# NEW THEORY OF THE EARTH'S MAGNETIC FIELD

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ABSTRACT

Following numerous experiments with the pivoted long triangularly formed needles made of various non-ferromagnetic materials freely rotating in the horizontal plane in the Earth's gravitational field, just as the needle of an ordinary magnetic compass, the conventional Earth's magnetic field is re-examined, since such needles after some very slow oscillations, assume the North-South direction of the ordinary magnetic compass. The Newton's theory of gravity is strictly utilized for the analysis of these gravitational experiments, but the origin of the geophysical co-ordinate system is moved from the center of mass of the Earth to the center of gravitation of the Earth, at which point the Earth's gravitational field is zero. That analysis leads to a new theory of the origin of the Earth's magnetic field as presented in this article with the critical review of the dynamo theory of the origin of the Earth's magnetic field, which theory is shown not to be valid in many cases.

## Section 1. INTRODUCTION

The large-scale Earth's magnetic field was recognized very long time ago and utilized for navigation for centuries, but its origin remains still a mystery. The Earth was considered to be a large permanent magnet, but that view had to be abandoned after the experiments in 1895 by Pierre Curie with heated permanent magnets, v. [1)] and [2)] for more details. The present view is that the Earth's magnetic field is caused by a dynamo action inside the Earth's core, presumably transforming its heat energy into the electrical current, which in turn generates the Earth's magnetic field, v. [2)] obviously violating the second law of thermodynamics.

Some facts, which will be discussed later in this paper, appear to present very serious challenges to that dynamo theory. On the other hand, pivoted long triangular horizontal needles made of various non-ferromagnetic materials assume after some very slow oscillations the North-South direction identical to the N-S direction of the magnetic needle of the ordinary magnetic compass. The analysis of those gravitational experiments leads to a new theory of the Earth's magnetic field, which will be compared critically in this paper with the dynamo theory.

## Section 2. PRELIMINARY DEFINITIONS AND CONSIDERATIONS

The International Gravity Formula is given by the expression, v. [3), p. 79]

$$g = 9.780490(1 + 0.0052884\sin^2\lambda - 0.0000059\sin^2 2\lambda) \quad m/s^2 \quad , \qquad (1)$$

where $\lambda$ is the geographic latitude. The second term is due to the rotation of the Earth, and the third term is used for fitting. This formula does not show the dependence on $r$ and $\phi$. The flattening $f^{-1} = 298.5$ must be used for the northern hemisphere, and the flattening $f^{-1} = 297.3$ for the southern hemisphere (v.[3), p. 79]).

It is strange to realize that the IGF (1) does not show at all explicitly the dependence on the Earth's flattenings. The explanation for this strange fact is that the present geophysical coordinate system is obviously used with that IGF, and the origin for that geophysical coordinate system was chosen to coincide with the center of mass of the Earth. Since by definition the first mass moment of the Earth and any mass distribution with respect to its center of mass is zero, it follows that the mass moment of the Earth, which could take into account the different flattenings as well as any variation of the Earth's mass density, is zero by the choice of the coordinate origin of the still currently used, but inadequate geophysical coordinate system.

So, to obtain the Earth's gravity formula, which could show explicitly its dependence on the different flattenings and the mass density variations of the Earth, it is necessary to choose a different point for the coordinate origin of the geophysical coordinate system. There is only one more point inside the Earth, or any mass distribution, beside the center of mass, which is physically significant, and that point is the center of gravitation, or the center of self gravitation, with self for emphasis. The center of gravitation is defined in this paper as the point at which the self gravitational field is identically equal to zero. It is strange, but the center of self gravitation is not defined in any available physics textbook to the best of knowledge of this author, although such a point must exist uniquely for any mass distribution, within any mass distribution, or even outside some very special mass distributions. Those two centers never coincide for any mass distribution of any size, except for the absolutely symmetrical mass distribution, which never occurs in nature.

The geophysical coordinate system with the coordinate origin at the center of self gravitation of the Earth will be used exclusively in this paper for all analyses with the Earth's gravitational field, since the IGF (1) is obviously inadequate. .

