Replacing the Foundations of Astronomy

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Napoleon Bonaparte: Mr. Laplace, they tell me you have written this large book on the system of the universe, and have never even mentioned its Creator.

Pierre-Simon Laplace: I had no need to hypothesize His intervention.

- *Reported from a conversation between the two men in 1802*

"The old argument," [Voldemort] said softly. "But nothing I have seen in the world has supported your pronouncements that love is more powerful than my kind of magic, Dumbledore."

"Perhaps you have been looking in the wrong places," suggested Dumbledore.

- *Harry Potter and the Half-Blood Prince*

Introduction: *Dramatis Personae*

The ancient view of the heavens was dominated by the Ptolemaic approach, which placed the earth in the center and pictured the heavenly bodies uniformly moving in concentric circles around it. Where circles would not suffice, the Ptolemaic theory used off-center circles and also mini-circles, called epicycles, for centuries – to fit theory to observations. The modern view of the celestial universe takes its start in the 15th century from the ideas of Nicolaus Copernicus and later Johannes Kepler. While Copernicus showed that calculations based on the heliocentric point of view provided a much more convenient and aesthetic alternative to the Ptolemaic theory, he still remained with the idea of using circles. Kepler, drawing on the data collected by Tycho Brahe, extended Copernican thought and was the first to highlight the inner harmony in the movements of the planets with his three main identifications from observation:

1. Every planet moves in an ellipse, with small eccentricity, and with the Sun at one of its focus

2. It covers equal areas in equal times

3. The different planets have an inner harmonic law: $\mathbf{R}^3$ is proportional to $\mathbf{T}^2$, provided eccentricities are small

Here **R** is the mean distance of the planet from the Sun, and **T** is its time period. Kepler figured out the third 'harmonic' law when his book *Harmonies of the World* was already in the press, so he did not have much time to develop those ideas in detail. He began his book with the idea that planets from Mercury to Saturn are spaced in terms of the five platonic solids, but after carrying out an analysis in terms of musical theory, he ended the book with a most interesting conclusion: he declared that all his calculations based on rigid models were ultimately failing, and he was forced to reconsider the heavens not in terms of rigid mechanical movements, but in terms of *harmonies of life*. He expressly states that:

> That is to say, in this house the world, I was asking not only why stones of a more elegant form but also what form would fit the stones***, in my ignorance that the Sculptor had fashioned them in the very articulate image of an animated body***… Wherefore, just as ***neither the bodies of animate beings are made nor blocks of stone are usually made after the pure rule of some geometrical figure,*** but something is taken away from

> the outward spherical figure, however elegant it maybe (although the just magnitude of the bulk remains), so that the body may be able to get the organs necessary for life, and the stone the image of the animate being; so too as the ratio which the regular solids had been going to prescribe for the planetary spheres is inferior and looks only towards the body and material, it has to yield to the consonances, in so far as that was necessary in order for the consonances to be able to stand closely by and adorn the movement of the globes.

This powerful conclusion showed clearly that no matter what model we may make of the heavens, and calculate to the utmost precision, unless we realize that it has to be compatible with the *phenomena of life*, we are treating the heavens like angular rocks and stones. And try as we might, they will not fit, just as a square does not fit in a round hole.

Kepler also had another current of interest in the upcoming ideas of magnetism by Queen Elizabeth's personal physician: William Gilbert. America had been discovered and oceanic navigation was at an all-time high, encouraging the use of the magnetic compass and the notion of earth as a giant magnet. Based on Gilbert's work *De Magnete*, Kepler suggested seeing the planetary movements also as being magnetic in nature. At the time of Kepler and even until the 18^{th} century, the cause of magnetism was still seen as an animate (in fact due to *anima* or soul) and also sometimes *astrological* in origin, and it did not have the purely inanimate connotation it took on later.

