Appendix 3

The Tychos – Our Geoaxial Binary System

2 November 2018, 2:07 am[1]

The Tychos solves "the Great Inequality"

Back in the 18th century, the spiny question of the observed behavior of Jupiter and Saturn ignited a humongous and long-lasting debate among our world's most celebrated astronomers and mathematicians (Halley, Flamsteed, Euler, Lagrange, Laplace and Poincaré, to name just a few). What every astronomy historian will know as "the Great Inequality" is a scientific saga of epic proportions. In short, the problem was that the motions of Jupiter and Saturn did not seem to obey either the Newtonian (gravitational) theory or the Keplerian (elliptical) theory. Not a trivial problem, you may say. Surely, Newton and Kepler couldn't possibly both be wrong, could they?

What had been observed, first by Kepler himself and later by Halley, was that Jupiter appeared to accelerate while Saturn appeared to decelerate. This was terrible news for mankind: it meant that (according to Newtonian theories) Jupiter would end up crashing into the Sun, while Saturn would be driven away into the depths of space![2]

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THE GREAT INEQUALITY OF *JUPITER* AND *SATURN*,

BY EDGAR ODELL LOVETT.

The Great Inequality of *Jupiter* and *Saturn* is a long-period inequality depending upon the difference between twice the mean motion of *Jupiter* and five times that of *Saturn*, in virtue of which the line of conjunctions slowly advances, and the planets return to their original configurations after periods of about 929 years.

As early as 1625 KEPLER remarked, on comparing the observations of TYCHO BRAHE with those of PTOLEMY, that the observed places of *Jupiter* and *Saturn* could not be reconciled with the admitted values of their mean motions (*Keplerus et Berneggerus, Epistolae mutuae*, p. 70; 12ª Argentorati, 1672; also, *Keplerus*, Opera VI, p. 617, 1866). The errors of both planets were found to increase continually in the same direction, with this difference, that the tables made the mean motion of *Jupiter* too slow, and that of *Saturn* too rapid.

In his memoir on the aphelia and eccentricities (*Phil. Trans.*, 1676, p. 683) HALLEY was led to the belief that the anomalous irregularities of the two planets were due to their mutual attraction. He also attempted to determine the magnitude of the inequality for each planet, and concluded from his researches that in 2000 years the acceleration of *Jupiter* amounted to 3° 49′, and the retardation of *Saturn* to 9° 16′. In his tables of the planets he represented the errors by two secular equations, increasing as the square of the time, the one being additive to the mean motion of *Jupiter*, and the other subtractive from the mean motion of *Saturn* (see GRANT'S *History of Physical Astronomy*, pp. 47 et seq.; and HOUZEAU'S *Vade-mecum de l'Astronomie*, § 246).

By comparing tables made at different epochs, FLAMSTEED confirmed the opinion that *Jupiter* was being steadily accelerated, and *Saturn* retarded (FLAMSTEED, J., *Exact Account of the Three Late Conjunctions of Jupiter and Saturn*, *London Phil. Trans.*, 1685, p. 244).