The equation of motion of a point mass $m$ moving with the velocity $\vec{v}$ in the Earth's gravitational field $\vec{g}_e$, including the Earth's rotation, is

$$m\vec{a} = -m\vec{g}_e - m\vec{\omega}\times(\vec{\omega}\times\vec{r}) - 2m\vec{\omega}\times\vec{v}, \tag{2}$$

where $\vec{\omega}$ is the constant Earth's angular velocity. The second term on the right side is the centrifugal acceleration, while the third term is the Coriolis acceleration. That equation can be found in any comprehensive textbook on mechanics and the potential theory, just like all subsequent equations, all with the standard notations.

The Earth's gravitational field at a point of observation defined by $\vec{r}$ is

$$\vec{g}_e = G\int\frac{\rho_{me}(\vec{r}-\vec{r}\,')dV'}{|\vec{r}-\vec{r}\,'|^3} = -\nabla U_e \quad . \tag{3}$$

The potential $U_e$ is given by

$$U_e = G\int \frac{\rho_{me} dV'}{|\vec{r} - \vec{r}'|} \quad . \tag{4}$$

G is, of course, the gravitational constant $G = 6.67\times10^{-11} kg^{-1}m^3s^{-2}$. $\rho_{me}$ is the mass density of the Earth per unit of volume.

Retaining only two terms, the Taylor expansion yields approximately for the points of observation on the surface of the Earth and the outside points

$$U_e = \frac{GM_e}{|\vec{r}|} + \frac{G\vec{M}_{1e}\cdot\vec{r}}{|\vec{r}|^3} = U_{0e} + U_{1e} \quad . \tag{5}$$

$M_e$ is the total mass of the Earth given by

$$M_e = \int \rho_{me} dV' \quad , \tag{6}$$

which is a scalar, while the vector $\vec{M}_{1e}$ is the mass moment of the Earth

$$\vec{M}_{1e} = \int \vec{r}' \rho_{me} dV' \quad . \tag{7}$$

The mass moment of any mass distribution with respect to its center of gravitation is defined as the intrinsic mass moment, and it represents the unique characteristics of that mass distribution. The mass moment is by definition zero with respect to the center of mass of that mass distribution, to repeat once more. The center of mass cannot be used as the coordinate origin without loosing an important characteristics of that mass distribution, namely its intrinsic mass moment The Earth's intrinsic mass moment must be obtained by the extensive geophysical measurements.

The potential defined by the Equation (5) and calculated in the geophysical coordinate system whose coordinate origin is at the center of self gravitation of the Earth, will be used exclusively here in this paper for the Earth's gravitational field $\vec{g}_e$, so to include the important intrinsic mass moment of the Earth, together with the centrifugal acceleration and the Coriolis acceleration term, if necessary, in the analysis of a number of the gravitational experiments, instead of the inadequate IGF.

## Section 3. GRAVITATIONAL EXPERIMENTS

The Earth's gravitational field was experimentally analyzed extensively for the first time by Galileo Galilei using a small ball, small enough compared to the Earth, so that it can be considered as a point mass, or the legendary apple of Isaac Newton. But the long triangular pivoted needles, made of any non-ferromagnetic material, freely rotating in the horizontal plane in the Earth's gravitational field, yield some very interesting results which are not found or described in the physics literature so far to the best of knowledge of this author.

An equilateral triangle of the base of 9 mm and the height of 100 mm was cut from the thin bronze sheet of the 0.16 mm thickness, and then shortened to 90 mm to represent a long trapezoid, whose mass was measured to be 0.8 grams. Using an appropriate tool and a steel ball of the diameter of 0.5 mm, a dent was made at the approximate center of weight or mass of that trapezoid. That dent is used for pivoting that trapezoid on the tip of the axle of the smallest mechanical watch. That tip is really a spherical calotte of the diameter of 75 microns. This watch axle was fitted co-axially into the brass cylinder of 2 mm diameter and of 25 mm in length, and then fitted vertically on an aluminum pedestal lying on the horizontal aluminum plate of about 1 mm thickness, which plate was electrically grounded.