Meanwhile, Kepler's contemporary – Galileo Galilei – was not only pointing his telescopes to the skies to find the moons of Jupiter, but was also discovering the law of falling bodies. The Aristotelian worldview that had held for more than a millennium had a garbled and confused idea of the behavior of inanimate projectiles such as rocks and cannon-balls, and still thought that they were *swimming* through the air by pushing the air behind them. It was Galileo who clarified this confusion and discovered a simple relation for most falling bodies: falling distance $\mathbf{R}$ is proportional to $\mathbf{t}^2$. This looks almost like an earthly version of Kepler's Harmonic law. Both of these formulae broke away from the habits of classic Greek science, which dealt only with speeds and not with accelerations and other variations of motion.

After Kepler's and Galileo's death, astronomy had come to a crossroads. There was one route that suggested the study of living things via harmonic and musical laws, opened up by Kepler, while the other path by Galileo opened up the study of "movements of stones": mechanics. The second path was chosen – by Newton.

The Newtonian Deviation

Newton set to work by abandoning all reference to harmonies and living qualities, and used Galileo's law of falling bodies as his starting point. There were several problems with this:

Problem 1: Galileo's law had $\mathbf{R}$ is proportional to $\mathbf{t}^2$ while the only known planetary law (Kepler's) had $\mathbf{R}^3$ proportional to $\mathbf{T}^2$. There was hence a discrepancy of a factor $\mathbf{1/R^2}$ between Kepler's and Galileo's laws.

Problem 2: Kepler's $\mathbf{R}$ was a two-dimensional average, and he had cautioned that his law is true only for orbits that are nearly circular. Galileo's $\mathbf{R}$ was simply a linear distance.

Problem 3: Galileo's law was for vertical rectilinear motion i.e. falling straight down until hitting the ground. It was not the same as a circular or elliptic motion, which is 2-dimensional, stable, and continuous.

Firstly, Kepler's and Galileo's laws were two different things, like apples and oranges. In order to *push* the Kepler's and Galileo's ideas together, the only possible way was to *assume* that Galileo's Law (acceleration) is valid as the *inverse square* ($\mathbf{1/R^2}$) for planetary motion! This would make up for the offset observed in the dimensions of $\mathbf{R}$ in the two ratios. This idea was already put forward by some of his contemporaries like Hooke, Wren and others, but Newton proceeded to assert it mathematically. By combining the two concepts, he asserted that an object in orbit was "falling continuously"! Two birds were hit with one falling stone. Hence problem 1 was pushed aside.

The second problem was a little trickier, since it is hard to make a variable averaged over two dimensions and reduce it to a line. But this was also done, by including the linear version of **R** as an implicit assumption in his proofs, and later extricating it out and calling it a 2D-averaged **R**. Since this operation was hidden in a number of dense proofs in his *Principia* (purposely written that way 'to avoid being baited by smatterers in mathematics' according to Newton) people came to believe that Newton proved Kepler's Third Law mathematically. He had done nothing of the sort, but had simply *assumed* a 1D version of the law without making it explicit. That way, there was no further use for Kepler's caution, and the distance **R** was indiscriminately applied for both circles and straight lines. Hence, 2D was made 1D, and Problem 2 was also brushed aside, *ad hoc*.

Finally, in order to apply Galileo's linear equation to circular motion, which is 2-dimensional, Newton had to *assume a linear attraction* of a body moving in a circle to another body, in other words: "gravity". A full mathematical approach requires that circular motion is only possible when there is equilibrium between the tendencies of the body to move towards the center and the tendency to move away from the center. It also requires forces that are distributed in all directions in 2D, to generate a circular or elliptical orbit. Common sense dictates unless something is pushing *out* as well as *in*, the system collapses inwards. In order to prove his ideas, Newton completely *ignored* the tendency of a body to move away, and focused only on the tendency towards the center. Still, there is one other dimension to deal with: the initial sideways velocity that is required to "start" the planetary movements in his theory. Newton did not say anything clear on that. Hence Problem 3 was also completely brushed aside.

