72. Relative velocities of light and gravity. March 7, 1873, *P.* xiii, 148–9.
73. The gamuts of sound and light; correspondence of wave-length of the musical note, C_{23}, with that of the Fraunhofer C line; approximations in other wave-lengths of the two gamuts; comparative harmonic estimates of solar mass and distance; indications of a magnetic gamut, four octaves below that of light. March 21, 1873, *P.* xiii, 149–54.
74. The music of the spheres; apsidal and mean relations to musical intervals. April 4, 1873, *P.* xiii, 193–8.
75. Harmonic Indications of Intra-Mercurial planets; influence of Neptune, Jupiter and Sun in establishing harmonic nodes of planetary aggregation; *prediction of an "unknown planet or other seat of solar and planetary perturbation"* (De la Rue, Stewart and Loewy, Watson, Mouchez, Oppolzer, and others). May 2, 1873, *P.* xiii, 237–9.
76. Correlations of Planetary mass. May 16, 1873, *P.* xiii, 239–43.
77. Harmonies of Cosmical Rotation. May 16, 1873, *P.* xiii, 243–8.
78. Weather Study; confirmation of views (45, 46) by observations of signal service bureau. May 16, 1873, *P.* xiii, 248–52.
79. The Planetary node between Mercury and Vulcan. May 16, 1873, *P.* xiii, 252.
80. Recent Confirmation of an Astronomical Prediction. Oct. 3, 1873, *P.* xiii, 470.
81. Comparison of Planetary Series; harmonic series the closest of all. Oct. 3, 1873, *P.* xiii, 471–7.
82. Transcript of a curious MS. work in cypher, supposed to be astrological. Oct. 3. 1873, *P.* xiii, 477–82.
83. Origin of Attractive Force. Feb. 6, 1874, *P.* xiv, 111–4.
84. Saving Fund Life Insurance. April 3, 1874, *P.* xiv, 148–9.
85. Cosmical Thermodynamics; fifty postulates of unitary force, with references to illustrative papers. April 17, 1874, *P.* xiv, 141–7.
86. Cosmical evolution; relations of mean proportionality to time, mass, density, and the velocity of light. May 15, 1874, *P.* xiv, 159–61.
87. Jupiter-cyclical Rainfall. June 19, 1874, *P.* xiv, 193–5.
88. Cyclical rainfall at Barbados. June 19, 1874, *P.* xiv, 195–216.
89. Gravitating Waves; important nodal positions of Sun, Earth and Jupiter. Jan. 1, 1875, *P.* xiv, 344–6.
90. Lunar monthly Rainfall in the United States, from observations of the Signal Service Bureau. April 16, 1875, *P.* xiv, 416–8.
91. Further Relations of Magnetic, Gravitating and Luminous Force; analogous equations in general physics, electricity, chemistry, and

cosmogony; consequent estimate of Sun's mass, from Maxwell's magnetic data. June 18, 1875, *P.* xiv, 607–9.

92. Planetary Illustrations of the Creative Fiat. Aug. 20, 1875, *P.* xiv, 609–12.

93. Yearly rainfall in the United States, from observations of the Signal Service Bureau. Aug. 20, 1875, *P.* xiv, 613–4.

94. The Beginnings of Development; planetary linkages; *the velocity of light is the limit between the living forces of association and dissociation;* variety of rhythmical relations; successive steps of nebular condensation. Sept. 17, 1875, *P.* xiv, 622–31.

95. Further Dynamic Coördinations; *mathematical deduction of the ratio between the mean vis viva of gaseous volume (heat under constant volume) and the vis viva of uniform velocity (heat under constant pressure)*; harmonies of products and powers of mass and distance. Dec. 3, 1875, *P.* xiv, 651–8.

96. Nebular action in the solar system; confirmations of Herschel's theory of "subsidence;" electrical conductivity of selenium, illustrating the ratio of velocities between solar waves originating at Sun's surface and in Earth's orbit (Bell, Tainter). April 21, 1876, *P.* xvi, 184–92.

97. On some fundamental propositions of central force; nucleal radius varying as the $\frac{3}{4}$ power of the atmospheric radius; oscillatory formulas of cyclical motion; views of various investigators; universal correlations. July 21, 1876, *P.* xvi, 298–310.

