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The Theory of a Variable "Constant" of Gravitation

SUMMARY

Sec. 1 Any attempt towards harnessing gravitation must seek out some indirect approach to its solution.

Sec. 2 Einstein's Theory, if final and complete, excludes any such harnessing.

Sec. 3 The author's Theory (developed mathematically in his book "Schwerkraft und Weltall", 1952) includes Einstein's fundamental ideas, but permits more complex effects from gravitation, through a varying value of the so-called "constant of gravitation".

Sec. 4 Selected data, both terrestrial and astronomical, which are best explainable by such varying gravitation.

Sec. 5 Further research on the origin of geomagnetism and of stellar magnetism, along the lines of the author's theory, is foreseen, for logical reasons therein stated, as the way, and the only way, by which the objective of the Gravity Research Foundation, the harnessing of gravity, may perhaps be indirectly gained.

This essay runs a full 2000 words and permission was obtained from Professor Stearns to submit it intact. If your Committee prefers to consider only essays strictly within the 1500 word limitation, Dr. Jordan authorizes the Committee, in reading Section 4 of his essay, to skip all except the 1st paragraph of said Section 4, something that will bring the complete remaining essay well within 1500 words

Pascual Jordan

The Theory of a Variable "Constant" of Gravitation

#1

THE PROBLEM

In the following I will attempt to give some suggestions which possibly may lead towards the objectives of the Gravity Research Foundation, harnessing gravitation. No direct approach, much less any immediate solution of the problem, is possible; much experimental work, and much deep theoretical research will be required before any practical results can be expected.

#2

IMPOSSIBILITY OF HARNESSING GRAVITATION, IF EINSTEIN'S THEORY IS CORRECT AND COMPLETE

Einstein's general Theory of Relativity - if it is correct and complete in its statements as to universal gravitation, rules out any possibility of harnessing gravity. Nevertheless, in Einstein's Theory many things may take place in the Field of Gravitation, far more complicated than those permitted by Newton's theory. For example, Einstein's Theory calls for gravitational waves, just as Maxwell called for electromagnetic waves. But the connection between Matter and the Gravitational Field, according to Einstein, is effected solely through the masses of its material parts, modified by their respective movements. Those movements may be disregarded if their velocities are small compared to the velocity of light. Chemical composition of matter, therefore, has no bearing on gravitation, and there is, therefore, no substance, nor can any substance be discovered or compounded which could ever act as insulator, reflector, or absorber of gravitation. There can be no such substance under Einstein's Theory.

The author's Theory, stated below (#3) agrees with Einstein's insofar as his conclusion that the composition of matter has no effect on gravitation. However, broader than Einstein's Theory, it does assert, indeed, a new attribute of gravitation, in which the movement of matter plays a definitely greater role. That feature may, indirectly, lead to a solution of the quest of the Gravity Research Foundation, as I shall indicate, in #5.

#3

THE THEORY OF A VARIABLE "CONSTANT" OF GRAVITATION

There exists, then, one Theory of Gravitation originating out of Einstein's own Theory which we shall now describe. This latter, which I have called the "Generalized Theory" (in German, "Erweiterte Gravitationstheorie") does not declare Einstein's theory to be false and inapplicable as to gravitation. But it does declare that a certain degree of generalization of his theory is necessary to explain all phenomena which are related to gravitation. If our Hypothesis is accepted, Einstein's Theory is too restricted - it must be "generalized".

The fundamental idea behind this new theory is the definition of f, the Newtonian Constant of Gravitation, in the Theory of Relativity, by the expression

(1) $G = \frac{8\pi f}{c^2}$

(where c is the velocity of light (3×10^{10} cm/sec^2) (and G, the universal "constant" of gravitation (6.67×10^{-8} dyne/cm^2/gm^2)

In agreement with Newton, Einstein admits that G is a true constant, unchanging in value, throughout space, and over all time.

Instead of this, we assert the Hypothesis

G is a variable.

G does vary, with time, and G may also vary from place to place.

Any changes in the value of G are necessarily extremely slight, over any span of time within the ken of man. But down the lifetime of the universe, G has diminished; for example, 2-1/2 billion years ago (half of time elapsed since creation) G was approximately twice its present value; 3-3/4 billion years ago (3/4 of the way

back to creation) G was approximately four times its present value; etc, etc., as one comes nearer to creation.

This idea was first proposed by Dirac . Various authors, including Einstein himself - later Thiry, Bergmann, Jonsson - have undertaken investigations of the Theory of Relativity, and through those studies they have all come close to, or even reached an agreement with,this idea. Since 1944 the author has been undertaking a series of mathematical investigations of this idea and of its bearing on the Theory of Relativity and on Cosmology. My mathematical investigations have been published in my book "Schwerkraft und Weltall", Brunswick, Germany, 1952. This brief paper stands on those mathematical conclusions of mine, so I shall not take the reader's time with my mathematics here, nor will I go into the aspects by which our theory bears on Cosmology and on the Origin of Stars, beautiful though those relations may be. There are, however, a number of phenomena in geophysics, geology, and astronomy clearly explainable by our theory, yet completely inexplicable otherwise. A few of these I shall mention briefly below, as supporting evidence - in the hope that the reader, convinced then of the advance represented by our theory, will be the more receptive to the theoretical considerations to be presented in #5 - theoretical considerations which point to what is probably the only way, circuitous though it may be, by which man may hope to ever harness gravitation.

