“Galileo and the Inquisition”

Russell J Lowke, December 3rd, 2002.

Galileo Galilei was born at Pisa on Feb. 15th 1564, and is the last of the great Italians to be known almost universally by his first or given name.[1] Galileo heralded in a new era of science. His insistence that nature was governed by mathematics changed natural philosophy from a verbal, qualitative account to a mathematical one, where experimentation became the recognized method of discovery. Galileo made fundamental contributions to the knowledge of motion, astronomy and development of the scientific method, but he is best remembered for championing the Copernican heliocentric system, which dictates that the Sun, and not the earth (as then believed), lies at the center of the solar system. Such a view required a complete change in comprehension of the universe, removing earth from the focus of all creation and instead placing it and all mankind as lost in the vastness of space. The Roman Catholic Church, by means of the Inquisition, deemed such a paradigm as heretical and muzzled Galileo, banning his book promoting the Copernican system, prohibiting reproduction of any of his work,[2] forbidding him to ever again deal orally or in writing with the Copernican question, and condemning him to life imprisonment at the Holy Office's pleasure.

The traditionally accepted astronomical system in the time of Galileo was the geocentric theory of the universe, according to which the earth was motionless and at the center. Its most influential advocates were Aristotle (378-322 B.C.) and Ptolemy (150 A.D.). The Aristotelian and Ptolemian systems were actually quite different. Geocentric theory being a mixture of both systems, although incompatible in their own contexts, in combination they created a consistent description of the universe.[3] Aristotle postulated a stationary earth encompassing a terrestrial region of change and decay, which was surrounded by a stable celestial region, comprised of the moon, the planets and the fixed stars, which were unchanging except for their motion in circles around the earth. The circles were conceived as hollow, vast, solid but invisible crystalline spheres, carrying in their rims the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn and the fixed stars. Aristotle

[1] James Brodrick. *Galileo and the Roman Inquisition*, (London: Catholic Truth, 1963): 3.
[2] Giorgio De Santillana, *The Crime of Galileo*, (Chicago: Univ. Chicago, 1955): 324.
[3] Jerome J. Langford, *Galileo Science anf the Church*, (Michigan: Univ. Michigan, 1971): 23.

established fifty-five such spheres to explain the celestial paths.[4]

Aristotle's model of the universe could not explain some planetary phenomena; the most striking of which was retrograde motion. In retrograde motion, a planet appears to slow down and move in reverse, or retrograde before resuming course. Planets also grow brighter or dimmer as they move through the sky. Such problems were explained by Ptolemy. He argued that planets moved on two sets of circles, a deferent circle, and an epicycle circle. Thus the retrograde motion was explained while keeping the planets in circular orbits around the earth [See Appendix 1.0 — Deferent & Epicycle Circles]. For cases where this did not fit, Ptolemy proposed an eccentric orbit, which had a center deferent from the earth. This accounted well for changes in a planet's brightness. Ptolemy's last device was the equant, where a planet sped up and slowed down, but when seen from an off-center point, actually appeared to be moving with uniform speed[5] [See Appendix 2.0 — Eccentric Orbit & Equant]. Ptolemy's astronomical treatise, known by its Arabic title as the *Almagest,* accurately enabled eclipses to be predicted, helped navigation, and did so effectively "save the appearances" of the heavens that it became the astronomical bible of the Western world for fourteen centuries.[6]

In 1530 Nicolaus Copernicas, a Polish astronomer, circulated an outline of his new astronomy, the heliocentric system. At one stroke he reduced the extreme complexity of the Ptolemian system to an elegant simplicity. The observed retrograde motions of the planets could be accounted for in terms of the earth's own orbital motion around the sun, added to or subtracted from the motions of the planets. Similarly, the variation in planetary brightness could also be explained by such movements. That Mercury and Venus were never seen opposite the Sun was solved by placing their orbits closer to the Sun than that of the earth. Copernicus was able to place the planets in order of their distances from the Sun by considering their speeds, and hence

