4 The Jesuit Rejection of Copernicanism

The College of Santo Antão's mathematics professors obviously knew that the heliocentric model put forward by Copernicus was not the sort of solution that Clavius had in mind. In his *Commentarius de Sphaera Ioannis de Sacro Bosco*, Clavius presented a somewhat concise refutation of Copernicus based on astronomical, physical and biblical arguments, which would become quite influential among Jesuit mathematicians.[1] In addition, in March 1616, the cardinals belonging to the Congregation of the Index, among whom Bellarmino was a leading character, deemed heliocentrism to be false and contrary to the *Bible*.[2] Copernicanism was, henceforth, considered a quasi-heretic theory.

As such, it nevertheless remained an issue for teaching and criticism at Jesuit colleges and universities.[3] Just like their confrères in Rome and throughout Europe, the professors of Santo Antão delved into the Copernican theory. While Lembo set out the Copernican planetary system but refrained from discussing its cosmological consequences in depth,[4] his successor in the mathematics chair at Lisbon, Johann Chrysostomus Gall, however,

1 On Clavius's critique of Copernicus, see particularly Lattis, *Between Copernicus and Galileo*, 106-44. Cf. also Volker R. Remmert, who argued that the rebuttal of Copernicanism within the Society of Jesus was due not only to the theologians but also to the mathematicians, and particularly to Clavius, who played a key role in building up a consensus to reject Copernicanism in the late sixteenth and early seventeenth centuries. Remmert, "Our Mathematicians Have Learned".

2 See, among the extensive bibliography on this issue, Fabbri, Favino, *Copernicus Banned*.

3 Renée J. Raphael has convincingly argued that the need to refute Copernicanism led the Jesuits to teach it rather than simply suppress it. Raphael, "Copernicanism in the Classroom".

4 Lembo included a drawing of the heliocentric system; Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 24*v*.

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did not avoid discussing the topic in greater detail. He approached it firstly when introducing his students to the main planetary rearrangement hypotheses as well as subsequently when making his point in favour of geocentrism and geostaticism.[5]

Gall, who taught in Lisbon from 1620 until 1627, when he departed for Goa, India, presented to his Portuguese audience the key features of the Copernican system. As he described it:

> The second system is that of Nicholas Copernicus and [f. 14*r*] Aristarchus, and other ancient authors. These authors, contradicting the common understanding, claim that the Sun stands still at the centre of the entire universe, and the Earth, together with all the other planets and elements, moves around it. They order the parts of the universe as follows: to the Sun they give the centre of the universe, to which follows Mercury, then Venus, and, in the third place, the great orb wherein the Moon's heaven moves, as an epicycle, in the centre of which is the Earth surrounded by the elements. The heaven of Mars follows the great orb, then that of Jupiter, then that of Saturn, and finally, the immobile Firmament. [f. 14*v*][6]

A diagram of the Copernican planetary system was added **[fig. 2]** to support his discussion of Copernicanism.

Nevertheless, rather than merely discussing the technical issues of heliocentrism, Gall's emphasis was placed on refuting this system. In Lisbon, he presented the standard criticism of Copernicanism. Like Clavius before him, his disapproval of heliocentrism relied on three sorts of arguments. In the realm of mathematical astronomy, Gall pointed out that the Earth's revolution motion would require the apparent position of the fixed stars to shift over the course of a year (the so-called parallax argument) or alternatively the celestial region, and particularly the space between Saturn and the fixed stars, to be much more extensive than astronomers had traditionally conceived – which clashed with the authority of Brahe and Christoph Scheiner.[7] As Gall put it:

> If the Earth moved, it would follow that the Firmament, the planetary heavens and the heaven of the fixed stars would be an immense space. There would also be a massive distance between Saturn and the heaven of fixed stars, with no reason or purpose for such a spatial immensity.[8]

5 The Portuguese public libraries and archives preserved two copies of Gall's lecture notes, respectively at the Biblioteca Geral da Universidade de Coimbra and the Biblioteca Nacional de Portugal. Copernicanism is discussed in Gall, *In Sphaeram*, BGUC, MS 192, ff. 14*r*-14*v*, 56*r*-58*v* and Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, ff. 43*r*-45*v*, 64*v*-65.

