

**OPTIMAL INCORPORATION OF MACH'S PRINCIPLE IN  
GENERAL RELATIVITY EXPLAINS  
ANOMALOUS QSO RED-SHIFTS &  
MISTAKENLY -ALLEGED 'MISSING' MATTER**

by

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**ABSTRACT**

This Essay is submitted in order to set the historical record straight and bring before the scientific community the facts regarding a grave miscarriage of justice at *Nature* magazine in 1975 of which the present author was an innocent victim who now, 22 years later, places before the bar of history incontrovertible documentary evidence that ideological biases in favor of *standard, constant Cavendish-parameter* General Relativity (**GR**), instead of the modification of it which Einstein himself is on record as hoping to see, caused suppression of important scientific discoveries which would have prevented much current puzzlement about QSO's with red-shifts  $z > 4$  which on the basis of much cogent evidence appear not to be at such cosmological distances, and which would also have prevented much current puzzlement about the allegedly 'missing' matter, for which the dynamical 'evidence' is quite spurious.

## 1997 Gravity Contest Essay

As is well-known, Einstein regarded General Relativity (GR) as incomplete unless it incorporated Mach's Principle, or more precisely the Newton-Berkeley-Mach (NBM) principle of *non-autonomy of mass*, which is sometimes stated as that any quantitative measure of mass should depend upon the distribution of mass in the remainder of the universe. [In some of my earlier writings I have referred to the NBM principle as the "autochthony of mass" because certain writers in psychology use "autochthony" as an antonym for "autonomy," but upon checking an unabridged dictionary and finding it a synonym for "indigenous" or "aboriginal" I realize my earlier usage is incorrect and beg the reader's indulgence in making the mental <sup>shift</sup> required when consulting the Appendices.]

Einstein thought that he had found a way to incorporate the NBM principle in GR by including it in the boundary conditions. Unfortunately after his death an arithmetic mistake was discovered in his calculations which meant that GR was still incomplete. Most experts have found the most satisfactory method of including the NBM principle in GR to be the so-called *tensor-scalar theory* of Pascual Jordan, which has been further developed by Brans, Dicke and Wagoner and will hereafter be referred to as the **JBDW** theory. In this theory the familiar **Cavendish parameter  $G$**  or **Newtonian gravitational 'constant'** is not actually a constant, but is the reciprocal of a scalar,  $\phi$ , which is a solution of the 4D curved-spacetime generalization of d'Alembert's Wave Equation with a source-term on the right-hand side which is proportional to the local density of mass  $\rho$  divided by  $c^2$ . The coupling constant was taken by Dicke to have the form  $8\pi/(3 + 2\omega)$ .

where, as is well known [cf. the standard texts of Misner, Thorne & Wheeler or of Weinberg], GR is recovered in the limit as  $|\omega| \rightarrow \pm \infty$ .

The Dicke coupling constant  $\omega$  is closely related to the well-known Eddington-Robertson parameter  $\gamma$  by the relationship  $\gamma = 1 - [1/(\omega + 2)]$ , according to which it is easy to see that  $\gamma = 1$  in the case of classical GR whereas  $\gamma < 1$  if  $\omega > -2$ , and in particular  $\gamma < 1$  if  $\omega > 0$ . For reasons to be explained, there has been an expectation or prejudice that  $\gamma \leq 1$ , and so most workers have simply assumed that the Dicke coupling constant is positive without further consideration of the case that it might be negative.

The reasons for expectation that  $\gamma \leq 1$  have to do with the fact that in this case, as cosmic time  $t$  increases,  $G$  decreases, in accordance with a 1937 conjecture of Dirac (based upon numerological arguments). It turns out that if a test body approaches a great mass, such as by doing a Cavendish experiment inside the orbit of Mercury, then in this case  $G$  will be found to be ~~greater~~<sup>less</sup> than its value on Earth, i.e.  $G$  ~~increases~~<sup>decreases</sup>. These two corollaries of the assumption that  $\gamma \leq 1$  will be symbolized as:

$$\partial G/\partial t < 0, \quad \delta G < 0. \quad (1)$$

As I have documented in the Appendices, only ~~4~~<sup>5</sup> brave souls appear to have dared to question majority opinion and to consider the possibility that to the contrary, Dicke was mistaken in assuming that  $\omega > 0$ , according to which one should consider  $\omega \ll 0$ , whence one has  $\gamma > 1$  and, contrary to (1):

$$\partial G/\partial t > 0, \quad \delta G > 0. \quad (2)$$

But as shown in the Appendices, the typical tests for comparing the predictions (1) against the predictions (2) involve very delicate and difficult

measurements, and are expected to discriminate between a null result only at the parts-per-billion level.

Moreover, as demonstrated in the standard texts cited, when  $\omega$  is very large, so that  $\gamma$  is very close to 1, the qualitative predictions of standard GR and the DJBDW modification of GR are essentially identical. Consequently the interest in DJBDW as a “foil” against which to test GR has waned enormously, and popular writings (cited in the Appendices) have declared that the DJBDW (briefly referred to as BD) theory is “dead.”