The most startling conclusions were drawn from these variations in the planetary motions. It was known that when the angular velocity of a body increases from century to century it must be approaching the center of motion; on the other hand a diminution in this velocity would indicate a recession of the planet from the sun. Hence it was inferred that the solar system would in the course of ages lose two of its most prominent members — that *Jupiter* would fall into the sun, while *Saturn* would be driven away into the depths of space. EULER and LAGRANGE had searched in vain for the cause of the anomalous behavior of *Jupiter* and *Saturn*, which appeared to be inconsistent with the law of gravitation; but in their researches they had neglected terms of the perturbations depending upon the cubes and higher powers of the eccentricities. In 1785 LAPLACE discovered from other considerations, that if we assume an acceleration of *Jupiter* a retardation of *Saturn* will necessarily result, and that in the very proportion observed; hence he set himself to examine the terms depending on the cubes of the eccentricities, and at once encountered the argument, $5n't-2nt+\text{const.}$ Taking account of the fact that five times the mean motion of *Saturn* is nearly equal to twice the mean motion of *Jupiter*, and that in virtue of the double integration for the perturbation in longitude, these terms are affected by the small divisor, $5n'-2n$, in the second power, he did not hesitate to conclude that the long inequality depends on terms having this argument. Computation at once confirmed this hypothesis, and made known the cause and law of the great inequality. From the nature of the cause thus made known LAPLACE immediately perceived that there would arise in other parts of our system similar long inequalities depending on near approach to commensurability in the mean motions. In the *Mécanique Céleste* and subsequent works on Physical Astronomy these long-period inequalities have been determined. The explanation of these long-period perturbations by the law of gravitation was justly regarded by LAPLACE as one of the strongest proofs of the exactness of this law. The theorems relative to the stability of the eccentricities, inclinations, and major axes of the planetary orbits previously enunciated, could of course be regarded as valid only after the discovery that the long-period inequalities result from the theory of universal gravitation.

The principal coefficient of the great inequality, as it affects the mean longitude of *Jupiter*, has been determined as follows:

(113)

In any case, this is what, by all accounts, was ominously predicted at the time (on the basis of Newton's gravitational theories): a truly apocalyptic scenario! Make no mistake, this was no petty matter: it was all about the very stability of our solar system so the stakes were "sky high". In fact, the Paris and Berlin Academies set up special prizes to encourage scientists to resolve the pesky and embarrassing matter. Euler (the most acclaimed Swiss mathematician of all times) was the first recipient of such a prize, although his calculations showed both Jupiter and Saturn accelerating, contrary to any astronomical observation ever made.

The magnificent Isaac Newton himself had recognized the problem of the apparent "instability" of our Solar System (on the grounds of the observed behavior of Jupiter and Saturn), but he never tackled the troublesome matter while basically saying (freely paraphrasing his words) that "God should take care of this problem in due time and restore the apparent, chaotic nature of our planetary motions". Kepler also gave up and admitted that only future generations may eventually unveil the mystery of our Solar System's apparent instability (suggested by Jupiter and Saturn's odd behavior). Kepler, for once, was right about that.

Enter Lagrange and Laplace, perhaps the two most acclaimed French "mathemagicians" of all times. The two French science icons engaged in a long struggle to try and justify the so-called Great Inequality, thereby rescuing the sacrosanct Newtonian gravitational laws. Depending on what old text books one may bump into, it was either Lagrange or Laplace who "solved the problem", basically concluding that, according to their formidably abstruse calculations, the so-called Great Inequality (the growing gap between Jupiter's and Saturn's celestial longitudes) was only periodic, i.e. only temporary, and would eventually reverse. In other words, the gap would gradually (in the course of

[1] https://cluesforum.info/viewtopic.php?p=2407015#p2407015
[2] http://adsbit.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1895AJ.....15..113L&db_key=AST&page_ind=0&plate_select=NO&data_type=GIF&type=SCREEN_GIF&classic=YES

about nine hundred years) diminish and cancel out itself. Our Solar System was, after all, a stable one. Phew!

However, it is unclear just how Lagrange and Laplace reached their "mathemagical" conclusions. In academic text books, we may only find some dreadfully complex equations and computational wizardry based on mere assumptions about how "planetary/gravitational perturbations" and "tidal friction effects" might cause these puzzling inequalities. To be sure, under the Copernican model's configuration there is no plausible explanation as to why Jupiter's and Saturn's celestial longitudes would oscillate back and forth, as observed. In time though—and here's where it gets funny—Lagrange and Laplace were "proven right": the apparent, relative accelerations/decelerations of Jupiter and Saturn were then observed, several decades later, as being reversed:

> *"In 1773, Lambert used advanced perturbation techniques to produce new tables of Jupiter and Saturn.The result was surprising. From the mid-17th century the Great Anomaly appeared to go backwards: Saturn was accelerating and Jupiter was slowing down! Of course, such behavior was not compatible with a genuinely secular inequality."*[3]

One of the greatest observational astronomers of the times, William Herschel, had also noticed the "back and forth" oscillations of Jupiter and Saturn:

> *"He [Herschel] describes Saturn's period as increasing [i.e. Saturn seemed to be slowing down] during the seventeenth century, Jupiter's period as diminishing [i.e. Jupiter seemed to be speeding up]: and he adds – 'In the eighteenth century a process precisely the reverse seemed to be going on.'"*[4]

So, after all, there was no apocalyptic scenario whatsoever for humanity to fear. Nonetheless, as pointed out by a number of contemporary independent researchers, the "Great Inequality" and its corollary, the very "Stability of our Solar System", both remain—to this day—unsolved riddles. For instance, here's what Antonio Giorgilli (a veteran Italian expert in this peculiar area of astronomical studies) and the author of "La Stabilitá del Sistema Solare: Tre Secoli di Matematica" ("The Stability of the Solar System: Three Centuries of Mathematics") warns the reader with:

> *"Su queste basi cercherò di illustrare che significato si possa dare alla domanda: "il sistema solare è stabile?"[...] Quanto alla risposta, non vorrei deludere nessuno, ma sarà: non lo sappiamo".*[5]

Well, we obviously cannot attain any firm knowledge of our solar system's behavior if we haven't even envisioned its correct geometric layout, can we? As I will presently illustrate, the Tychos model's geometric layout provides the simplest imaginable explanation for the "Great Inequality". Now, what you need to know is that, as seen from Earth, Jupiter and Saturn appear to conjuct about every 60 years (or actually a whisker less than 60 years, due to Earth's 1-mph motion).

Since Jupiter employs 12 years to circle around us, while Saturn employs 30 years to do the same, the two will regularly "meet up" every 60 years, i.e. 5 x 12 (=60) and 2 x 30 (=60), respectively.

These "60-year conjunctions" move around our celestial sphere in anti-clockwise manner, as illustrated below:[6]

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représentées à la figure 17, où le point vernal (longitude zéro) se trouve vers le bas. Ces longitudes se trouvent aux sommets d'un « triangle » qui tourne lentement, d'un angle de 9° en soixante ans.

La figure 18, due à Kepler, est un schéma analogue pour des conjonctions plus anciennes.

< The Jupiter-Saturn conjunctions basically proceed anticlockwise around our celestial sphere ca. every 60 years

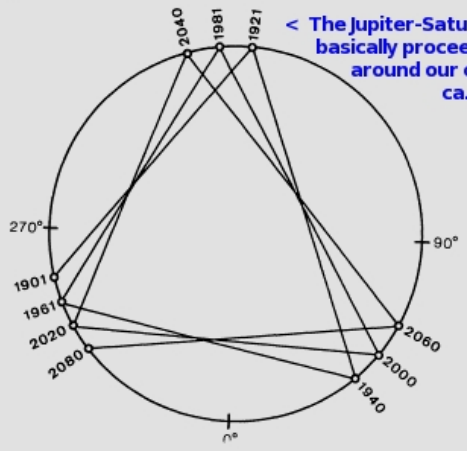


Fig. 17. — Positions des conjonctions Jupiter–Saturne de 1901 à 2080.
Le triangle reliant les conjonctions d'un cycle de 60 ans tourne lentement.

