12) The aether is therefore arranged about the sun with the density following the law, $\sigma = \nu r$, which results from wave-agitations having amplitudes, $A = k/r$. The energy of the forces generated by these waves is proportional to the square of the amplitude, and therefore we have for the force,

$$f = k^2/r^2 \qquad (15)$$

which explains all the observed effects of gravitation, magnetism, etc.

13) Now quite aside from the simplicity and continuity of the process of reasoning here outlined, it remains a fact that the wave-theory is adequate to explain all the observed phenomena of nature. The simple law of density of the aether here imagined may therefore be admitted to really pervade the universe. So far from being homogeneous, the aether is really very heterogeneous. Indeed, it is a gas, behaving as an elastic solid — an infinite aeolotropic elastic solid — fulfilling the law of density, $\sigma = \nu r$, and of wave amplitude, $A = k/r$, and therefore yielding forces following the law, $f = k^2/r^2$, as required by *Newton* in 1721, for explaining the cause of universal gravitation.

At the earth the density of the aether is 219 times what it is at the sun's surface, because the earth's mean distance is 219 times the solar radius. But *Newton*'s formula for the velocity,

$$V = C\sqrt{(E/D)} \qquad (16)$$

would give a change of velocity if the density alone increased, while the elasticity E remained constant.

Now the velocity of light across the planetary spaces was originally found by *Römer*, 1675, from the eclipses of Jupiter's satellites, and subsequently confirmed by the elaborate researches of *Delambre*, on the motions of these satellites (cf. C. d. T. 1788, and Astronomie Théorique et Pratique, 1814). By discussing a thousand eclipses of the 1st satellite *Delambre* fixed the constant of aberration at 20".255, while *Michelson*'s velocity of light, near 300 000 kms., and the solar parallax 8".80 makes the aberration about 20".48.

Thus V is about the same for the aether across the diameter of the earth's orbit, and for the aether of the terrestrial atmosphere, in which the velocity has been investigated experimentally by *Cornu, Michelson, Newcomb* and others.

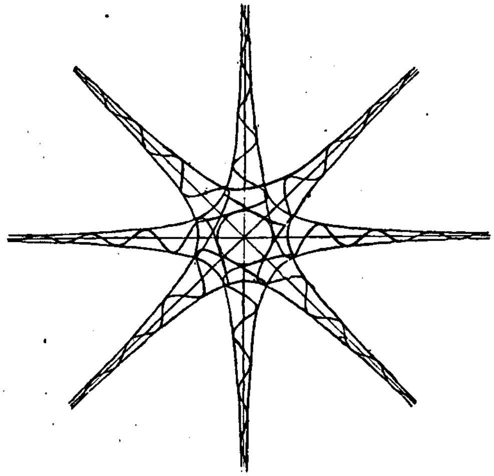

Fig. 1. Diagram showing graphically the decrease of the density of the aether towards the sun, owing to the asymptotic increase in wave amplitude.

Accordingly, this observational fact requires us to hold that E increases in about the same ratio as D, so that our law of V for the heavenly spaces becomes,

$$V = C\sqrt{(\nu' r/\nu r)} \qquad (17)$$

and therefore $E = \nu' r$. Thus both the elasticity and rigidity of the aether increase directly as the radius from the sun, or other heavenly bodies.

The reason for this remarkable law is this: namely, the viscosity of a gas depends upon the friction of the molecules projected from one layer of gas into the adjacent layer, and vice versa. In the case of the aether the viscosity becomes rigidity. And with the increase of the density of the aether particles there should be more molecules projected into the adjacent layers mutually, by the ordinary kinetic exchange, in strict proportion to the density. Thus the rigidity of the aether increases directly as the density, as in the above formula.

It may be noted that by the formula of *Newton*, an increase of the density by the factor 219, without change in E, would lead to a reduced velocity of only about $^1/_{15}{}^{th}$ of the original. No such enormous difference, in the velocity of light as determined by observations of Jupiter's satellites, and that found by terrestrial experiments, is admissible; and thus the above law of rigidity of the aether is approximately verified by the comparison of celestial and terrestrial observations. But a more exact test of the value of V, from eclipse observations of Jupiter's satellites, taken as directly as possible across the diameter of the earth's orbit, for comparison with the experimental value found by *Michelson*, is highly desirable.

3. The Relation between the Mean Molecular Velocity of a Gas and that of a Wave transmitted in such a Medium.

The Philosophical Magazine for June and September, 1877, contains two important articles on the theory of gases by Dr. *S. Tolver Preston*, and also notes on the conclusions then reached by the celebrated Professor *J. Clerk Maxwell*, with whom *Preston* was in correspondence. In the first of these papers, p. 452, § 19, *Preston* reaches the following remarkable conclusion: »That the velocity of propagation of a wave (such as a wave of sound) in a gas is solely determined by, and proportional to, the velocity of the molecules of the gas; that this velocity of propagation of the wave is not affected by density, pressure, or by the specific gravity of a gas, or by anything else excepting the velocity of its molecules«.

In the second Postscript, p. 453, *Preston* states *Maxwell*'s conclusion as follows:

»Professor *Clerk Maxwell*, to whom this paper was communicated, and who has taken a kindly interest in the subject, has worked out mathematically the velocity for a wave or impulse propagated by a system of particles moving among each other according to the conditions of equilibrium investigated in the first part of this paper — the diameter of the particles being assumed so small as to be negligible compared with their mean distance, and the particles being further assumed spherical, so that there is no movement of rotation developed at the encounters (which would involve loss of velocity)«.