Now the described trapezoidal needle was placed at its dent on the tip, i.e., pivoted. Since the dent was made approximately, the pivoted needle assumed a position, which was not horizontal. It can be made to be strictly horizontal by filing it carefully all around its sides. It must be emphasized that the described dent point of the strictly horizontal needle cannot be exactly the center of mass of that needle, but only approximately, since the Earth's gravitational field is not exactly uniform. A strictly uniform gravitational field is necessary to determine exactly the center of mass of any object, but the exactly uniform gravitational field does not exist in nature.

Now the movement, i.e., the rotation of that horizontal trapezoidal needle was observed. This author's living room in his Belgrade apartment on the 4th floor of an ordinary apartment building was used for the experiments. The room was tightly closed and without any heated object in order to avoid any air movement-draft.

It was observed that the needle rotated quite slowly, finally assuming the direction identical to the North-South direction of the magnetic needle of an ordinary magnetic compass. The sharp end of the trapezoidal needle pointed towards the North. That needle remained in that position indefinitely until disturbed by the deliberate air movement-draft. After such deliberate air disturbance passed, the trapezoidal needle rotated quite slowly and assumed again the identical N-S direction.

The above described experiment was performed with the identical results using similarly constructed needles made of brass, aluminum and beech wood, except that in the case of the wooden needles, the small brass piece was suitably attached for the dents for pivoting, since beech wood or any other wood exhibits too strong friction with the pivoting tip. All these experiments were repeated in a number of apartment buildings in Belgrade with the identical results . These experimental results were demonstrated also during this author's seminar lecture on November 22, 2007 at the Faculty (College) of Mechanical Engineering of the University of Belgrade. Some early gravitational experiments and theoretical research of this author are described in Reference [4)] and Reference [5)] .

It should be mentioned that the ruby bearings, which are used in mechanical watches, exhibited stronger friction than the described dents for pivoting. But it must be emphasized that those dents must be made very, very carefully to reduce friction, which is a very serious problem in the above described gravitational experiments.

All above gravitational experiments can and must be repeated and checked at the various locations around the Earth, North as well as South of the equator. It must be mentioned that small ordinary permanent magnets and rather small coils carrying electrical current, i.e., small conventional magnets, caused some minor expected movement of the described gravitational trapezoid needles. These effects must be carefully studied in future experiments using very large electromagnets, very much larger than the trapezoid needles used in the above described experiments.

## Section 4. ANALYSIS OF GRAVITATIONAL EXPERIMENTS

First, diamagnetism and paramagnetism of those needles cannot explain the obtained results of these gravitational experiments. It is described in the literature that needles made of diamagnetic and paramagnetic materials may rotate in strong non-uniform magnetic fields, but the Earth's rather weak magnetic field is practically uniform within a room of the ordinary apartment buildings in Belgrade, in which these experiments were performed. The possible presence of ferromagnetic traces within those needles was checked and ruled out, particularly for the wooden needles. Numerical estimates of effects of diamagnetism and paramagnetism are given in [4].

The analysis of the above described gravitational experiments is carried out by using strictly the classical Newtonian mechanics. The rotation of the trapezoid-needle strictly in the horizontal plane is very slow, so this is almost a problem of statics.

Let $\rho_{m1}$ be the volume mass diensity of the pivoted or suspended trapezoidal needle. Then by definition, the torque exerted on that needle only by the Earth's gravitational field $\vec{g}_e = -\nabla U_e$ , the Equation (5) for $U_e$ , is

$$\vec{T} = \int \vec{r}\,' \times (-\rho_{m1}\vec{g}_e dV') \quad , \tag{8}$$

where $\vec{r}\,'$ is the position vector of integration from the pivoting or suspension point $P_s$. It is obvious that if $\vec{g}_e$ is uniform, so that it can be brought before the integral sign, the result is zero, i.e.

$$\vec{T} = \vec{g}_e \times \int \rho_{m1}\vec{r}\,' dV' = 0 \tag{9}$$

in view of the assumption about the pivoting-suspension point. The conclusion is that only due to the non-uniformity of $\vec{g}_e$ , the torque (8) can yield a non-zero value.