The planetary-level inverse-square law of force was hence constructed in this fashion, by simply *assuming* it out of thin air. It was asserted that just as an apple falls to the ground, all the heavenly bodies fall towards each other and end up rotating around one another because of it. On top of that, similar to magnetism, it was also asserted that the bodies "attract" one another. This is about as logical as asserting that if two balls are rolling towards each other, they necessarily "attract" each other. Furthermore, based on which body was rotating around which and at what speed, heavenly bodies were assigned *masses*. This needed a new concept of "gravitational mass", once more simply created. All of these elements were combined into the "Theory of Universal Gravitation," and what was true on earth was claimed to be true in the heavens. The numerical backing for the *entirety* of this theory was the numerical relationship of *one* particular motion of the moon with the value of gravity on earth – almost like building an entire castle on a single reed. And yet he claimed: "I feign no hypotheses."

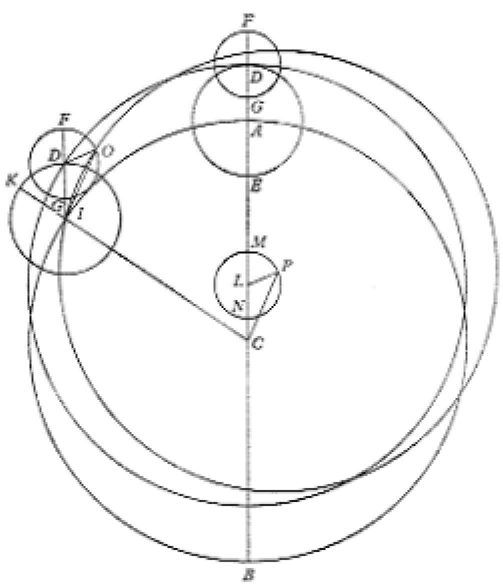
Naturally, there was backlash from continental Europe, from the likes of Huygens and Leibniz, for assuming a force of attraction out of nothing. However, their arguments lacked teeth, since they had not mathematically shown that circular motion cannot simply be defined by an attraction. The followers of Descartes had some idea that circular motion required circular forces, and hence continued to ascribe planetary motion to celestial vortices, but they did not have the mathematical capacity to challenge Newton's derivations of "attraction towards a center". The philosopher Hegel vigorously criticized Newton's concepts, but since Newton was so far ahead mathematically, Hegel's protests were ignored by the scientific community. It did not help that Newton was constantly embroiled in priority disputes lasting decades, with Leibniz, Hooke and others – the atmosphere of open discussion was barely existent. Newton's high position, as President of the Royal Society for 24 years and Master of the Mint for 30 years, also brooked no argument. Newton's works were popularized in Europe with great energy by the likes of Voltaire and Hume, and within a few decades, the theory of gravitation had become very well-known.

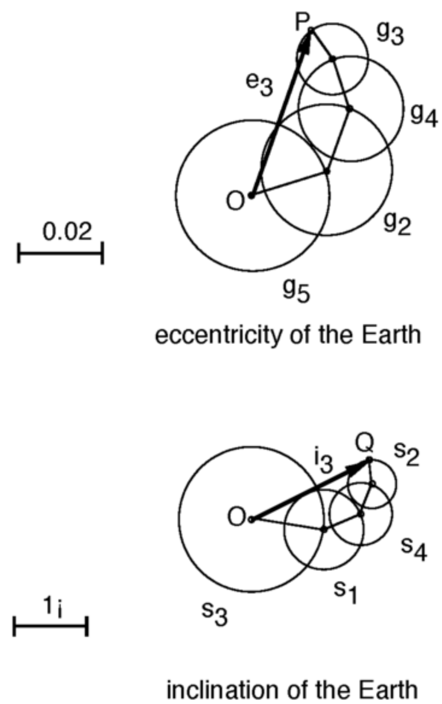
Epicycles Once More

Following the Newtonian era, in the 18th century there were a series of mathematicians – Bernoulli, Clairaut, Euler, D'Alembert, Lagrange, Laplace, Leverrier – who basically picked up where Newton left off and ran with it. There were no descendants to the wholistic viewpoints of Tycho and Kepler, but only those who made several improvements of a mathematical nature to Newtonian theory. Calculus became a powerful tool in calculating the effects of gravitation of all the planets upon each other, due to their assumed masses. The motion of the nearest neighbor – the Moon – was a surprisingly hard nut to crack even for Newton, and several new mathematical techniques had to be invented just to tackle that.

