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GRAVITATION - A DISCUSSION

by J. W. Wickenden
305 Corbett Street
Carson City, Nevada

It is quite well known that neither Newton nor his contemporaries or successors could shed any light on the essential nature of gravitational attraction. The action of the law of gravity was indeed well and rigidly demonstrated in the Principia, but Gravity's alter ego, Inertia, had small mention therein outside of the First Law of Motion. Yet Inertia might be called the measure of Mass, which in turn formed the all-important subject matter of the Law.

As a parallel circumstance, it could be mentioned that Newton, although the father of the corpuscular theory of light, never attributed the idea of Mass to his light particles. That fundamental truth had to wait for Relativity, and Einstein.

So far as discussion and research on this matter are concerned, Gravity has been grounded in a manifold of three dimensions, with 3 orthogonal axes, , unless, indeed, the latest wave theory of Gravity has led writers to go farther afield and adopt other spaces than the so-called Euclidean. There is, however, no likelihood that the Lobachevskian (space at constant negative curvature), the Riemannian (space at constant positive curvature), or the Euclidean (the space of zero curvature) will add anything significant or clarify our discussion; hence the following

will be used.

The Law of Motion as expressed by Newton and adopted in dynamics generally since that time is , but only if mass (m) is invariant and where (a) equals acceleration. This expression, it will be noted, is based on the dynamical coneept of force, also on the kinematical concept of motion; while kinetic energy is expressed by or in tensor form

which again may be expressed by Lagrange's equation

where : activating force

: kinetic energy.

These expressions are placed here as they will serve in later discussion, where the query is posed: What will happen if a certain body is placed in a gravitational field--a body such that the impact of gravitation alone upon it will generate heat?

Given 2 masses, M_1 and M_2, whose mass centers are connected by the position vector R_{12}, whose densities are and , in a Euclidean space covered by Cortesian coordinates the force of attraction takes place in the plane passing through the mass centers and along the vector R_{12}. Under these conditions Newton's law states that

where F equals gravitative force, alpha equals a constant, depending upon the units employed and here taken as 1.

No assumption is made beyond this regarding the body, and no other stipulations; we simply assume the space is Euclidean and that Newton's and Lagrange's Laws are applicable.

The line joining the centers of the mass particles is the position vector R_{12}, along which gravitational forces act.

Now we know that perpendicular to the plane passing through the mass centers and the vector R_{12} all virtual velocities are nil; there remain, however, the forces parallel to this vector, whose sum must equal the gravitational force

Under these circumstances motion will ensue over some distance, δR_{12}, with a resulting kinetic energy expressed by

if, and only if, the mass remains invariant.

If now we postulate that the mass attracted is of such nature that the gravitational pull produces heat, then the attracted mass is not invariant, since it is discharging molecules over an arc, whose section proves it to be spherical, at an unknown rate, since this rate is a function of the temperature. In any case, however, is the rate of loss, for t_0 is less that t and t is less that t_1; hence the total loss after time t is the integral

hence the residual mass is

or, if we replace the density function,

plus a constant of integration.

If denotes the surface of M_2, T its temperature and E entropy per unit of mass, the total input of heat is

and the emission of energized molecules is

which cannot exceed the kinetic energy. This latter is expressed by Lagrange's equation:

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Now in equation ( ) both the expressions and may be treated as constants and be brought outside the integral signs, thus leaving

or by differentiating in regard to t,

that is rate of emission of activated molecules equals rate of emission per unit area times entropy per unit mass. Under the gravitational stress the molecule M_2 moves along the position vector R_{12} and acquires a kinetic energy ; that is, rate of emission of activated molecules equals the rate of emission per unit area times entropy per unit mass.

Under the gravitational stress the mass moves along the position vector R_{12} the distance dR_{12} and acquires the velocity V^2 or

and kinetic energy

while the work performed,equalling the change in kinetic energy, is

We will now consider a surface molecule and investigate what takes place under the gravitational stress. No heat transmission takes place into this molecule, and no force except the initial gravitational stress, which takes place along the vector R_{12}; on the other hand, there is a tendency for the outer layer of molecules to slip over those (deformation) that immediately underlie it and which is resisted by the force of cohesion among the molecules.

From thermodynamics we have

that is, increase of internal energy equals increase of internal heat, plus work done in the process, or internal energy equals work plus temperature and if we call temperature T, entropy E, and mass M_2, we obtain

But T is a constant here, namely space temperature; hence it goes outside the integral sign, or , which is the equation (supra) marked (in all vital respects).

In other words, the emission of heat in such circumstances is equal to the internal heat generated, and no increase in heat in the body can be effected.

We conclude, then, that without knowing the nature of the gravitational force or the nature of the substance interposed in it and supposedly able to engender heat, the heat could not build up and so would reach some unknown value and would become stationary, finally dissipating. It may be remarked that the facts of Stellar Astronomy support this view.

It might appear that a comet's tail is a direct contradiction, as the comet approaches perihelion, but a little reflection will dispose of it entirely. The sun's heat and light rays bombard the comet, driving matter from the head of the comet outwardly, more particularly as the perihelion distance diminishes; conversely, the length of the tail decreases on the outward journey. Gravity plays only a relatively unimportant part.

For any given set of circumstances the second right hand member may be considered constant, and T, the space temperature, is likewise unvarying, so that we have the internal energy equalling a function of the entropy.

Now we know that the entropy in general is always tending to a greater value, but in the case of space the increment of heat is minimal, so that the heating effect on a body exposed to gravitational attraction alone is likewise minimal.

We are thus able to infer that in the reaches of space, where other forms of matter occur of a form or nature unknown to us, the attraction of gravity cannot produce results, whose sum total is a contradiction of the effects we see in our own vicinity.

We have presupposed, however, that our so-called Euclidean space is universal, but in a more specific Riemannion or Lobacherskian manifold results might be otherwise, if taken in the large.

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