98. Aethereal influences in the solar system; evidence of 58 accordances. Jan. 5, 1877, *P.* xvi, 496–505.

99. Chemical atoms, molecules and volumes; laws of Boyle, Charles, and Avogadro. Feb. 2, 1877, *P.* xvi, 505–8.

100. Further illustrations of central force; increase of velocity through "subsidence" should produce rupture in the periphery of a stationary nebula at $\frac{r}{n}$ when $n = 2 \div (3 - 2\sqrt{2})$; this influence shown by various planetary belts and positions; "subsidence" tending to form confocal elliptic orbits, with major axes of $\frac{3r}{2}$ and minor axes $\sqrt{2}\ r$, and belts, on account of collision, at $\frac{2r}{3}$; influence of the modulus of light and various ratios in positing planetary belts. July 20, 1877, *P.* xvii, 98–100.

101. Harmonies of solar spectrum; identity of law in luminous and planetary nodes. August 24, 1877, *P.* xvii, 109–12.

102. Results of wave interference; symmetrical formula, introducing masses of Sun and Jupiter, Sun's equatorial radius, Jupiter's projectile radius, and the velocity of light; significance of Earth's position and density; cosmical and molecular wave lengths: confirmation of "subsidence" and of harmonic undulations, by the moons of Earth, Mars, Jupiter, Saturn, and Uranus; *Alexander's adoption and confir-*

mation of my harmonic predictions. Jan. 18, 1878, *P.* xvii, 294–307.

103. Criteria of the Nebular Hypothesis. March 1, 1878, *P.* xvii, 341–5.
104. Radiation and rotation ; explanation of Kirkwood's analogy ; belts of planetary pairs. June 21, 1878, *P.* xvii, 701–4.
105. Crucial Harmonies ; nine confirmations of prediction. Oct. 4, 1878, *P.* xviii, 34–6.
106. The limiting constant of gravitation ; new method of identifying the velocity of light with gravitating force. Oct. 18, 1878, *P.* xviii, 41–3.
107. The Philosophy of Christianity. Feb. 7, 1879, *P.* xviii, 129–53.
108. Further confirmations of prediction ; two additional evidences of harmonic solar disturbance. Feb. 21, 1879, *P.* xviii, 209.
109. Harmonies of Lockyer's "Basic Lines;" the fundamental wave-length representing a centre of spherical gyration, in Earth's reaction against solar action ; the other lines all harmonic. April 4, 1879, *P.* xviii, 224–6.
110. Spectral estimates of Sun's distance. April 4, 1879. *P.* xviii, 227–9.
111. Correlations of mass ; equations between masses of Sun and four outer planets ; centres of various nebular influences. April 4, 1879, *P.* xviii, 229–32.
112. Approximate quadrature of the circle. June 20, 1879, *P.* xviii, 281.
113. Apparent semi-diameter of the Sun, and nebular origin of the terrestrial day. Dec. 19, 1879, *P.* xviii, 380–1.
114. Velocity of light and Kirkwood's analogy ; *five estimates of the velocity of light based on the Nebular Hypothesis.* Jan. 2, 1880, *P.* xviii, 425–9.
115. Controlling centres ; various estimates of mass and distance according to the Nebular Hypothesis. Jan. 2, 1880, *P.* xviii, 429–34.
116. Nodal estimate of the velocity of light. March 19, 1880, *P.* xviii, 4–9.
117. Cometary Paraboloids ; comparison of planetary positions as determined by inter-stellar action, with M. Gaussin's geometrical approximations ; stellar approximations the closest. April 16, 1880, *P.* xviii, 18–20 ; also *Comptes Rendus*, 19 Avril and 3 Mai, 1880, *T.* xc. pp. 912,1061.
118. Cosmical determination of Joule's equivalent ; correspondence of centrifugal "lift," indicated by the difference of polar and equatorial temperatures, with the centripetal fall which would give the equatorial velocity of rotation ; confirmation of Clarke's discovery, that the molecular volume of chemically combined water is variable, while that of crystal water, or molecularly united water, is invariable. April 16, 1880, *P.* xviii, 20–1.
119. Relations of Chemical Affinity to Luminous and Cosmical Energies ; simple ratio of mean molecular velocities in gases, to velocities of terrestrial rotation and revolution ; harmonic wave-lengths in Vogel's hydrogen and Paalzow's oxygen-spectra. April 16, 1880, *P.* xviii, 21–5.