Introducing the proper expressions for $\vec{g}_e = -\nabla U_e$, $U_e$ given by (5), we obtain

$$\vec{T} = \int \rho_{m1} \frac{GM_e(\vec{r}_s + \vec{r}\,') \times \vec{r}\,'}{\left|\vec{r}_s + \vec{r}\,'\right|^3} dV' - \int \rho_{m1} \frac{G\vec{M}_{1e} \times \vec{r}\,'}{\left|\vec{r}_s + \vec{r}\,'\right|^3} dV' + $$
$$+ \int \rho_{m1} \frac{3G\left[\vec{M}_{1e} \cdot (\vec{r}_s + \vec{r}\,')\right](\vec{r}_s + \vec{r}\,') \times \vec{r}\,'}{\left|\vec{r}_s + \vec{r}\,'\right|^5} dV' \quad ,$$

or, after some obvious simplifications and assuming that $|\vec{r}''|$ is very, very much smaller than $|\vec{r}_s|$ (distance from the Earth's center of gravitation, i.e., the coordinate origin, to the pivoting or suspension point), very approximately

$$\begin{aligned}\vec{T} = GM_e\vec{r}_s \times \int \frac{\vec{r}'\rho_{m1}dV'}{|\vec{r}_s + \vec{r}'|^3} - G\vec{M}_{1e} \times \int \frac{\vec{r}'\rho_{m1}dV'}{|\vec{r}_s + \vec{r}'|^3} + \\ + 3G(\vec{M}_{1e}\cdot\vec{r}_s)\vec{r}_s \times \int \frac{\vec{r}'\rho_{m1}dV'}{|\vec{r}_s + \vec{r}'|^5}\end{aligned} \quad . \qquad (10)$$

The pivoted or suspended object-needle was assumed to be rod-like with its well defined intrinsic first mass dipolar moment $\vec{m}_1$ directed along its axis. It is concluded that the two integrals in (10) must be the vector quantities along the same axis proportional to $\vec{m}_1$, especially if the axial symmetry of that test object-needle is assumed. Thus

$$\int \frac{\vec{r}'\rho_{m1}dV'}{|\vec{r}_s + \vec{r}'|^3} = k_3\vec{m}_1 \quad , \qquad (11)$$

and

$$\int \frac{\vec{r}'\rho_{m1}dV'}{|\vec{r}_s + \vec{r}'|^5} = k_5\vec{m}_1 \quad , \qquad (12)$$

where $k_3$ and $k_5$ are the scalar quantities which depend on the geometry of that test object-needle and its non-homogeneous mass distribution. Hence

$$\vec{T} = GM_e k_3\vec{r}_s \times \vec{m}_1 - G\vec{M}_{1e} \times \vec{m}_1 + 3Gk_5(\vec{M}_{1e}\cdot\vec{r}_s)\vec{r}_s \times \vec{m}_1 \qquad (13)$$

This is an interesting result. Note that the vector $\vec{M}_{1e}$ generally has a component along $\vec{r}_s$, which is practically the vertical direction, as well as a component normal to that direction, i.e., in the horizontal plane. Thus, the torque (13) tends to align $\vec{m}_1$ with the vertical direction and also in the direction of the horizontal component of the vector $\vec{M}_{1e}$. The balancing direction of the vector $\vec{m}_1$, i.e., of the rod-like or needle-like pivoted or suspended object, depends on many factors, but mainly on the position of the pivoting or suspension point along that pivoted or suspended needle, since the center of mass, which is assumed to be the pivoting or suspension point, may be very difficult to be determined in practice, i.e., always in the non-uniform gravitational field. Nevertheless, the pivoted or suspended needle with the non-homogeneous mass distribution along its length must assume an angle with respect to the vertical direction, and an angle measured in the horizontal plane from the North, which angles depend on the vector $\vec{M}_{1e}$, which is, to repeat once more, the intrinsic first mass dipolar moment of the Earth. These angles may be referred to as the inclination and the declination respectively, to use the terminology associated with the magnetic compass. In view of the geophysical data, $\vec{M}_{1e}$ is directed from the southern to the northern hemisphere of the Earth. It must be determined experimentally.