Nevertheless, in 1974-75 I went to the trouble of cranking through all of the standard results of GR and of its DJBDW modification in the case wherein

$$\omega \ll 0, \quad \gamma > 1 \quad (3)$$

in which case, contrary to popular belief, the results are not qualitatively similar to those of GR/DJBDW at all! I call this case the **MJBDW** theory, in honor of the late **Edward Milne**, as its central results have already been published by him, although derived from Newtonian mechanics (in the same way that the Milne-McCrea Theorem shows that the Friedman-Lemaitre equations of GR for a hyperbolic cosmology can be derived from purely Newtonian assumptions about a large number of particles, whose distribution is homogeneous and isotropic, and whose total energy constant is positive [as in an explosion]). Moreover, it is not possible to take the known analytical results in the case

$$\omega > 0, \quad \gamma \leq 1 \quad (4)$$

and simply transform them into the results appropriate for the MJBDW case

(3) by setting  $\omega = -|\omega|$ ; instead, one has to go back to first principles and find the analog of the Schwartzchild singularity by a new derivation; the final closed-form answer is an algebroid function of surprisingly great complexity in its dependence upon the unspecified parameters. (As can be seen in detail in the Appendices, which presents the final answer quite explicitly so that the reader may verify its correctness, its derivation required two weeks of hard work.)

These MJBDW results in complete detail have been on file with the Gravity Research Foundation since March 30, 1975. In May of 1975 I submitted a paper to *Nature* in which I applied reasonably sophisticated statistical techniques (later approved by a colleague who held a doctorate in statistics) to examine the then 25 known astrophysical measurements of  $\gamma$ , arriving at the result that to more than two standard deviations,  $\gamma >$

As will be seen in explicit detail in the Appendices, the consequences of the Eddington-Robertson parameter's being greater than unity are radically different from those of GR/DJBDW in several cases wherein the gross observational *differences* in a MJBDW cosmology would be overwhelming, rather than minuscule.

In particular, in a MJBDW-modified GR cosmology,

**[1]** although compact objects can exist, *true "black holes" are physically impossible* [as argued by Einstein, Rosen, Hoyle, <sup>Stama</sup> & others], in that as the Michell-Laplace-Schwartzchild **black-hole radius**  $R_{MLS}$  is approached externally, gravity reverses sign and become infinitely repulsive, so that no particle can penetrate this boundary:

[2] gravitational red-shifts in the surface layers of a nearby star can have *arbitrarily large red-shifts*  $z$ , so that for QSO's the Hubble Law is not necessarily applicable;

[3] the Virial Theorem gets two additional terms which are qualitatively what is needed to eliminate the problems of galactic and supergalactic rotational curves being contrary to Keplerian expectations (unless there is non-luminous mass present)

The fact is, that on a purely Newtonian basis, the idea of “missing mass” is highly dubious, as proved in one of the Appendices by exhibition of an explicit 4-parameter rotation curve which can fit any hitherto observed galactic or extra-galactic rotation curve by mere adjustment of the 4 parameters, and yet which is derived from a model of utmost simplicity consisting of a solid sphere combined with a flat disk, each having arbitrary mean densities and radii

But the anonymous referee for *Nature* in 1975 rejected my paper, opining dogmatically that “the author attempts to prove too much from too little; he should WAIT until the resurface radiotelescope at Arecibo gives more accurate results.” In other words, the referee could not logically deny that the known evidence favored (3) instead of (4), but his prejudices in favor of (4) were so great that he favored suppression of contrary evidence in hopes that “more accurate future measurements” would support (4)! protested to the Editor of *Nature*, who had courtesy to send me a personal letter saying that the referee was of such stature that he had to accept his view over mine.

Some two decades later, I picked up *The New Physics*, edited by Paul

Davies, and happened to open to a graph depicting the results of a decade of long-baseline interferometric studies of QSOs by the US Geodetic Survey in which the final result is that  $\gamma = 1.0002$  plus or minus a debatable error, so that

$$\omega = -5,002 < -2 < 0. \quad (5)$$

Accordingly, the time has come for the scientific community to abandon its prejudices (which have led to the impasses noted in the title of this paper) and consider that the modification of GR which Einstein himself would have preferred is the MJBDW theory that *Nature* arrogantly suppressed in 1975

P.S. As a bonus, I include a result in purely *Newtonian gravitational astrophysics*, namely that from the Newtonian n-body problem one may derive a new natural constant (independent of the masses of the Sun and planets, and independent of the Cavendish parameter  $G$ ), namely the distal ratio between planets observed by Titius some 230 years ago (and popularized by Bode as “**Bode’s Law**”), which as shown in an Appendix is, *observationally*, for our present solar system of 9 planets exactly

$$\beta = .795, \quad (6)$$

whereas from my mathematically rigorous closed-form solution it is predicted to be:

$$\beta = 1/\left[\left(\frac{3}{2}\right)^{2/3} - 1\right] = 1.794980124888927\dots\dots (7)$$

Enclosures

Appendices A-1 through A-15