

## Earth's mass overestimated (additional suggestions 1)

Edgars Alksnis  
e1alksnis@gmail.com

Taking into account public interest in topic, I will criticize heavy Earth concept here more broadly. This results in indigestible mix of astrophysics, celestial mechanics, history of solar system, planetary science, geochemistry, geology, magnetism, seismology, and so on. Hydrogen and hydrous Earth concepts get some points

*There is a strong tendency for modern writers (including some notable contributors) in the Earth sciences to be unduly black and white in their pronouncements - rather over-steady to 'prove' and 'disprove' and to declare the 'beliefs' and 'disbeliefs' of themselves and others in contexts where cautious assessments in terms of probability would be wiser. (This tendency is not confined to the Earth sciences.) Here, I have striven to avoid words such as 'proof', 'true', 'false', 'right', 'wrong', 'valid', 'invalid', except in formal deductive arguments. In inductive arguments, I have sought to 'infer', not 'deduce'; I have been at pains to distinguish between 'mathematical models' and 'facts', not only with density distributions and the like, but also with (so-called) physical 'laws'; and so on...*

K.E.Bullen, 1975

As journey to Earth's center is not possible, suggestions about internal composition of the Earth and subsequently, its mean density, necessary remain without hard proof. Help from other disciplines was sought, with mixed results. Thus reanalysis of topic mean delving in endless array of data in time span of more than three centuries- and in fact, it is not enough. Here is a need to analyze, how one *ad hoc* reasoning influences others, how hypotheses become "theories" simply due the fact, that no one objected them for certain time period and so on. Likely computer could do this better than human. After introduction I will in short comment related points from:

Celestial mechanics,

Classic experiments with torsion balances and pendulums,

Composition and occurrence of meteorites (together with earthly causes of craters),

Planetary theory,

Astrophysics (iron from stars),

Seismology,

Geomagnetism,

Other related subjects.

Analysis could go deeper and broader in the future.

Introduction

Earth's mass is an astronomic constant. By start of millennia main arguments of mainstream, seen on Wikipedia, were 1. Newton's modification of Kepler's 3rd law, 2. Cavendish experiment, 3. suggestions from parameter MG. In the course of general attack to mainstream physics, Miles Mathis disproved Cavendish experiment (torsion balance) and Schiehallion experiment (pendulums). There were no reaction from Wikipedia till author disproved Newton's modification of Kepler's 3rd law (Alksnis, 2018). This time Wiki realized, that Earth's mass value is groundless. Some three rounds of changes on page "Earth mass" has been done. As of 25.08.2021, Wiki simply refers to recommendation of International Astronomic Union as basis of value of Earth's mass and (somewhat counterintuitively) add some dowser-like historic experiments, do not mentioning unsuccessful ones. Simple calculation of Earth's mass, using Newton's modification of Kepler's 3rd law

$$P^2/A^3 = 4\pi/GM$$

could not be seen here anymore (however similar wrong calculation one can see on Wikipedia's page "Solar mass" (as of 02.09.2021) - looks like they are waiting for special critique of author). We could see parallels of state of geophysics with sad situation in astrophysics when a century ago some scientists considered, that they can explain all Universe, based of interpretation of laboratory experiments and theoretic suggestions. They proposed heavy solar core with density around 150 g/cubic centimeter, so geophysics could easy progress with Earth's core density number further.

### Celestial mechanics

Initial data for guessing about a "system of the world" for Hooke, Wren and Newton were approximately as follows (data from known other Moons of Jupiter and Saturn are not shown):

<b>Primary</b>	<b>Radius r, Earth radiuses</b>	<b>Secondary</b>	<b>Radius, Moon radiuses</b>	<b>Semi-mayor axis A, in Moon distances</b>	<b>Orbital period P, days</b>	<b>A<sup>3</sup>/P<sup>2</sup></b>	<b>A<sup>3</sup>/P<sup>2</sup>/r<sup>3</sup></b>
<b>Sun</b>	109	Mercury	1.40	150.65	88	441.5	0.00034
<b>Jupiter</b>	11.2	Io	1.05	1.10	1.77	0.42	0.00030
<b>Saturn</b>	9.45	Enceladus	0.15	0.62	1.37	0.12	0.00014
<b>Earth</b>	1	Moon	1	1	29.53	0.00115	0.00115