In principle it is always possible to slightly move the pivoting point and find such a point of pivoting for which the first term, the third term and the appropriate portion of the second term in the Equation (13) cancel each other, which is written mathematically

$$\left\{GM_e k_3 \vec{r}_s - Gk_3 \vec{M}_{1ev} + 3Gk_5 (\vec{M}_{1e} \cdot \vec{r}_s)\vec{r}_s\right\} \times \vec{m}_1 = 0 \quad ,$$

i.e.,

$$M_e k_3 \vec{r}_s - k_3 \vec{M}_{1ev} + 3k_5 (\vec{M}_{1e} \cdot \vec{r}_s)\vec{r}_s = 0 \quad , \tag{14}$$

which is the condition obtained in the above described experiments with the needle strictly horizontal after very careful filing it all around its sides. $\vec{M}_{1ev}$ is the vertical component of $\vec{M}_{1e}$. Of course, $\vec{M}_{1e} = \vec{M}_{1ev} + \vec{M}_{1eh}$, where $\vec{M}_{1eh}$ is the horizontal component of $\vec{M}_{1e}$. Thus, the Equation (13) reduces to

$$\vec{T} = -Gk_3 \vec{M}_{1eh} \times \vec{m}_1 \quad . \tag{15}$$

This formula (15) defines mathematically the gravitational dipole-dipole interaction subject to all above stated assumptions. To repeat, $\vec{M}_{1eh}$ is the horizontal component of the vector $\vec{M}_{1e}$. This gravitational dipole-dipole interaction has been derived applying strictly the laws and the rules of the classical Newtonian mechanics. This is mathematically identical to the torque acting on the magnetic needle in the conventional Earth's magnetic field. Note that the monopolar term of the Earth's gravitational field is absent in this expression (15). It is cancelled by the pivoting or suspension. Only the dipolar term of the Earth's gravitational field causes that torque which acts on the trapezoidal needle forcing it to rotate. It must be emphasized that this mathematical model collapses totally and is not possible to be recognized, if the origin of the geophysical coordinate system is moved from the center of self gravitation of the Earth to the center of mass of the Earth. Thus, it appears that this mathematical model bears some resemblance to the heliocentric theory of Mikolaj Kopernik, or of his forerunner and harbinger Aristarchos of Samos some 18 centuries earlier, since in the both cases, the correct choice of the proper coordinate system leads to truth and solution.

It is easy to show that the centrifugal acceleration $\vec{a}_c$ (the second term in the Equation (2)) does not exert a noticeable torque on the pivoted or suspended needle, subject to all previous assumptions and approximations used in the derivation of (15). Namely,

$$\begin{aligned} \vec{T}_c &= \int \vec{r}\,' \times \rho_{m1} \vec{a}_c dV' = -\int \vec{r}\,' \times \rho_{m1} \{\vec{\omega} \times [\vec{\omega} \times (\vec{r}_s + \vec{r}\,')]\} dV' \approx \\ &\approx -|\vec{\omega}|^2 \vec{r}_s \times \int \rho_{m1} \vec{r}\,' dV' + (\vec{\omega} \cdot \vec{r}_s)\vec{\omega} \times \int \vec{r}\,' \rho_{m1} dV' \end{aligned} \quad . \tag{16}$$

This torque $\vec{T}_c$ is zero if the pivoting or suspension point of the pivoted or suspended needle (object) is at its center of mass as it was assumed. But when that pivoting or suspension point is moved along that needle- test object, then this torque $\vec{T}_c$ must, in principle, modify somewhat the effect of the torque $\vec{T}$ (15), but by no means substantially, since the centrifugal acceleration due to the rotation of the Earth is only about 0.5 per cent of the Earth's gravity on the equator and zero on the poles. $\vec{\omega}$ is the vector from the South to the North along the axis of rotation of the Earth by definition for the right-hand coordinate system, which is, very probably, also the general direction of $\vec{M}_{1e}$. The Coriolis acceleration is of no consequence, since the pivoted or suspended test rod-like object is at rest when the balance is achieved.