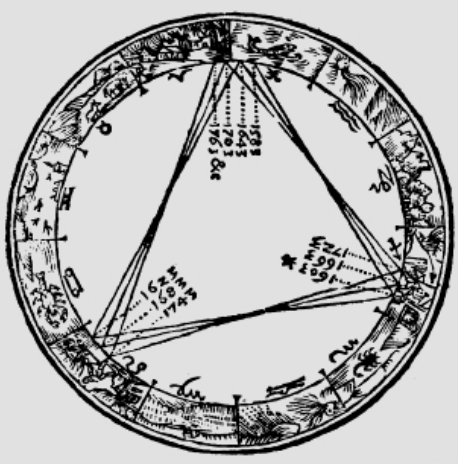


Fig. 18. — Figure extraite du De Stella Nova (Prague 1606).
(Collection Observatoire de Paris. Cliché J. Counil)

3 https://www.academia.edu/25687069/And_Yet_It_Stands_The_Stability_of_the_Solar_System_in_Eighteenth_Century_Physical_Astronomy

4 https://books.google.com.br/books?id=S68RAAAAYAAJ&lpg=PA128&ots=7wm1K4Xbxv&dq=the+great+inequality+jupiter+saturn&pg=PA128&redir_esc=y#v=onepage&q=the%20great%20inequality%20&f=false

5 "On these grounds I will attempt to illustrate what significance we can give to this question: 'is the solar system stable?' [...] As for the answer, I don't wish to disappoint anyone, but it will be: we don't know". http://www.mat.unimi.it/users/antonio/ricerca/papers/sns.pdf

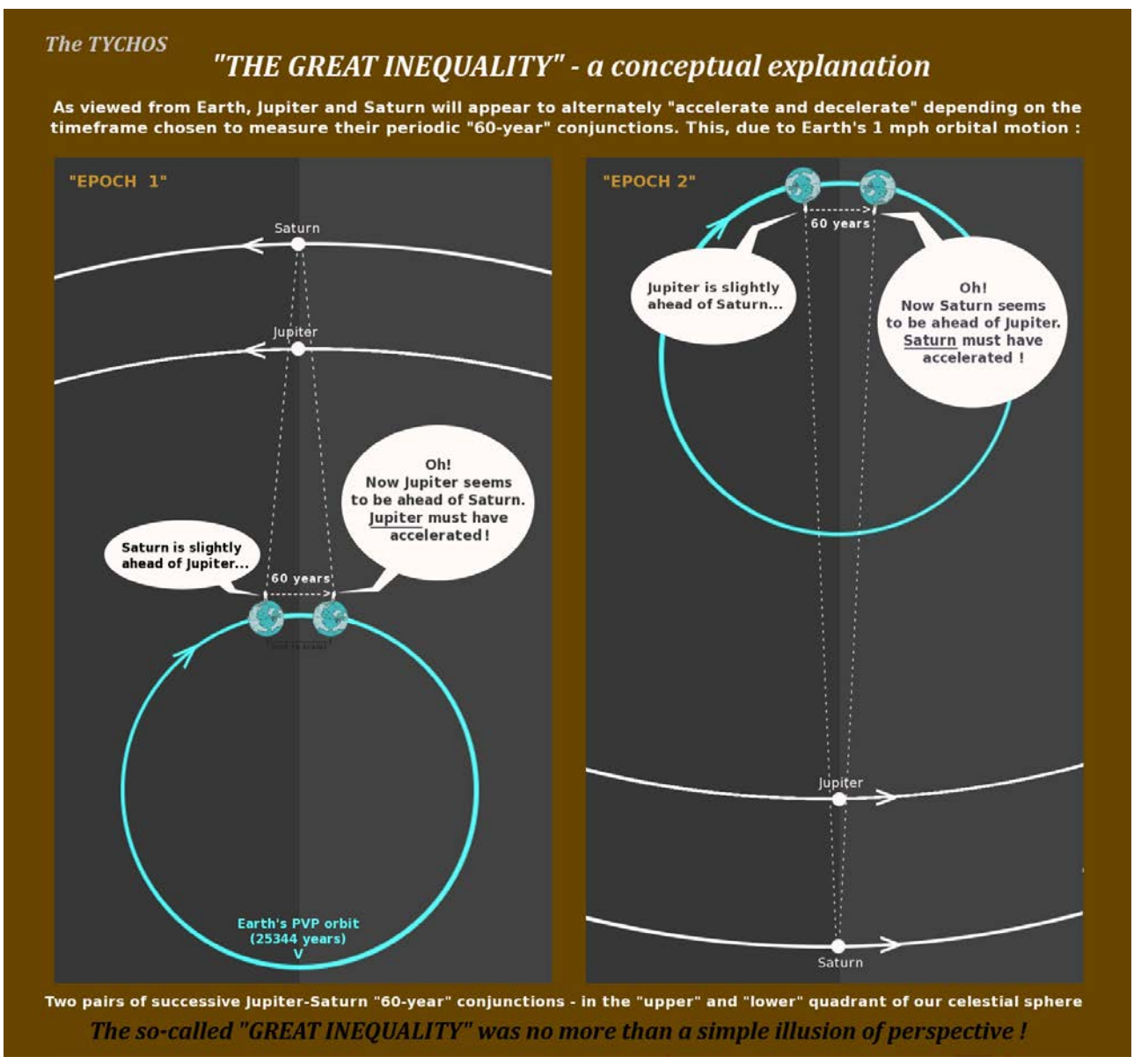
6 http://adsbit.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1980LAstr..94...27M&db_key=AST&page_ind=1&plate_select=NO&data_type=GIF&type=SCREEN_GIF&classic=YES

