

A partial development somewhat like this is given in certain treatises on physics, such as *Wüllner's Experimental Physik*, I.784, and *Mitchie's Elements of Wave Motion*, p. 11, but no importance is attached to the result, as in my *Electrodynamic Wave-Theory of Physical Forces*, I.14-157, 1917. So accurately is this true, that when I brought this simple formula for the wave amplitude,  $A = k/r$ , before the Academy of Sciences of St. Louis, in a public address, Sept. 21, 1917, great surprise at the simplicity of the formula was expressed by such experienced investigators as Professor *F. E. Nipher*, and President *E. A. Engler*. Thus it is necessary to develop the subject a little more fully in the present paper, since no adequate discussion of the problem appears to be available in existing works on physical science.

Let us now consider the arrangement of the density of the aether about the sun.

1) Suppose we consider carefully the amplitude of the waves from the sun in any solar spectral line, such as that of sodium,  $D$ . It is evident that if we disregard all other radiations, and fix attention upon this sodium light alone, then as the wave amplitude varies inversely as the distance from the sun's centre, this amplitude of our vibrations constituting sodium light will be 219 times greater at the sun's surface than at the surface of the earth — since the earth's mean distance is 219 solar radii.

2) Similar reasoning will hold for the waves of light of the spectrum of such elements as strontium, barium, boron, calcium, hydrogen, carbon, iron, nickel, cobalt, copper, titanium, etc. Thus all the light waves of all elements conform to the law:  $A = k/r$ .

3) All these chemical elements also radiate heat waves which follow the same law of amplitude. And for both light and heat the above law holds rigorously true. If there be any other type of waves in the aether, the same law will hold for these undulations also.

4) Now magnetism and gravitation have been referred to electrodynamic waves, in the author's work on physical forces, 1917. If these waves exist, they also will follow the same law  $A = k/r$ ; and, that they do exist is shown by a variety of phenomena, which admit of no other interpretation. For example, the electrodynamic action of a current of electricity is due to waves: thus arise electrical forces: also magnetic forces, gravitational forces, etc.

5) Gravitation admits of no other explanation, while on this explanation we have an immediate insight into the fluctuations of the moon's mean motion, which so long proved utterly bewildering to astronomers. And there must be not only a cause of gravitation, but a simple one, harmonizing with electrodynamic action, in the generation of electrical forces, magnetic forces, etc. The electrodynamic wave-theory alone fulfills this necessary and sufficient condition, for the following special reason.

6) The aether is shown to have an elastic power 689 321 600 000 times greater than that of our air in proportion to its density. Hence it will have practically unlimited power of contraction, and thus be able to generate the

stupendous forces required for holding the planets and stars in their orbits.

7) But this will be possible only if the aether is arranged according to the law of density  $\sigma = \nu r$ ; which in turn will follow if electrodynamic waves recede from the sun, having amplitudes  $A = k/r$ . For the amplitudes increasing towards the sun's centre insures a decrease of density of the aether about that centre, owing to the increasing wave-agitation near the sun's surface.

8) Now all these mutual arrangements, favorable to the wave-theory, would not exist, unless that theory represented a law of nature. Because not only are all facts of the aether harmonized, but also all the forces brought under the principles of the conservation of energy, and of least action. Thus nature not only acts simply, but also by the most uniform processes throughout all space. It is not therefore admissible to hold any theory of the aether other than that it is an infinite aeolotropic elastic solid, with the density arranged about the heavenly bodies to increase directly with the distance. And the wave amplitudes varying inversely as the radius,  $A = k/r$ , supports this theory, by geometrical considerations, which exclude every other theory of the medium for the interpretation of the forces operating throughout the physical universe.

9) In the course of the article *Aether* (*Encyclopedia Britannica*, 9th. ed., 1877), *Maxwell* calculates the density as  $\rho = 1.07 \times 10^{-18}$ , thus implying homogeneity, and speaks of this medium as "a vast homogeneous expanse of isotropic matter."

But it is obvious on reflection that this medium cannot be homogeneous<sup>1)</sup>; for in that case there would be no stresses in the medium for generating the forces which govern the mutual interaction of bodies throughout space. The mutual actions between bodies is an observed fact. In motion the bodies are everywhere found to describe ellipses, parabolas or hyperbolas about one another. Nothing but forces, due to tension between the bodies, and increase of pressure beyond them, could possibly produce this remarkable power for holding the planets in their orbits.

10) Thus forces imply waves, and waves lead to forces, when the mutually interpenetrating waves are so directed as to undo one another, and cause the collapse of the medium in the right line between the bodies. As the gravitational forces are of enormous intensity, it follows that the elastic power of the aether has to be tremendous, in order to generate the forces actually observed.

11) Accordingly, the existence of forces implies stresses in the aether: the stresses imply waves: the waves imply heterogeneous density in the medium, which must vary with the radius from any mass according to the law  $\sigma = \nu r$ . There is no other view of the aether which can be held. Homogeneity of density would imply no stresses; no stresses would imply no forces; no forces would imply an inert universe; which is contrary to observation and thus wholly inadmissible.

<sup>1)</sup> In the *Baltimore Lectures*, 1904, p. 265, under date of Nov. 16, 1899, Lord *Kelvin* says: "We have strong reason to believe that the density of ether is constant throughout interplanetary and interstellar space". This error is very widespread, and its persistence shipwrecks physical research!