#4

OUTSTANDING GEOPHYSICAL, GEOLOGICAL AND ASTRONOMICAL EVIDENCE SUPPORTING OUR THEORY

It was first brought to my attention by my friend, Joel E Fisher, that there exist many well known facts in geology and geophysics hitherto completely unexplained, but readily explainable under the proposal that the constant of gravitation has diminished over geological time.

For example, consider our terrestrial sphere - its outer crust consists of two distinct and separated types of rock, granitic and basaltic - the former

characteristic of the continental blocks, the latter characteristic of the floor of both the Pacific and Atlantic Oceans. (Ewing recently confirmed this, as to the Atlantic). Further, this basaltic layer also underlies the granite of the continents. The granitic continents thus seem to "swim" on a sea of heavier basaltic rock, like ice on water. The earth is like an orange, from which some of the skin is missing. Reasonably, that skin must once have uniformly covered the earth - what happened to what is missing?

Several authors, including Gamow, have proposed that the missing portion of this (granitic) crust was thrown off by centrifugal force, to form the moon. There are, however, very weighty objections to such a proposal, and it is no longer accepted.

Fisher proposes; the core of the earth must necessarily have expanded over geological time, if the constant of gravitation has been diminishing, for all matter (solid or liquid) at pressures exceeding those at a depth of 100 kilometers, is compressible (or expansible) on any further change of pressure (Bridgman - and independently, theoretically, Linus Pauling). Thus, as gravitation diminished, the "weight" of the overlying crust of the earth also diminished, permitting the already compressed core to expand. That outer 100 kilometers-thick crust could not itself expand as, unlike the inner core, it was not then in a compressed state - that outer crust would simply be rent asunder as tension grew within it by reason of the expansion of the floor on which it rested, the core. The granitic continents today are thus themselves equal in area to the surface of a smaller ancient earth. The crevasses between the pulled-apart continents expose the raw inner meat of that earth - today's basaltic ocean floors, - rock which oozed up from depth, into the gaps between the parted continents. Wegener pointed out, in his debated proposal drifting continents, how the eastern seaboard of the Americas fitted most beautifully, both as to coastline, and as to the geological age of matching regions, with the corresponding opposite western seabord of Europe and of Africa. Wegener had no motive power to push his continents apart; diminishing gravitation shows that

they were pulled apart, by an expanding floor, beneath. As these continents were pulled apart, their centers of mass would be translated across as much as tens of degrees of latitude or longitude, involving transfer of vast moments of momentum. This transfer of what is, in fact, part of the earth's own inertia, Fisher believes provides the source of the major forces of orogeny. Such an origin of orogenic forces (a by-product of diminishing gravitation) would thus be yet one more support for diminishing gravitation, for there are no other acceptable explanations of the source of these titanic orogenic forces. Fisher further points out that radioactive material in the crust of the earth appears to be sufficient to have raised the temperature of the crust to 3000°K - after due allowance for loss of heat by radiation into space (Linus Pauling, and others). How is it that our crust is not that hot, today? This same expansion of the core of the earth necessarily absorbed a tremendous amount of heat in its expansion, Fisher points out. That very same expansion of the core, by its thermodynamic cooling, would have absorbed that excess of radioactive heat in the crust, giving our earth's surface its unique constancy of temperature ranges.

Further direct evidences of expansion of the earth may be found in deep, narrow, oceanic trenches - notably the African rift, also. Then, too, what of the origin of the great mountain fault systems, on which so many theories have been proposed? The very multitude of proposals negates all of them. But Fisher's proposal of an expanding core offers a simple, logical explanation of recurring examples of tension in the crust.

To H. Binge, I am further indebted for pointing out that the problem of widespread Vulcanism, as well as intrusion, constitutes an enigma - until one accepts the theory of a diminishing gravitation, with its resulting tension in the crust. To assume that deep-seated magmas have near-explosive power to force their material through miles of overlying rock up to the surface, is fantastic - unless tension in the crust facilitated the opening of passages. Diminishing gravitation,

again, provides that requisite tension.

Against this background of phenomena of tension on our earth, consider Mars, smaller in mass, with a gravitational field weaker than the earth's. No fault-mountains, no vulcanism there, but a vast system of trenches (canals) and clear evidence of a dual set of crust-materials similar to that on our earth - except that the Martian equivalent of our granitic (continental) rock is shallower in thickness, than with us. If we apply Fisher's proposal of an expanding core of the earth to Mars, making due adjustment for a thinner granitic shell, and a smaller sphere, the processes which led up to present-day Martian geography ("canals") become evident.

Even further, take our moon - much smaller than Ma rs; its expansion must have been relatively slight - we see as evidence of this small scale expansion those fine-grained "rillen", the "rays" of the Moon, cutting across its surface.

