Nature **(March 30, 1911)**

Letters to the Editor: Sir Oliver Lodge
Re: A Kinetic Theory of Gravitation

The subject of Mr. Brush's article in *Nature* of March 23 (p. 129) is certainly of profound interest, and will continue to be so until the problem as to the nature of gravitation is solved. Meanwhile, a few questions raised are comparatively simple. Anyone asked, Where lies the energy of a raised weight? Must surely reply, "In the aether", i.e., in the medium, whatever it is, that is driving the weight down towards the earth. A critic who either doubts or asserts this will not be confused -- as Mr. Brush suggests he will be -- by the suggestion that the weight might be raised up so high as to reach the neutral point between the earth and moon -- a suggestion which carries with it the tacit questions, "Where is the energy now?" and "What has become of the work done?" -- for this case is no more troublesome than the case of a weight raised and hung on a hook. Something -- some opposition force -- sustains the weight, i.e., opposes the pull of the earth, and it matters little whether the opponent be a shelf beneath it or the moon above it. The important thing to understand is the nature of the downward propelling force -- indeed, of both the upward and the downward force -- in either case.

The question whether the energy of a raised weight is potential or kinetic is of little or no importance. The energy is certainly potential, according to our definition of potential. So is the energy of a strained spring: for there also the atoms are separated against their mutual (cohesive) attraction, and there again the energy really resides in the aether. But that all energy may turn out to be ultimately kinetic -- when we come to understand what elastive stress fundamentally is -- that proposition is not negatived in the least.

Mr. Brush proposes a shadow theory of gravitation, a modification of Le Sages's theory except that the pressure is supposed due to the non-syntonic impact of waves traveling in all direction, instead of to a bombardment of utterly minute particles flying at random. There is nothing new in a shadow theory, and all such theories are faced with the difficulty of plausibly explaining the absence of noticeable screening -- a difficulty which is bound to reduce them to acquiescence in an approximation.

The contribution which Mr. Brush makes to the discussion is the suggestion that the supposed gravitational aether-waves are the result of accumulated thermal radiation from all past and present suns, the wave-lengths having automatically increased during their long storage.

To this view several objections might be urged -- one of them being that in that case the constant of gravitation would be secularly increasing; another, that it should be greater in a hot enclosure, say the interior of a sun, than elsewhere; but a more salient objection is raised by the inquiry as to which is cause and which is effect. How did the bodies get hot and so radiate? Was not their heat perhaps due to their having clashed together with gravitational energy itself derived from the aether?

The fact is that every question concerning origin involves us always with insuperable puzzles, and that is just the main difficulty about gravitation. An atom of matter, by its very existence,

sets up a fixed stress in the aether, varying directly as the mass and inverse as the distance -- that is only another way of stating the law of gravitation; we are trying to understand the nature and cause of that stress. It appears to be one of the fundamental properties of matter, and until we can understand what is meant by the generation or destruction of an atom -- i.e., of an electron if that is the fundamental unit -- we are hardly likely to understand its gravitational influence more than any other of its fundamental properties -- including, perhaps, existence itself.

Let this not be understood as a negative prediction or estimate of impossibility -- such predictions are always absurd; it may be that when the structure of an electron is understood, we shall see that an "even-powered" stress in the surrounding aether is necessarily involved. What I do feel instinctively is that this is the direction for discovery, and what is needed is something internal and intrinsic, and that all attempts to explain gravitation as due to the action of some external agency, whether flying particles or impinging waves, are doomed to failure; for all these speculations regard the atom as a foreign substance -- a sort of "grit" in the aether -- driven hither and thither by forces alien to itself. When, someday, we understand the real relation between matter and aether, I venture predict that we shall perceive something more satisfying than that.

Oliver Lodge
University of Birmingham
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