

It is well known that the centrifugal force is given by the expression, $f = mv^2/\rho$ (1)

where m is the revolving mass, v is the instantaneous velocity, and ρ the radius of curvature of the orbit. As the planetary orbits and the orbit of the moon are not far from circular, we may with sufficient approximation calculate the centrifugal force for circular orbits. In the case of the earth's attraction for the moon, it suffices to take the earth's weight in metric tons, the moon's mass = $1/81.45$, and the distance of the moon 60 terrestrial radii, so that the weight at the earth's surface is to be reduced by the divisor 3600. Then, as gravity balances this centrifugal force, we have for the attraction of the earth on the moon:

$$f = (5.956292 \times 10^{21}) / (81.45 \times 3600) \\ = 20.3137 \times 10^{15} \text{ metric tons.} \quad (2)$$

This enormous tension would require for its support the full breaking strength of a weightless solid circular column of steel 645 kms in diameter, when the steel has the tensile strength of over 30 metric tons to the square inch = 6.4 sq. cms, and such a small bar of steel would thus about lift a modern battleship of the largest type. The tensile strength of the above single column, 645 kms in diameter, would be equivalent to about 500000000000 columns of such weightless steel, each of one square foot cross section, 922 sq. cms, or about one such column to each area $16 \times 16 = 256$ sq. feet of a hemispherical cross section of the earth. So much for the stresses which control the moon's motion.

But the gravitational attraction of the sun upon the earth is very much more powerful than that of the moon. The attraction of the sun upon the earth is of course equal to that of the earth upon the sun, which is easily seen to be

$$f = 332750 / (23445)^2 \times 5.956292 \times 10^{21} \\ = 3.60572 \times 10^{18} \text{ metric tons} \quad (3)$$

where the number 332750 represents the sun's mass, in units of the earth's mass, and 23445 is the sun's mean distance, in units of the earth's radius.

This attraction of the sun on the earth is equivalent to the tensile strength of 1000000000000 weightless circular pillars of steel, like that discussed above, but each having a diameter of 30 feet, about 9 metres. This is equivalent to the tensile strength of a forest of weightless steel pillars, each 11 inches or 28 cms in diameter, on each square foot of a hemispherical cross section of the earth; so that the surface of the globe would be almost covered with these cables of steel.

Such calculations of the enormous gravitative power of the heavenly bodies were first brought to my attention by Professor *Joseph Ficklin*, of the University of Missouri, about 33 years ago, and have never been overlooked in my subsequent studies of the cause of gravitation. Now with these concrete figures before us, we see that the cause assigned for gravitation must be adequate to sustain these tremendous forces, miraculously pulling like stupendous cables of steel, imagined as weightless as spider webs, yet stretched to the utmost limits of their tensile strength across the celestial spaces, for holding the planets in their orbits.

Accordingly *Einstein's* proposal to do away with the aether is chiefly remarkable for the lack of understanding of

the physical universe which it displays. Sir *Isaac Newton* himself denounced those who believed action could occur across empty space as not having a competent faculty of thinking in philosophical matters. In his letter to *Bentley*, 1692-3, Febr. 25, he says:

"That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial, I have left to the consideration of my readers."

In a paragraph cited below, *Maclaurin* tells us that *Newton* held gravitation to be due to impulses of the aether, but could not make out exactly how they arose; and this passage shows that *Newton* did not regard this medium as ordinary material.

a) It is shown below that the elasticity of the aether is 689321600000 times greater than that of our air in proportion to its density: it has therefore enormous power of contraction, if any natural process be at work to cause it to collapse.

b) It is shown in the *Electrodynamic Wave-Theory of Phys. Forc. I, 1917*, that between any two sources, as the sun and earth, the waves so interpenetrate, with rotations in opposite directions, as to decrease the stress and cause collapse of the medium between the sun and the earth; and this therefore develops an enormous tension, with maximum stress in the right line between the bodies, while beyond them there is corresponding increase of stress and thus an external pressure also overcoming the effects of the centrifugal force, and compelling the planet to follow the Keplerian ellipse about the sun in the focus.

c) It is shown in section 7 below, that the potential is simply an expression for the total accumulated stress, due to the waves from all the individual atoms of a body, — each wave following the law of amplitude,

$$A = k/r \quad (4)$$

and giving an element of force, as in gravitation,

$$f = k^2/r^2. \quad (5)$$

Accordingly we see that *Laplace's* definition of the potential, 1782, points directly to the wave-theory:

$$V = \iiint \{ \sigma / \sqrt{[(x-x')^2 + (y-y')^2 + (z-z')^2]} \} dx dy dz. \quad (6)$$

d) Therefore it is natural to hold that gravitation is a wave phenomenon in the aether, and to dismiss all other hypotheses as not fulfilling conditions essential to a true physical cause. This wave-theory of gravitation will give a new ground for the deflection of the light of stars when the paths of their rays pass through the gravitational field of the sun, as indicated in the eclipse of May 29, and reported at the meetings of the Royal Society and Royal Astronomical Society, Nov. 6, 1919.

e) It will be shown below that both the density and rigidity of the aether increases as we go outward from the sun, according to the laws