Let's now see how the Tychos model accounts, in the simplest possible way, for the mystery of the "Great Inequality":

1: Whenever (in a certain epoch) Jupiter and Saturn are observed, over a 60-year interval, to conjunct in the "upper quadrant" of our celestial sphere, *it will seem as if Jupiter is accelerating*.

2: Whenever (in a certain epoch) Jupiter and Saturn are observed, over a 60-year interval, to conjunct in the "lower quadrant" of our celestial sphere, *it will seem as if Saturn is accelerating*.

This is because, as Earth moves slowly (at 1 mph) around its PVP orbit, Jupiter and Saturn will alternately conjunct as they proceed in the opposite or in the same direction as Earth. My below graphic should clarify conceptually what causes the so-called "Great Inequality"—one of astronomy's still unsolved mysteries:



Antonio Giorgilli then points out something of paramount interest to the Tychos model's paradigm. Here's a paragraph from his aforementioned paper ("The Stability of the Solar System: Three Centuries of Mathematics") that I have translated into English, to the best of my ability:

> *"The first long-term simulations have been carried out since the end of the 1980s by some researchers, including A. Milani, M. Carpino, A. Nobili, GJ Sussman, J. Wisdom, J. Laskar. Their conclusions can be summarized as follows: the four major planets (Jupiter, Saturn, Uranus and Neptune) seem to move quite regularly even over a period of a few billion years, which is the estimated age of our Solar System. On the other hand, the internal planets (Mercury, Venus, Earth and Mars) present small random orbital variations, in particular of their eccentricity, which cannot be interpreted as periodic movements: we must admit that there is a chaotic component. Not that the orbits change much, at least not in the short term, but there may be, for example, small variations in the eccentricity of the Earth's orbit that have very significant effects on the climate: the glaciations appear to be correlated with these variations."*[7]

In other words, this nicely goes to confirm that, as proposed by the Tychos, there are two distinct groups of celestial bodies in our Solar System:

1. The Binary group (or "the inner planets") composed of the Sun, Mars, Mercury and Venus (and of course, Earth and our Moon)
2. The P-type group (or "the outer planets") composed of Jupiter, Saturn, Uranus and Neptune (and Pluto, small as it may be)

And thus—in the simplest possible fashion—the Tychos model resolves another historical impasse of astronomy: "The Great Inequality".

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[7] http://www.mat.unimi.it/users/antonio/ricerca/papers/aimeta_2016.pdf