[4] James Brodrick, *The Man, his Work, his Misfortunes*, (Great Britain: Birchall, 1964): 17.
[5] "Ptolemy" *Encyclopædia Britannica* <http://www.britannica.com>.
[6] James Brodrick, *The Man, his Work, his Misfortunes*: 18.

constructed a coherent and relatively simple system of the planets.[7]

Nevertheless, not all of the difficulties of the Ptolemian system could be explained, and Copernicus kept some of the cumbersome epicycles and other adjustments, and some of the Aristotelian crystalline spheres. The result was a much neater system, but not so striking as to prompt universal agreement. There were many implications that caused considerable concern. If the earth revolves on its axis once in 24 hours, then why do objects not fly off it? And why do objects dropped from towers not fall to the west as the earth rotates to the east beneath them? What really bothered Copernicus and his contemporaries, particularly Galileo, was that if the earth revolved around the Sun, then the apparent positions of the fixed stars should shift as the earth moves in its orbit. No such shift (stellar parallax) could be found, and indeed would not be found until the nineteenth century.[8] For the lack of parallax there were only two explanations: either the earth was at the center of the universe, or the stars were so far away that no shift could be detected, and the earth floated in an enormously vast cosmos of mostly empty space.

In 1533, Pope Clement VII requested a public lecture in the Vatican gardens, explaining the Copernican theory. He was quite favorably impressed, and Copernicus was urged to publish the complete details of his system. Copernicus was reluctant to do so, fearing ridicule (not persecution), and his fears were not without foundation. In 1533, Martin Luther said:

> People give ear to an upstart astrologer who strove to show that the earth revolves around the sun and the moon... This fool wishes to reverse the entire science of astronomy; but sacred Scripture tells us that Josue commanded thye sun to stand still, and not the earth.[9]

It wasn't until 1543, as he lay on his deathbed, that Copernicus finished writing the proofs of his great work on his heliocentric system, calling it *Six Books Concerning the Revolutions of the Heavenly Orbs*. He died just as it was published. Copernicus dedicated his work to Pope Paul III and the text was entrusted to Andreas Osiander to oversee its publication. Osiander, a Lutheran

[7] "science, history of" *Encyclopædia Britannica* <http://www.britannica.com>.

[8] The asronomer Friedrich Bessel, after years of patient observation, determined the parallax of the star 61 in the constellation of the Swan. James Brodrick, *The Man, his Work, his Misfortunes*: 81.

[9] Jerome J. Langford: 35. [Martin Luther, Tischreden, ed. Walsch, XXII, 2260]

theologian, was well aware that Luther opposed the new system and, wishing to avoid theological difficulties, wrote an unsigned preface which appeared to be by Copernicus himself. This preface stated the heliocentric system to be merely a hypothesis intended to serve as a computing device, and in no way represent true physical reality. There is little doubt that Copernicus meant his book to represent the real motions of the heavens. Osiander's preface was later used by the Inquisition against Galileo to argue that if Copernicus himself did not consider his system representative of physical fact, then Galileo should not attempt to prove that it did.[10]

In June or July of 1609, Galileo Galilei heard of an optical instrument invented in Holland by which distant objects could be made to appear closer. Aided by reports of the Dutch invention, and a great deal of trial and error, Galileo made his own three-powered spyglass from lenses for sale in spectacle makers' shops.[11] Galileo taught himself the art of lens grinding and started improving upon the instrument to make increasingly powerful telescopes. In the Fall of 1609 Galileo began observing the heavens with instruments that magnified up to 20 times.[12] Important discoveries were not long in coming. First Galileo looked to the moon. He drew the Moon's phases as seen through the telescope, and saw that the moon was not a perfect sphere, as had been thought, but is rough and uneven. He writes:

> ...the surface of the moon is not smooth, uniform, and precisely spherical as a great number of philosophers believe it (and the other heavenly bodies) to be, but is uneven, rough, and full of cavities and prominences, being, not unlike the face of the earth, relieved by chains of mountains and deep valleys.[13]

In January, 1610, Galileo discovered the satellites of Jupiter, particularly significant as no longer could it be said that all the celestial bodies revolved around the earth. Here was a planet traveling a major orbit and carrying *four* moons with it.[14] He saw spots upon the Sun and saw that the Milky Way was "...nothing but a congeries of innumerable stars grouped together in clusters...