It is obvious from the Equation (15) that the balance position is reached when that torque becomes zero, i.e., when the vectors $\vec{M}_{1eh}$ and $\vec{m}_1$ become collinear. Since the trapezoidal needle assumes the N-S direction identical to the N-S direction of the magnetic needle of any ordinary magnetic compass, as experiments show, it is concluded that there must be some definite connection between the intrinsic mass moment of the Earth and the magnetic moment of the Earth.

The only logical conclusion is the identification of these moments with the suitable constants of proportionality, which must obviously depend on the materials of which the observed objects are made and on the units used. Thus, the described gravitational experiments prove that the intrinsic mass moment of an object is equal to the magnetic moment of that object with a suitable constant of proportionality. This conclusion is very far reaching with some very serious consequences in science, so that in the opinion of this author, the above described experiments must be strictly repeated and checked, to repeat once more. This author is very interested to hear about those results at various locations around the world, particularly South of the equator. Note that the intrinsic mass moment of a gravitational object is strictly a macroscopic category, while the magnetic domains are microscopic, whose alignment results in a conventional magnetic moment of a magnetized object.

The scalar potential of the Earth's magnetic field $U_{mage}$ is given by, v. [1)]

$$U_{mage} = \frac{\mu_0 \vec{m} \cdot \vec{r}}{4\pi |\vec{r}|^3} \quad , \tag{17}$$

where $\vec{m}$ is the Earth's magnetic moment, and $\mu_0 = 4\pi \times 10^{-7}\ H/m$ is the absolute constant. Thus, the Earth's magnetic field is $\vec{B}_{mage} = -\nabla U_{mage}$. The torque given by (15) is obviously due only to the dipolar term of the Earth's gravitational (scalar) potential given by the Equation (5), so we write

$$n_2 U_{1e} = n_2 \frac{G\vec{M}_{1e} \cdot \vec{r}}{|\vec{r}|^3} = U_{mage} = \frac{\mu_0 \vec{m} \cdot \vec{r}}{4\pi |\vec{r}|^3} \quad , \tag{18}$$

where $n_2$ is a suitable constant of proportionality. Consequently

$$n_2 G\vec{M}_{1e} = \frac{\mu_0 \vec{m}}{4\pi} \quad , \tag{19}$$

which means that the intrinsic mass moment of the Earth is identified as the magnetic moment of the Earth. Thus, if $\vec{m}_{mass}$ designates the intrinsic mass moment of a mass distribution, then $\vec{m}_{magn}$ is its magnetic moment, so that

$$\frac{4\pi G n_2}{\mu_0} \vec{m}_{mass} = \vec{m}_{magn} \quad , \tag{20}$$

where $n_2$ is a suitable constant which depends on the material of the observed object, i.e., the mass distribution and its form. This magnetic moment is defined obviously as a macroscopic quantity, while the conventional magnetic moment of a magnetized object, generally ferromagnetic, is a sum total of the aligned microscopic magnetic moments of the domains, whose size is quite small, but not atomic.