In the process, a new form of theory became popular: *Perturbation theory*. In this approach, a small approximate deviation from Newton's law is assumed, based on empirical data, and then a rigorous calculation of differential equation is used to nail down the actual value of the deviation. It does not take much to recognize that this was simply the approach taken before Kepler by Copernicus and others for over a thousand years – adding epicycles to make the observations fit. It is the same concept, but now dressed up in gravitational disguise:

Copernican Theory	**Newtonian Theory**
Circular motion is primary	Inverse square law is primary
Variations: epicycles	Variations: perturbations
30-50 circle variables	100's of perturbation variables
Geometric techniques	Calculus techniques
Variables fit to observation	Variables Fit to observation





Copernicus' solutions

Laplace-Lagrange solutions

In other words, the entire thought process took several steps backwards, to redo the same process as the Ptolemaic-Copernican epicycle theory, only with different variables. The more logical way of approach would have been to redirect the focus of the improved mathematical techniques to the assumptions in Newton's theory, but instead the same equations were re-derived with calculus, without examining the assumptions. Hence any modern day textbook gives the same derivation for circular and elliptical motion that Newton first derived in his Principia. The equivalence of the epicycle theory and gravitational theory has not been realized, and any new discovery that fits in with the mathematical framework of Newtonian gravity is lauded as a "triumph of the theory of gravitation." In reality, it is simply the triumph of fitting curves to the data or minor linear extrapolations – something that had already been done at least since 2^{nd} century AD. Yet the situation is conceptually identical.

As for problem 1 – the presence of rotational motion – there was no solution provided by Newton to the reasons as to why all the planets rotate in the same direction. Laplace, and also independently, Kant, suggested that a primordial nebula started rotating to give it the initial velocity. However, neither bothered with the complication that there are an *infinite* series of linear pushes and pulls necessary for maintaining an orbit even for a simple circular or elliptic motion. It was not as simple as giving an initial jolt to set the whole system running, like a machine. Yet, this 'explanation' has stood for 200 years, till today.

Just like the Ptolemaic theory, there had to come a point where the calculations would not fit observation. This point was reached in several areas, such as that of the motion of the Moon, but one received particular attention at the end of the 19^{th} century: the precession of the perihelion of Mercury. In order to fill this hole, another theory – the General Theory of Relativity – was proposed by Einstein. And what was the mathematical difference between Newton's law of Gravitation and the General Theory of Relativity? The Relativity theory added a term that depends on the *fourth* power of the distance, to the inverse-square law! In other words, acceleration also depends marginally on $\mathbf{1/R^4}$ instead of just on $\mathbf{1/R^2}$. Hence, this theory did not question the assumptions at all and neither did it have even the slight empirical backing that Newton had with Kepler's and Galileo's laws; instead a new assumption that gravity is based on the notion of "curved space-time" was simply added to the system. In a nutshell, that is the actual achievement of General Relativity.

The Dead End

In the late 19^{th} century, one of the French mathematicians – Henri Poincaré – had already discovered that many of the terms being used in the "perturbation" series by mathematicians like Laplace and Lagrange were becoming infinite for long periods of time, making the system unstable. In simple words, the solutions 'blow up' fairly quickly. He also showed that the general problem of 3 mutually gravitating bodies was *insoluble through any mathematical analysis!* Many physicists and mathematicians built up modern "Chaos theory" based on these ideas, to show simply that one cannot calculate the movements of the planets accurately. Thus began the field of non-linear dynamics.