[10] Jerome J. Langford: 36.
[11] James Brodrick. *Galileo and the Roman Inquisition*: 8.
[12] "Galileo" *Encyclopædia Britannica* <http://www.britannica.com>.
[13] James Brodrick. *Galileo and the Roman Inquisition*: 9.
[14] Jerome J. Langford: 40.

many of them rather large and quite bright, while the number of small ones is altogether beyond calculation." No one had had suspected the existence of additional stars.[15]

These discoveries were earthshaking, and Galileo quickly produced a little book, *Sidereus Nuncius* (*The Sidereal Messenger*), in which he described them. In the preface he declared quite openly that the sun, not the earth, was at the center of the universe. The book sold out almost as soon as it was printed and liberal-minded intellectuals saw it as a great contribution to human knowledge. But the atmosphere was not all peace and triumph. University Aristotelians came forth with angry retort. A leading philosopher, Lodovico delle Colombe, could not believe that the moon was not a perfect sphere, suggesting that its craters were covered with a smooth transparent substance. One of the foremost philosophers at Pisa, Giulio Libri, is said to have refused even to look through the telescope.[16] Other discoveries found after the publication of *Sidereus Nuncius* were the puzzling appearance of Saturn, much later to be shown as caused by a ring surrounding it, and the discovery that Venus goes through phases just as the moon does — further evidence of the heliocentric system. Although Galileo's discoveries did not conclusively prove the earth to be orbiting the Sun, he had undermined the very roots of Aristotle's system of the universe.

Opponents of Galileo saw Scripture to be a more effective silencer than their attempts at reasoning. Colombe was the first to use the Bible as a weapon directly against Galileo in his treatise, *Against the Motion of the earth*,[17] using such scriptural proof that the earth does not move as found in: "Who laid down the foundations of the earth, that it should not be removed for ever" (Ps. civ. 5) and "The World also shall be stable, that it be not moved " (I. Chron. xvi. 30).[18] Speculation came to rest on the scriptural difficulties in the new system. People wanted to know how to interpret texts such as that of Josue 10:12-13. "Josue prayed to the Lord and said..., 'Stand still, O sun, at Gabaon, O moon, in the valley of Aialon!' And the sun stood still, and the moon

[15] James Brodrick. *Galileo and the Roman Inquisition*: 10.
[16] Jerome J. Langford: 41.
[17] Jerome J. Langford: 51.
[18] F. Sherwood Taylor, *Galileo and the Freedom of Thought* (Great Britain, Watts, 1938): 77.

stayed, while the nation took vengeance on its foes." Josue would hardly command the Sun to stand still if it never moved anyway. There were many biblical texts quoted against the new astronomy.[19] Galileo was alarmed by Colombe's attack, but at the time was enjoying a triumph. In March 1611 he went to Rome, and was received with high acclaim. The Archbishops and Princes of the Church were delighted to witness wonders of the sky, and eagerly studied the new discoveries.[20]

On December 14, 1613, Don Benedetto Castelli, Galileo's favorite disciple, wrote to Galileo and informed him of a conversation he had had in the presence of the Grand Duke and the Dowager Grand Duchess Cristina di Lorena. Talk had turned to Galileo's discoveries and Boscaglia, lecturer in Physics at Pisa, conceded their truth, but said that the motion of the earth was incredible and impossible, principally as Holy Scripture was contrary to such opinion. Galileo replied to Castelli in his famous letter of December 21, 1613, in which he uses current Catholic doctrine as to the relations of science and the Scriptures, as outlined by St. Augustine, who claimed that Scripture was not meant as literal proof for or against physical theory. Such doctrine was far from that of the time, and Galileo was a layman, unqualified to intrude into the domains of theology.[21] The Council of Trent (1545-1563) had decreed in this regard:

> ...no one relying on his own judgment shall, in matters of faith and morals pertaining to the edification of Christian doctrine, distorting the Scriptures in accordance with his own conceptions, presume to interpret then contrary to that sense which holy mother Church, to whom it belongs to judge of their true sense and interpretation[22]

Castelli was perhaps unwise to copy the letter and freely distribute it. Just over a year later, on February 5, 1615, the Dominicans of the covent of St. Mark denounced to the Holy Office of the Inquisition the letter Galileo wrote to Castelli. Fortunately the Inquisition's report was colorless, and stated that on the whole the letter did not deviate from Catholic doctrine. Nevertheless, Galileo knew that forces were being moved against him and, believing in the power of

[19] Jerome J. Langford: 53.
[20] F. Sherwood Taylor: 79 — 80.
[21] F. Sherwood Taylor: 82 — 83.
[22] Jerome J. Langford: 56.

reason and argument, hoped that authorities might be persuaded to view the Copernican system in accord with Catholic faith. Galileo wrote to the Grand Duchess Cristina de Lorena a much-enlarged version of the original letter to Castelli, stating his convictions as to the relation between religion and science.[23] It was at this time that a Carmelite friar, Paolo Antonio Foscarini, published a work attempting to show the Copernican system not contrary to Holy Scripture. Foscarini sent a copy to Saint Robert Cardinal Bellarmine, and asked his opinion of it. This unexpected support from a qualified theologian may have been a factor in Galileo's decision to write to Archbishop Piero Dini in Rome, saying that Copernicus had not intended his system to be a mere theory and that he, Galileo, wanted it either accepted as a fact or rejected completely.[24]

In 1615 Galileo descended upon Rome, specifically to win the support of the Church authorities. He explained to Cardinal Orsini that he believed he had conclusive proof for the heliocentric system (he did not), and wished to present the argument to Pope Paul V. On February 19, 1616, theological Consultors of the Holy Office were summoned to give a formal decision on the Copernican system.[25] Two propositions representing Galileo's doctrine were submitted.

I. The sun is the center of the world and completely immovable by local motion.
II. The earth is not the center of the world, nor immovable, but moves according to the whole of itself, and also with a diurnal motion.

On February 23 the Consultors met and decided on the following censures:

> The first proposition was declared unanimously to be foolish and absurd in philosophy and formally heretical inasmuch as it expressly contradicts the doctrine of Holy Scripture in many passages, both their literal meaning and according to the general interpretation of the Fathers and Doctors.

For the second proposition:

> All were agreed that this proposition merits the same censure in philosophy, and that, from a theological standpoint, it is at least erroneous in the faith.

[23] F. Sherwood Taylor: 85.
[24] Jerome J. Langford: 59.
[25] Jerome J. Langford: 91.

Galileo believed completely in the physical truth of Copernicanism, but he wanted it recognized almost overnight, and thereby brought condemnation upon himself. He had prematurely approached the Pope before obtaining enough factual evidence asserting Copernicanism. The Consultors were mostly eminent theologians, not mathematicians or astronomers. "Formally heretical" in their first censure means that the proposition that the Sun is the center was considered directly contrary to faith, tagging the proposition with the strongest possible censure. The second proposition, the motion of the earth was censured as "erroneous in the faith," meaning that it was not directly contrary to Scripture, which was not definite in stating the earth's immobility.[26] Foscarini's book was banned, as were various technical and non theological works, such as Johannes Kepler's *Epitome of Copernican Astronomy*. Copernicus's1543 book, *De revolutionibus orbium coelestium libri vi* ("Six Books Concerning the Revolutions of the Heavenly Orbs"), and was suspended until corrected.[27]