This identification is in fact the gravitational model, i.e., the new theory of the Earth's magnetic field obtained by the correct and strict application of the classical Newtonian mechanics. If that identification is denied, then the fact remains that at every point of the Earth there exist two presumably different fields producing identical final results as described earlier in this paper on objects made of different materials, which is absolutely absurd. To deny the existence of the torque given by the Equation (15) means to deny the validity of the entire mechanics, including statics, which is totally absurd. The consequence of the obtained experimental results is that the mass monopoles are actually the so far missing magnetic monopoles with a suitable constant of proportionality, while the so far totally ignored gravitational dipole mass moments are really the magnetic moments with a suitable constant of proportionality. This means that the gravitational scalar potential of any mass distribution, beside the usual form as shown by the Equation (4) for the Earth, must be given in the general case by

$$U = G\int \frac{\rho_m dV'}{|\vec{r}-\vec{r}\,'|} + G\int \frac{\vec{M}_1 \cdot (\vec{r}-\vec{r}\,')dV'}{|\vec{r}-\vec{r}\,'|^3} \qquad , \qquad (21)$$

where $\rho_m$ is the volume mass density of that mass distribution, and $\vec{M}_1$ is its vector mass moment density per unit of volume. This appears to explain the reports of the numerous research papers during the 1980's about various gravitational anomalies and speculating about the possible "fifth" force, which is absurd.

Once more, if the coordinate origin of the utilized coordinate system is moved from the center of gravitation of the Earth to the center of mass of the Earth, then the described and truly observed experimental effect cannot be considered theoretically, since $\vec{M}_{1e}$ , the Earth's intrinsic mass moment, is zero in such a coordinate system, i.e., the presently still used erroneous geophysical coordinate system. Since the torque defined by the Equation (15) is quite small and nobody was looking for it, due to the reasons as described in this paper, that effect was not found experimentally so far. And the obvious gravitational model of the origin of the Earth's magnetic field remained "buried under the ruble of traditional prejudice", to quote Arthur Koestler from his book *The Sleepwalkers* [6).

## Section 5. CRITICAL COMMENTS

Any true theory of the origin of the Earth's magnetic field must be applicable to all observed planetary, solar and stellar magnetic fields. The magnetic field of the planet Mercury was observed by the Mariner 10 and it was unexpected and produced a great surprise, v. [7). Namely, the dynamo theory relies on the hot, molten core of the planet Earth to produce the electrical current and the Earth's magnetic field. But the planet

Mercury is considered and observed to be a dead planet without any heat in its core. Consequently, the dynamo theory fails to explain the presence of the observed magnetic field of the planet Mercury, although some researchers assume and believe now that Mercury is not a dead planet. But the new gravitational theory has no problem whatsoever to explain the presence of the Mercury's magnetic field. The planet Mercury is certainly far from being absolutely perfectly spherical. Therefore, it must possess its intrinsic mass moment, and, consequently, its magnetic field.

The observed magnetic field of the Moon is impossible to explain by the dynamo theory, since the Moon is certainly a dead celestial body without any heat in its interior, but it can be easily explained by this new gravitational theory of the origin of the Earth's magnetic field.

The magnetic dipole of the Sun was observed to be normal to the axis of rotation of the Sun, v. [8) ], i.e., approximately in the ecliptic plane, which is approximately the plane of the trajectories of all the planets. But the direction of the Earth's magnetic dipole is not too far from the direction of the Earth's axis of rotation, which fact is necessary for the dynamo action. So, it is practically impossible to explain the Sun's large-scale magnetic field by the dynamo theory. But it is obvious that the Sun, being a large ball of plasma, is subject to the stretching by the gravitational fields of all planets, with the most pronounced stretching due to the planet Jupiter, which is by far the largest planet of our planetary system. Thus, the Sun's center of mass is pulled from the Sun's center of self gravitation creating the Sun's intrinsic mass moment, i.e., the Sun's magnetic moment as a vector in the ecliptic plane almost normal to the axis of rotation of the Sun, mainly by Jupiter, whose period of revolution around the Sun is 11.86 years. The other planets do have some influence, and this obviously explains the solar cycle. This gravitational model appears to be quite consistent with all the facts about the magnetic field of the Sun, while the dynamo theory fails in this case.