6 Gall, *In Sphaeram*, BGUC, MS 192, ff. 14*r*-*v*: "O segundo sistema he de Nicolao Copernico, e de Aristarco, e doutros antigos. Estes contradizendo ao comum sentir dos homens, afirmão estar o Sol immouel no meo de todo o uniuerso, e a terra com todos os mais planetas e elementos mouerse ao redor delle. Pelo que ordenão as partes do uniuerso desta maneira: ao Sol dão o centro, a este segue Mercúrio, logo Vénus, no terceiro lugar o orbe grande, no qual se moue o ceo da Lua, como epiciclo, no centro do qual esta a terra rodeada dos mais elementos. Ao orbe grande socede o ceo de Marte, logo o de Júpiter, depois o de Saturno, e finalmente o firmamento immouel".

7 Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, ff. 43*v*-44*v*.

8 Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, f. 43*v*: "porque este mouimento da terra se seguiria primeiramente huma huma imensidade do firmamento e dos mais caeos, e estrellas fixas e necessariamente ouuera entre o Saturno e estrellas fixas huma distancia imensa sem se saber o proueito nem fim destas grandes".

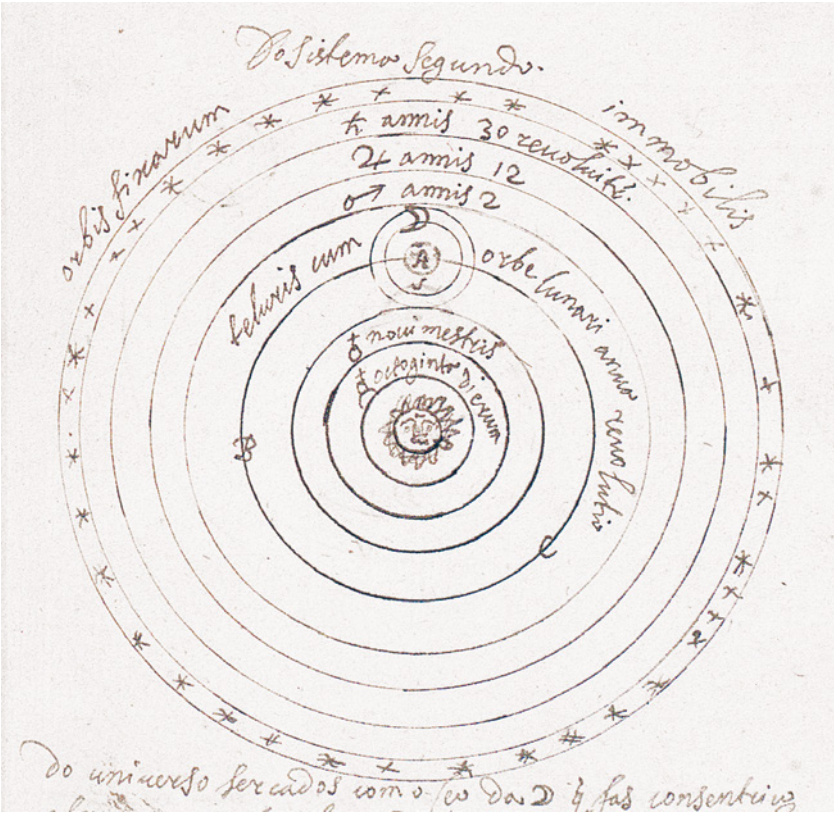

Figure 2 The Copernican system according to J.C. Gall (*In Sphaeram*, BGUC, MS 192, f. 15*r*)

Additionally, the German Jesuit proposed the typical set of physical evidence that he maintained contradicted the notion of the Earth's rotational motion, namely the fact that a small rock, when thrown directly upwards, falls back in exactly the same place and not at some distance eastwards; were the Earth to be moving very fast in an eastward direction, a bird flying eastwards would neither ever reach its destination nor fly at the same speed in both the easterly and the westerly direction.[9] The Copernican theory also violated the basic cornerstone of Aristotelian physics; that is to say, a simple body cannot move with more than one simple motion. If this was the case – Gall argued along the lines of the Aristotelian natural philosophy – the Earth's motion would necessarily be downwards. Furthermore, the Earth could not be subject to any violent movement because no extrinsic cause could impel it to move, not even the Sun, as Gall pointed out, alluding to Kepler. Thus, the Earth could not be provided with the three motions attributed to it by Copernicus.[10]

Finally, Copernicus's heliocentric theory conflicted with the many biblical passages that state that the Earth stands still at the centre of the universe.

9 Gall, *In Sphaeram*, BGUC, MS 192, ff. 56*v*-57*v*; Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, ff. 44*v*-45*r*.

10 Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, f. 43*v*.