Bellarmine was instructed to notify Galileo that he could no longer hold or defend the censured propositions, but remained free to discuss the Copernican system (could teach it), as could any Catholic, provided that he did not hold it to be more than a mere astronomical hypothesis.[28] Contrary to this is an administrative minute placed in the Vatican files at this time, which states that Galileo was admonished "not to hold, *teach*, or defend" the Copernican theory "in any way whatever, either orally or in writing."[29] This document is unsigned, and appears to have been prepared in case Galileo resisted the censures, which he did not. Rumors spread that Galileo had been compelled to recant his opinions and been given salutary penance, in answer to these rumors Galileo appealed to Cardinal Bellarmine for an affidavit as to what had actually happened. Bellarmine agreed, and wrote a signed affidavit dated 26th May 1616. Galileo preserved that affidavit, and produced it as his chief defense during his trail in 1633, twelve years after Cardinal

[26] Jerome J. Langford: 90.
[27] "Galileo" *Encyclopædia Britannica* <http://www.britannica.com>.
[28] Stillman Drake. *Galileo* (Great Britain: Oxford, 1980): 66.
[29] Jerome J. Langford: 93.

Bellarmine's death.

Galileo was now in a difficult position. He had excellent income, unlimited time, facilities for research, at was at the height of his powers, but his central interest was Copernican theory, for which he was forbidden to publish any defense. For seven years he published nothing. In 1624, Galileo's old friend and admirer, Maffeo Barberini, was elected as Pope Urban VIII. Galileo attempted to persuade Urban to rescind the decree of 1616, which Urban refused to do. Then Galileo described to Urban an erroneous theory of the tides of his own devising, a theory which depended on Copernican motions of the earth. Erroneous as his theory was, Galileo was entirely correct in that any scientific explanation of the tides must involve motion of the earth.[30] After six audiences with Urban, he was granted permission to publish his tide theory — provided he made it clear that the earth's motions were taken only hypothetically.[31]

Galileo returned to Florence to write his *Dialogue on the Two Great World Systems*, in which he defended Copernicanism openly as established physical truth. What's more, he unwittingly included at the end of the work an argument suggested to him by Urban, and put it into the mouth of Simplicio, his third character, and fool of the discussion. Furthermore, Galileo resorted to extreme practices to get his work printed and censored by censors entirely under his influence. The *Dialogue* was published at Florence in February 1632.[32]

Six months later the printer was ordered by Rome to suspend further sales. In October Galileo was summoned to Rome to stand trail before the Inquisition for flagrant disobedience to the commands laid upon him in 1616. He delayed coming on pleas of illness, but was told to come to Rome or be brought in chains and pay the expenses of arresting officers sent from there. He finally left in February 1633. On arrival in Rome he took up residence at the Villa Medici, and remained there nursing his health undisturbed. When he at last he surrendered himself formally to the Inquisition, he was not, as is usual in such cases, put in prison. Instead he was assigned a

[30] Stillman Drake: 75.
[31] Stillman Drake: 72.
[32] James Brodrick. *Galileo and the Roman Inquisition*: 39-40.

comfortable suite of rooms, and permitted to have the service of a valet, where he stayed under an extremely mild form of house arrest for a month. During his trial he was actually granted permission to return to the Villa Medici, a procedure totally unprecedented. Contrary to popular belief, Galileo never spent a day of his life in a prison cell.[33]