**Table 1. Data, Newton used in "modification of Kepler's 3-rd Law".**

Thus when radius of central body grows (and mass as proportional to radius in cube), so does also Keplerian proportion  $A^3/P^2$ . By comparison of numbers from the Sun, Jupiter and Saturn one could think about certain proportionality between self-rotating central mass and orbital parameters of secondary. Case of Earth, however, was complete disaster. That's why Newton turned to "older kinematic theory" (Kollerstrom, 2000). As since Kepler here was an understanding, that planets are moving because Sun is rotating (Gal, 2002), this was move in right direction. Main task here was- to predict lunar motion. Newton and contemporaries could not know, that the Sun, Jupiter and Saturn are active elements in celestial mechanics, but the Earth- passive one. Otherwise, Newton understood things right (better than Cartesians). It can be seen from his letters and his prize for astronomer Borelli. Newton knew well, what mystifications he is doing by formally adding gravitation to Kepler's 3rd Law and in fact gave up with "universal gravitation" right in *Principia* (Hegel, 1801) and in third letter to Bentley. Interestingly here is to note early critique of Newton from Simmes (Griffin, 2004) while considering low density Earth.

In general, lunar orbital parameters obviously do not seem Keplerian, that should reflect catastrophic past of solar system (Velikovskiy, 1950; De Grazia, 1984). Moon is receding, its orbit thus is not stable. We are short of analogic examples, most close is Pluto- Charon pair. Accepted mass of Charon is 12, 2% from Pluto's one,

orbital period- 6.39 days. This renders proportion between fast spin of the Earth and long lunar orbital period (29.53 days) of Moon “impossible”.

From the other point, comparison of some numbers from Earth with that of Venus-

1. Higher orbital elongation of Earth,
2. Higher inclination of Earth's orbital plane relative to solar equator,
3. Faster perihelion precession

As well as relative large orbital inclination of the Moon against Earth's equator shows that Earth's vortex is more active than Venusian one- largely due to Earth's spin, but should be also effect from liquid state of Earth. These also are non-Keplerian effects. Thus operations of mainstream with formal parameter **MG** are groundless. However, they are moving closer to neoCartesians with new definition of “frame dragging”, for example.

Other “proof” of Earth's mass historically comes from analysis of precession of equinoxes. This suffers from poor understanding of celestial mechanics.

As other exact methods for this task are limited, International Astronomic Union have a problem here. Disciples of Newton continue with their mathematical abstractions, producing “densities of asteroids” in the range of 0.7-7.0, irrespective on their position in solar system. In some cases this could be really dangerous, for example with “low density near Earth asteroids”.

### **Classic experiments with torsion balances and pendulums**

After death of a master, Newtonians realize, that for celestial mechanics they are left with some mysterious geometric constructions only. Thus they 1. Started to search for unknown planets, using Newton's theory and 2. Looking for experiments with torsion balances and pendulums. First route ends with Neptune discovery hoax (actually they discovered non- gravitational disturbances from larger planets (later detected in first experiments with “gravitation wave detector” (Joseph Weber) and with special constructions of Russian astrophysicist Nikolai Kozyrev)).

Experiments with torsion balances have too less signal to noise value. For example, Cavendish could be remembered as a man, which detected effect from 24.8 hour lunar cycle. Both routes suffer from poor concept for interaction between two bodies. Here is understanding that gravity works in  $1/r^2$  mode only near spheres. Mountains they use for pendulum experiments are not a spheres. Interestingly that all mountains in vicinity of which experimentators found some anomalies (Schiehallion, Pichincha volcano, Chimborazo) presented geological anomalies near which a higher vortical activity should be expected. Or, if you want this in mainstream language, “*gravitational waves are disturbances in the curvature of space time, generated by accelerated masses that propagate as waves outward from their source at the speed of light. They were proposed by Henri Poincare in 1905 and subsequently predicted in 1916 by Albert Einstein on the basis of his general theory of relativity. Gravitational waves transport energy as gravitational radiation, a form of radiant energy similar to electromagnetic radiation*”.