In the middle of the 20^{th} century, with computers entering the field, the mathematicians pretty much gave up on calculating the orbits by themselves and programmed the computer to do it, even though it was mathematically *shown* that these orbits were incalculable. They had to be satisfied with approximations or numerical methods (or "brute force" methods.) The result of it all was that after 300 years, Newtonian/Einsteinian thought lands in the same spot that Kepler ended: the orbits point to a *living* or chaotic system. Only now, there is the additional baggage of all the wrong concepts introduced with regard to "inverse-square law", "gravitational attraction", "gravitational mass" and "curved space-time" along with uncountable number of minor assumptions. In this process, an enormous amount of human effort was put to derive thousands of terms in equations over centuries. The entire enterprise has been a wild goose chase – very much like the attempt to calculate the value of "pi" with 100% accuracy.

Moving Forward

It is clear that the only way to get out of the dead end and move forward is to go back to the point of deviation, and start retracing the steps from where Kepler and Galileo left off. Some researchers *have* done that, unheralded.

It is seen that many of the objections regarding the lack of understanding of forces for circular motion were already put forward by Hegel, using his check of philosophical consistency. His philosophical successor, Rudolf Steiner, was equally critical of the Newtonian approach, and in the early part of the 20th century, gave several new ideas to carry forward the research into astronomy. For starters, he insisted that no *ad-hoc* assumptions must be introduced in the understanding of science, and to stick to the phenomena like Goethe did in his approach to life. Based on that, he mentioned that only centric forces are no longer applicable for celestial phenomena, but one has to include other concepts such as forces *away* from the center and rotating/shearing forces to account for planetary movements. He also explained that astronomical movements cannot be calculated, but can only be characterized, by identifying harmonic patterns between living systems and celestial changes systematically. Other complicated shapes like lemniscates were suggested for study, to determine the mutual movement of the planets and stars. Several researchers like Lili Kolisko, Ernst Lehrs and Elizabeth Vreede carried forward these suggestions.

Dewey Larson, an American engineer, figured out the reciprocity of inward and outward forces necessary for astronomical motions, and described it in his book *Beyond Newton*. He developed the concepts by taking circular, linear and vibratory movements as the primary movements, and set up an entire system of physical theory (Reciprocal System) step-by-step in a Hegelian fashion where physical phenomena can be understood without arbitrary assumptions using nothing but motion (see *Nothing But Motion*). He predicted Quasar properties before they were discovered, and also identified that stellar evolution was backwards from what modern astronomy makes of it. After covering a wide range of phenomena, his researches also led to the conclusion that all phenomena have natural *limits*, and also that *life* has to be included as a component of astronomical phenomena. This takes care of all the problems with extrapolation that have faced physicists for centuries.

Other researchers have shed additional light on these phenomena. Johannes Schlaf and, recently, Simon Hytten have discovered several problems with the conventional Copernican viewpoint that do not line up with experience. KVK Nehru and Bruce Peret have re-evaluated the Reciprocal System to include both linear *and* rotational motion as equally primary, solving a dilemma that had been unresolved since the time of Descartes. Peret has determined the several details of planetary evolution from these standpoints. Miles Mathis has independently detected both the problems with the conventional explanations for orbital motion as well as the need for an outward force against gravity, and has also, among other things, shown how Lagrange implicitly assumed it in his equations.

Although these few researchers are plugging along, it is imperative that the entire process of astronomical study be approached afresh, since very little research has been done on the relationships of cosmic harmonies to life. The flaws that were propagated over centuries must be recognized for what they are; otherwise astronomy will continue to get stuck in its own rigid orbit. When it is clear that a fresh foundation of this nature is needed, it is possible to move forward from the vague notions of ancient astrology and confused notions of modern astronomy to a clear exposition of the relationship of man to the stars.

Additional Research

Other papers by the current author:

For Problem 1: Importance of Conic Section “size” in the Derivation of Propositions X-XVI in Newton’s *Principia* (Book I)

For Problem 2: Original Form of Kepler’s Third Law and its Misapplication in Propositions XXXII-XXXVII in Newton’s *Principia* (Book I)

For Problem 3: Celestial Dynamics and Rotational Forces in Circular and Elliptical Motions