Galileo was interrogated for the first time on 12 April 1633 by Fra Vincenzo Maculano da Firenzuola, who startled Galileo by reading to him the unsigned minute stating that he had been issued an absolute injunction"not to hold, *teach*, or defend" the Copernican theory. In retort Galileo produced his signed affidavit given to him by Cardinal Bellarmine. Galileo was never summoned before the commissary in 1616, and the unsigned minute has been the subject of much debate. Historians have tried to show the minute as spurious and claim it was inserted as a preconceived trap.[34] Most significantly, the document is only a *registratur* or report, and is unsigned. Careful research of the record with X-ray and ultraviolet tests, has proved the record untampered, and certified it to be written by the same hand as the files preceding and following documents, which were definitely written in 1616.[35] At the close of the first interrogation, when Firenzuola asked Galileo if he had applied for permission to print the *Dialogue,* Galileo replied that he had thought it unnecessary, as in the book he had not defended the opinion that the earth moves and that the sun is stationary, but rather supported the opposite of the Copernican view. [36]

Five days later, on 17th April, experts appointed to examine the *Dialogue* concluded that Galileo had not only discussed Copernican theory as a hypothesis, but had defended it as physical fact, and had referenced those who differed in opinion as "dumb idiots," and "mental pygmies, hardly deserving the name of human beings." Any pretense that the *Dialogue* refuted Copernicus was clearly dishonest. Galileo was under oath and the Inquisition could rightfully charge him with perjury. They did not.[37] Maculano, his interrogator, was sent to privately endeavor to argue him out

[33] Ibid.
[34] James Brodrick. *Galileo and the Roman Inquisition*: 43.
[35] Jerome J. Langford: 94.
[36] James Brodrick. *Galileo and the Roman Inquisition*: 44.
[37] Ibid.

of his folly, and on April 28th reported:

> After many and many arguments and rejoinders had passed between us, by God's grace I obtained my object. He clearly recognized that he had gone too far and erred in his book, and he was ready to make this confession before his judges.[38]

At this point Galileo had become so apprehensive of the Inquisition that he even suggested he write a second dialogue pronouncing the Copernican system false. He was summoned for his third and final examination on June 21, and questioned under oath about his real convictions on the Ptolemian and Copernican systems. He answered that after the Decree of 1616, he had always held as indisputable the position of Ptolemy, that is, the stability of the earth. Three times over he was pressured to speak his real mind, as he had shown it in his *Dialogue*, the third time torture was mentioned, but still he maintained that ever since 1616 he had rejected Copernicanism. The hearing was a pure formality, as was the threat of torture, and Galileo knew it. On the following day, June 22, his sentence was read to him. Galileo was ordered to solemnly abjure the Copernican opinion, to be imprisoned at the pleasure of the Holy Office, and to recite once a week the seven penitential psalms for the following three years. He was then handed the formula of abjuration and required to recite it on his knees. He did as he was told very abjectly.[39]

Galileo's actual penalty, although it appeared harsh, was to some degree lenient. The prison to which Galileo was sentenced was the Villa Medici on the Pincian Hill. He spent only twelve days there, and was then permitted to leave Rome and stay at the palace of his friend Archbishop Piccolomini in Sienna. For the remaining nine years of his life he remained technically under the jurisdiction of the Inquisition, and was allowed to return to his farm at Arcetri. The Inquisition even delegated to his beloved nun daughter, Suor Maria Celeste, the duty of reciting for him his Seven Penitential Psalms.

Galileo had been over zealous in approaching Vatican in 1616, and later, when given the chance to postulate hypothetically, had insisted on deriding his contemporaries, and championing