There were also negative pendulum experiments, which Wikipedia ignored (in Himalaya and on higher see for example (Mathis)). Thus Wikipedia wants us to believe, that physicists several centuries ago with primitive equipment accurately weighed the Earth.

Perhaps popular ways how to use torsion balance “off label”- for example, for predicting of distant earthquakes (Khalilov, 2011) will show complexity of geophysics here.

### **Composition and occurrence of meteorites (together with Earthly causes of craters)**

While thinking about possible sources of Earth's iron a century ago, Williamson and Adams were impressed from frequency of occurrence of iron in meteorites. Today it is considered, that percent of iron and iron-stone meteorites is some 6% from witnessed falls only. Iron containing meteorites could occur in very specific conditions- perhaps by hydrogen reduction of olivine like minerals. This process produces a lot of water. (Geological periods of intense volcanism should be reconsidered from this angle). Some of “meteorite craters” could be formed by explosion of Earth's hydrogen (cf. Larin, 1993).

## Geochemistry

Geochemistry rarely supported heavy Earth story. Earth is full with hydrogen and helium (cf. Tian et al, 2005; Anderson et al, 2006, Gilat and Vol, 2012, dos Santos et al, 2019, Buttitta et al, 2020). This has less to do with radioactive decay processes. More is known about hydrogen compounds, which actually sparked a discussion about Earth core density deficit within mainstream. Hydrides, carbides and helium adducts can be investigated in laboratory. They understandably reduced density of “iron core”. For Gilat and Vol (2012) this was enough to dismiss hydrogen-rich concept of Larin.

Monserrat et al (2018) concluded, that helium adducts FeHe and FeHe<sub>2</sub> become stable at terapascal pressures. Samaras (2009) tells us that “the presence of helium in metals can drastically alter their mechanical properties, even at low concentrations... as well as promote swelling”. Lan et al (2010) estimated helium degassing rate from ocean floor as  $3.3 \times 10^5$  to  $4.8 \times 10^5$  4 He atoms/ cm<sup>2</sup>\*s= highest in the world. Mainstream typically considered, that helium-3 could not be produced inside the Earth. Helium is so specific molecule, that we could not be sure for this, however.

From other point, Terasaki et al (2012) tells us that “the hydrous mineral,  $\delta$ -AlOOH, is stable up to at least the core-mantle boundary, and therefore has been proposed as a water carrier to the Earth’s deep mantle”.

## Planetary theory

Planetary theory is in poor state. To our knowledge, first more mainstream dissent with high percent iron Earth was from Bless in 1931. From knowledge of his day, Bless concluded, that most popular element in Earth’s crust, stars and meteorites is oxygen. Thus high iron percent of the Earth seem illogic- and heavy radioactive metals, which seemingly produce Earth’s internal heat, does not help, as they could not heat Earth from deep core.

Earth contains hydrogen and helium still so do not likely has been completely melted. In this regard, concepts of hydrogen-rich (Larin, 1993) and hydrogen/oxygen rich Earth (Semenenko, 1990) get significant points. First theory suggests, that Earth’s core comprises from iron and silicone hydrides with continues degassing. Viscous liquid Earth’s core.

Density of silicon hydrides in normal pressures are low. Density of iron monohydride could be 17% less than that of iron. However, non-stoichiometric compounds are expected with lower density (density of liquid hydrogen is thought about 71kg/m<sup>3</sup>).

Hydrogen/oxygen rich Earth theory states, that solid Earth’s core comprises of metal hydrides and carbides, and non-solid Earth’s core- from degradation products of mentioned compounds. Density of iron carbide is 4.9, silicon carbide- 3.2, nickel carbide- 14.9.