Krause maintains that the moon once possessed an atmosphere - that could only have been possible if gravitation were once far more potent than today. Cold Titan, satellite of Saturn, appears to possess an atmosphere today. Possible today, at low enough temperatures - but in earlier times, when Titan was hotter - gravitation must have been stronger, else that hotter atmosphere could have never been held.

Again, from Gamow and Teller's mass-luminosity ratios, our sun must once have been more luminous than today, if gravitation was once stronger. This fits in beautifully with ter Haar's belief that our earth's atmosphere, in former geological eras, was packed with dense clouds - such as one sees on Venus, nearer the sun, today As a matter of fact, such a dense cloud cover must have existed in the Carboniferous period, when temperatures were so uniform over the entire earth, and where there is abundant evidence of seasonless years - e.g., trees without annual rings.

Thus, the theory of a diminishing constant of gravitation is supported by very broad empirical evidence, phenomena which are only explainable by this theory Further, its mathematical justification stands as set forth in my above-mentioned book, a step forward towards the ultimate truth.

THE PROBLEM OF GEOMAGNETISM

This, the final part of my essay, does give some hope of harnessing gravity. This hope results from the possibility that the theory of a diminishing constant of gravitation may also explain the hitherto unsolved problem of the origin of terrestrial magnetism. While my own investigations on this point are to date still incomplete, I am convinced that a solution of this further great problem is now beginning to be visible.

Recently certain definite empirical facts have become established, as follows:

(a) Other heavenly bodies also possess magnetic fields - in particular many of the fixed stars possess very powerful magnetic fields, so powerful, in fact, that the earth's, in comparision, is quite insignificant

(b) The Earth's magnetic field is variable - possibly periodic, as is the case with many fixed stars. Over past geological time, it has actually reversed its polarity, as proven by the recent discoveries that dipoles in ancient lava flows, parallel as within one flow, may nevertheless be oriented at any odd angle even up to 180° away from that of the earth's present field.

These facts refute the claims of Elsasser and of other authors that the magnetic fields of the earth and of the fixed stars did originate from principles already known - there must be some yet undiscovered key for the general origin of stellar magnetism.

Blackett some years ago did attribute this magnetism to some unknown laws of nature, but his line of thought can not be reconciled with modern understanding of Electrodynamics and Relativity. I am convinced that further research in the direction of the mathematical theory of a varying constant of gravitation will provide us with the necessary background for solving the problem of terrestrial and stellar magnetism;

and, if it is a fact that a varying constant of gravitation is the cause of magnetism in rotating celestial bodies, then, we must eventually succeed in artificially inducing substantial changes in the gravitational field of rotating masses, through electromagnetic experiments upon the same.

There is still a long way to go from these first suggestions, before the achievement of harnessing gravitation. But I am convinced that this avenue of approach, probably the only way, holds forth much promise of success.

# # #

Hamburg, Germany
September 27, 1954

1950

Professor Doctor Pascual Jordan, Hamburg University, Hamburg, Germany.

Born October 18, 1902, in Hannover, Germany, the son of the painter, Professor Ernst J. Jordan.

He attended the Realgymnasium in Hannover, and studied in Hannover and in Göttingen; in particular Physics, Mathematics, Zoology.

After serving in Göttingen and in Hamburg as Privatdozent, he was named Assistant Professor of Theoretical Physics in Rostock in 1929; in 1935, senior Professor, there; in 1944, Professor of Theoretical Physics at Berlin University; in 1947, at the University of Hamburg, where he is today.

Internationally known as a Scientist, he was awarded the Max Planck medal in 1942.

He worked with M. Born and W. Heisenberg, along with Pauli, Dirac, and others on the origination and development of Quantum Mechanics, during which work they completely verified that Quantum Theory, originated by Planck; he also later did research work with the same group on quantum-electro-dynamics.

He is the author of many books and papers on these subjects. His most fruitful fields have been in the Theory of Relativity, Cosmology and Bio-physics.

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JOEL E. FISHER
25 West 43rd Street
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October 7, 1954

Gravity Research Foundation
New Boston
New Hampshire

Re: 1954 Competition for Essays on Gravity

Gentlemen

I am enclosing, on behalf of Dr. Jordan, Hamburg, Germany, his essay in triplicate, submitted for the above competition

While the original German text was within the 1500 word maximum, I realized that its translation into English would run beyond that, so I communicated with Dr Howard O Stearns of your Board, asking whether the 1500 word limitation could be waived in this instance, and he told me to proceed with the translation as it stood, so here it is - quite a bit over the 1500 word limit

If it should be that your Committee nevertheless prefers to stand on the 1500 word limitation, Dr. Jordan authorizes your Committee in reading Section 4 of this essay to skip all except the first paragraph of said Section 4. This omittable material, close to 1000 words, is a summary of the numerous facts in geology and geophysics which are at present quite unexplained, but would become readily explainable under the proposals set forth in his essay; its omission would not interfere with his argument, although its inclusion would add greatly to a realistic understanding of his ideas

Very truly yours

Joel E Fisher