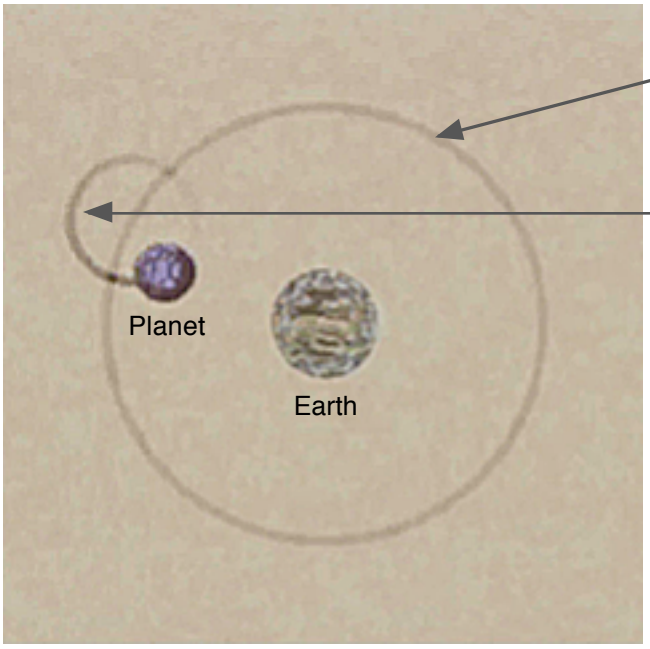
[38] James Brodrick, *The Man, his Work, his Misfortunes*: 136.
[39] James Brodrick, *The Man, his Work, his Misfortunes*: 140.

his thesis with an erroneous theory of the tides. He lacked conclusive proof of a heliocentric system, proof which would not be forthcoming for decades. Many of his contemporaries believed him crazy. Galileo pressed for the church to embrace a radical shift in ideology, an ideology that placed the earth and it's inhabitants as insignificant in a vast cosmos, rather than safely and securely in the center. The Inquisition's subsequent prohibition of the heliocentric thesis, a thesis which later became an established fact, has since stood exemplary of the struggle of the forces of reason and enlightenment against those of authority and superstition.[40] Ironically, as Galileo abjured from addressing the heliocentric thesis directly, he spent his remaining years writing the book on which his universal fame as a physicist rests, his *Dialogues Concerning Two New Sciences,*[41] upon which Newton would later expand, and from which modern physics was born.

[40] Jerome J. Langford: fwd ix [Stillman Drake].
[41] James Brodrick. *Galileo and the Roman Inquisition*: 47.

Appendices

1.0 — Deferent & Epicycle Circles



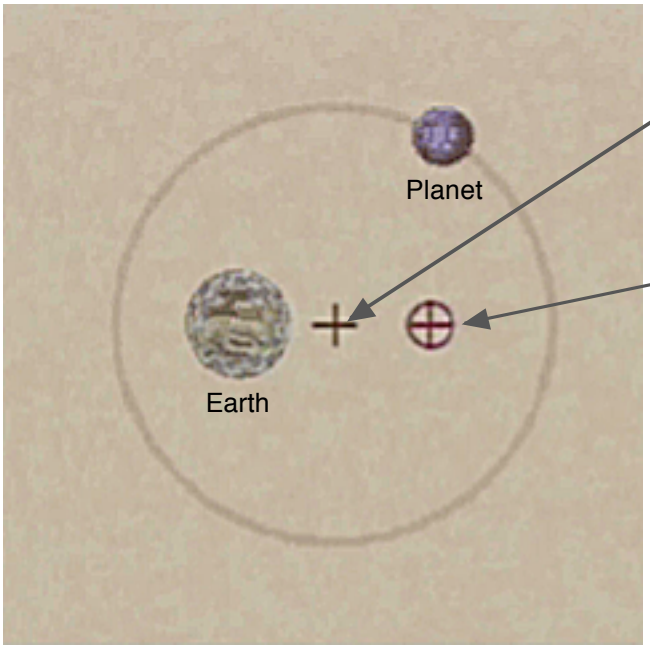
Deferent Circle:

A large circle, centered on earth.

Epicycle Circle:

A small circle whose center moves around the circumference of the deferent circle.

2.0 — Eccentric Orbit & Equant



Eccentric Orbit:

Circle centered on a point displaced from the earth, with the planet moving around the circumference.

Equant:

Planet speeds up and slows down, but when seen from an off center point (equant) actually appears to be moving with uniform speed.

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