Both theories try to explain mechanism of mantle turbulence with geochemical factors.

## History of solar system

NASA continues to tell us pathetic hypothesis: “our solar system formed about 4.5 billion years ago from a dense cloud of interstellar gas and dust. The cloud collapsed, possibly due to the shockwave of a nearby exploding star, called a supernova”. After “collapse of cloud” mainstream history of solar system should have been peaceful local accretion. So when Velikovsky (1950) write about celestial bodies, which changed their orbital distances and nearly collided with Earth, he was dismissed as a crank. Investigations of an asteroid belt decades later stimulated alternative thinking on topic. Early critique of mainstream has been seen by Vsekhsviatskii (1975). After calculations of orbital dynamics (van Flandern, 2007) taboo for catastrophism here has been lifted. Same pertains also for changes in orbital distances of planets, which, in fact, had been known for centuries (case of repulsion between Jupiter and Saturn). Investigations of exoplanetary systems show bankruptcy of celestial mechanics, as “hot Jupiters” could not formed so near to parent stars, as they are today.

Morbideilli et al (2001) speaks about water-rich planetary embryos in today’s asteroid belt. In fact, question is more revolutionary- could Earth be formed around Uranus (agreement with mythologies)? Undoubtedly this

was water-rich region. Mythological transitions of the Earth by route Uranus- Saturn- Jupiter- Sun (cf. Velikovsky, unpublished) are in accord with vortical celestial mechanics.

### **Astrophysics (iron from stars)**

Unfortunately for heavy Earth narrative, easy detection of iron in stellar spectra could lead to observational bias. Survey of stars with exoplanets had shown that “the planet-harboring stars have high metallicities, containing lots of alpha elements like silicon, titanium and magnesium. Further, the ratio of such heavy elements to the amount of iron was consistently higher in stars with planets, with the greatest discrepancy observed for magnesium.

While affirming the importance of stellar metallicity in planet formation, the new study also implies that metals other than iron may play a more crucial role than previously considered, particularly for low-mass planets, researchers said.” (Space.com, August 24, 2012).

### **Seismology**

Developers of seismologic models stressed, that models do not represent real Earth (Kennett, 2021).

### **Strange geomagnetism**

Geomagnetism is weak concept- especially in times of “pole shift”. Restrictions, caused by anti-dynamo theorem of (Cowling, 1934) further complicate work of theorists. More likely, that “pole shift” reflects processes in mantle (cf. Biggin et al, 2012).

Considerations from geology and geophysics time by time complicates general narrative of heavy Earth. Thus Hausoel et al. (2017) theorized, that it is crucial for the dynamo effect that Earth’s core contains up to 20% nickel. Densities of kamacite and taenite are about 8.0, ferronickel- about 3.8, while current accepted number for core density is around 12.0.

### **Other related subjects**

It is not possible to explain Earth’s internal heat with radioactive decay from the core only. Production of energy here could be connected with turbulence of liquid masses- by analogy with Jovian planets. Needless to say, that this further complicates story of heavy Earth.

Vortical celestial mechanics show, that Earth’s vortex is active. Earth’s interior should be with liquid turbulent component.

### **Conclusions**

From the beginning, heavy Earth’s story remain without hard proof. Incoming geochemical, geological and astronomical data often complicate general narrative. Low density Earth is frequent motif in mythology and this idea has followers till today (cf.Griffin, 2004).

In author’s opinion, current state of matters here could be compared with question of value of charge of an electron. First, Millikan (1913) reported a value for the fundamental electric charge that was within half a percent of today’s accepted value. Than physics gradually come to more realistic one. Have we a century for correction of old errors in these turbulent times?

### **References**

Alksnis E. (2018) Astronomers do not know, how to calculate masses. *General Science Journal*.