The reversal of the Earth's magnetic field is easily modeled and understood by this gravitational, new model of the Earth's magnetic field. The gravitational field in the region around the centers of self gravitation and mass is quite weak, so that those two centers are subject to changes, particularly if the external forces, i.e., external gravitational fields change. Due to those changes, it is quite probable and, indeed, it is observed that those two centers flip with respect to each other. It is interesting to mention that during the reversal, the Earth's magnetic dipole assumes the direction normal to the Earth's axis of rotation for a while, just before the reversal with the extraordinarily rapid change, v. [9) ]. Such reversal is easily understood on the basis of this gravitational, new model, but it represents a serious, challenging problem for the dynamo theory, which is impossible to overcome.

The paleomagnetic measurements indicate that the intensity of the Earth's magnetic field decreased during the warm Earth's periods and increased during the cold ice periods. That strange fact cannot be explained by any existing theory. But this gravitational model can easily explain this fact. Namely, during the cold period ice accumulates on the poles of the Earth, thus increasing its intrinsic mass moment, i.e., the intensity of its magnetic field. On the other hand, during the warm period there is a substantial melting of the polar ice caps resulting in an increase of the levels of the oceans. So the Earth as a consequence becomes more spherical in a way, which results in a decrease of the Earth's intrinsic mass moment, i.e., in a decrease of the intensity of its magnetic field as the paleomagnetic measurements do show. The warming of the Earth is observed for some time with the decrease of its magnetic field and the increase of ocean levels and is widely reported even by all news media.

The observed variations of the conventional Earth's magnetic field due to the various causes, due to the Sun, the Moon and the planets, as well as the earthquakes are easily understood and modeled by this new theory of the Earth's magnetic field.

## Section 6. CONCLUSION

The above exposed new theory of the Earth's magnetic field appears to be quite consistent with all the known facts about the Earth's magnetic field and all other known facts about the planetary and solar magnetic fields, while the dynamo theory appears to fail in some instances, and it obviously violates the second law of thermodynamics. This theory logically explains the fact that some animal species, homing pigeons, etc., can detect the Earth's magnetic field. They, hovering, i.e., mastering the Earth's gravity, are capable to detect even the tiniest variation of the Earth's gravity field. The reported beneficial effects of small magnets often placed around the human spine are produced probably by the slight, but beneficial modifications of the Earth's gravity around those parts of the human body, which this theory can explain easily.

The old legend that the Vikings, the legendary ocean travelers, determined the N-S direction by observing the direction of a wooden stick floating in water is easily understood and explained by this theory.

The experimentally found identification of the intrinsic mass moment with the magnetic moment, and the identification of the mass monopoles with the so far missing magnetic monopoles, obviously require some minor modifications of the existing theory of magnetism within the electromagnetic field theory. It is a fact that such modifications make the theory of magnetism more logical. For instance, the fictitious "sheet" electrical currents for the permanent magnets, which are obligatory in the present theory of magnetism, are absolutely unnecessary in the theory of magnetism with the required modifications, thus logically unifying two major classical theories of gravitation and electromagnetism, v. [10)] .

The elementary particles are defined in the present theoretical physics as the point masses and only with their centers of mass. Such treatment of the elementary particles implies that the elementary particles are dimensionless and totally rigid, and not subject to any deformation by the outside forces, including the inexorable gravitational fields. If the elementary particles, no matter how small they may be, are defined by their centers of self gravitation and the centers of mass, then they appear to be the finite objects with the finite dimensions, which may be subject to the deformations by the outside forces, including the outside gravitational fields. Consequently, for instance, a neutron must possess its intrinsic mass moment in the unavoidable external gravitational field, and in view of all the above described gravitational experiments, that intrinsic mass moment is its magnetic moment, beside its mass. Therefore, there is no need whatsoever for the hypothetical quarks and all associated hypothetical terms such as gluons, strangeness, color, etc., which appear to be only absolutely unnecessary mathematical fictions without any physical reality. As it is well known, some outstanding scientists, Heisenberg, Chew and others, disapproved of the quark hypothesis.

Gravitational fields do pervade the Universe and are present everywhere. Since the conventional magnetic fields appear to be the manifestations of the gravitational fields in accordance with this theory, and as such, the conventional magnetic fields also do pervade the Universe, being present everywhere.

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