Anderson D. et al (2006) Helium: fundamental models. *Mantleplumes.org*

Biggin A. et al (2012), Possible links between long-term geomagnetic variations and whole-mantle convection processes. *Nature Geoscience*, DOI: [10.1038/NCEO1521](https://doi.org/10.1038/NCEO1521)

- Buttitta D. et al (2020) Continental degassing of helium in an active tectonic setting (northern Italy): the role of seismicity. *Scientific Reports*, DOI [10.1038/s41598-019-55678-7](https://doi.org/10.1038/s41598-019-55678-7)
- Cowling (1934)- see Shneider C. (2011) Cowling's Theorem. Internet.
- De Grazia A. (1984) *The Disastrous Love Affair of Moon and Mars: Celestial Sex, Earthly Destruction and Dramatic Sublimation in Homer's Odyssey*. Metron publications.
- dos Santos L. Et al. (2019) Observability of hydrogen-rich exospheres in Earth-like exoplanets. *A&A*, **622**, A46.
- Gal O. (2002) Meanest Foundations and Nobler Superstructures: Hooke, Newton and "the Compounding of the Celestial Motions of the Planetts", *Springer*.
- Gilat L., Vol A. (2012) Degassing of primordial hydrogen and helium as the major energy source for internal terrestrial processes. *Geoscience Frontiers*, **3**, 911-921.
- Griffin D. (2004) Hollow and habitable within: Symmes theory of Earth's internal structure and polar geography. *Physical Geography*, **25**, 382–397.
- Hausoel A. Et al (2017) Local magnetic moments in iron and nickel at ambient and Earth's core conditions. *arXiv:1707.03789*
- Hegel G. (1801) Dissertation. Jena.
- Khalilov E. (2011) GLOBAL NETWORK FOR THE FORECASTING OF EARTHQUAKES – GNFE. INTERNATIONAL SYSTEM OF GEODYNAMICS MONITORING. Internet.
- Kennett B. (2021) Seismological Models, mineral physics and spin transitions in the lower mantle. [www.geodynamics.org.au](http://www.geodynamics.org.au)
- Kollerstrom N. (2000) Newton's forgotten lunar theory. *Green lion press*.
- Lan T. et al (2010) Evaluating Earth degassing in subduction zones by measuring helium fluxes from the ocean floor. *Earth and Planetary Science Letters*, **298** (3).
- Larin V. (1993) *Hydridic Earth: The New Geology of Our Primordially Hydrogen Rich Planet*. Polar Pub
- Mathis M. (2008) The Cavendish experiment. *General Science Journal*.
- Mathis M. The Schiehallion experiment exploded. Internet.
- Monserrat B. et al (2018) Helium-Iron Compounds at Terapascal Pressures. *Phys. Rev. Lett.* **121**, 015301.
- Morbidelli A. et al, (2002) The Formation of a Water-Rich Earth. Internet.
- Samaras M. (2009) Multiscale Modelling: the role of helium in iron. *Materials Today*, **12**, 46.
- Semenenko- see Семеновко, Н. П. (1990) *Кислородно-водородная модель Земли / Ин-т геохимии и физики минералов АН УССР. — Киев : Наукова думка. ISBN 5-12-001407-0.*
- Terasaki H. et al (2012) Stability of Fe–Ni hydride after the reaction between Fe–Ni alloy and hydrous phase ( $\delta$ -AlOOH) up to 1.2 Mbar: Possibility of H contribution to the core density deficit. *Physics of the Earth and Planetary Interiors*, **194/195**, 18-24.
- Tian F. Et al (2005) A hydrogen-rich early Earth atmosphere. *Science*, 308, 1014.
- Van Flandern T. (2007) The challenge of the exploded planet hypothesis. *International Journal of Astrobiology*, **6**, 185 – 197.
- Velikovsky I. (1950) *Worlds in collisions*. McMillan.
- Velikovsky I. In the beginning. Internet.
- Vsekhsviatskii S. (1975) Is it possible to clarify the real history of the solar system. *Problemy Kosmicheskoi Fiziki*, no. 10, 96-103. In Russian
- Williamson E., Adams L. (1923) Density distribution in the Earth. *Journal of the Washington Academy of Sciences* **13**, 413-

© Edgars Alksnis, 2021