Gall invoked some of the usual passages deployed in this debate: *Psalm* 75:4, 93:1, 103:5, *Ecclesiastics* 1:5 and *Jos*. 10:13.[11] In this context, the Jesuit added a subtle reference to the Protestant Copernicans (whom he did not name), who recommended "understanding these passages in a non-literal sense".[12] After Gall, this became a leitmotif in the Jesuit criticism of Copernicanism. Borri, who discussed the *Copernici hypothesi repugnat Physicae* very cursorily,[13] explicitly refuted any attempt to understand the *Bible* critically in a historical context.[14] Approximately a decade later, the Irish Jesuit Simon Fallon would address the point more directly in his criticism of the recourse to the theory of accommodation by Copernican astronomers:

> Neither is it worth what Kepler and others answer by claiming that the Scripture speaks, in those passages, in the common and ordinary sense of men, nor is it worth the fact that this hypothesis has pleased, in the past, some learned men in the Scripture, nor the fact that the same Copernicus dedicated this work to [the Pope] Paul III, as one can conclude from the Prolegomena to this book, because as regards the interpretation of the Holy Scripture, there is a very well received rule that advises not to deviate from the real meaning of the words when the proper sense of their meaning can be verified. It should also be added that there is already a statement produced by the Cardinals against this opinion as well as the fact that this book is prohibited by the Index until amended.[15]

Fallon here epitomised the essential attitude that Jesuit intellectuals were required to adopt in the Copernican dispute: to interpret biblical passages in the literal sense.[16] As this book shall demonstrate in its final section, this literalist approach conditioned the Jesuits' cosmological discussion and correspondingly their own ongoing relationship with Tycho Brahe's heliocentric system. Furthermore, the Irish Jesuit recalled the critical events of 1616 deriving from the Galileo affair, specifically the statement produced by the cardinals of the Congregation of the Index that banned Copernicanism, condemned Foscarini's book and censured Copernicus's *De Revolutionibus* and similar books. The authority of the *Bible* and the Church thus emerged as undisputable in cosmological matters.[17]

11 Gall, *In Sphaeram*, BGUC, MS 192, f. 58*r*.

12 Gall, *In Sphaeram*, BGUC, MS 192, f. 14*v*: "ainda que seos defensores, sem necesidade, pretendam auerse de tomar estes lugares no sentido menos proprio".

13 Borri, *Collecta astronomica*, 42-3.

14 Borri, *Collecta astronomica*, 43: "Neque admittenda est Kepleri, et aliorum circa terrae stabilitatem intepretatio, qui dicunt scripturam ad Vulgi sensum se accomodasse".

15 Fallon, *Compendio Spiculativo*, BNP, cod. 2258, f. 97*v*: "Nem vale o que responde Keplero e outros dizendo, que a Scritura falla aly no sentido comum e ordinario dos homens, como também não nem vale o parecer bem algum dia esta hypothesi a alguns varões doctos na Scritura, nem o ter dedicado o mesmo Copérnico esta obra a Paulo III, como tudo se vê nos Prologuomenos deste mesmo liuro, porque no explicar da Sagrada Scritura he mui bem recebida a regra, que senão há de desuiar do que as palauras soão, quando no sentido proprio se pode verificar o que dizem. Acrescentasse auer iá contra esta opinião huma declaração dos Cardeaes e também ser este liuro prohibido pello expugatorio até se emendar". Another copy of this manuscript can be found at BNP, cod. 2125 (Fallon, *Sphera Arteficial e Natural*).

16 On the Jesuit bond to biblical literalism, see in particular Kelter, "The Refusal to Accommodate". See also Blackwell, *Galileo, Bellarmine, and the Bible*.

17 This led Gall to conclude that, "if its author (Copernicus) lived today, he would not support those things because he was a good Christian and dedicated [the book] to Pope Paul III"

Document III

Capítulo IV

Do mouimento, e quietasões do globo da terra e augoa [1625]. Johann Chrysostomus Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, ff. 43*r*-45*v*

Não tartaremos nestes capítulos do mouimento de cada hum destes elementos em particular com que apartados de seus lugares proprios se tornão a elles por meio de sua grauidade mas se explicarmos primeiramente se toda a bolla composta de ambos iuntos tem algum mouimento proprio. Item se pode dizer que a dita Bolla esta quieta em que centido e donde naçe a dita quietação.

1ª Conclusão

O globo da terra e augoa não se moue ao redor do Sol. Esta conclusão vai contra alguns philozophos antigos e principalmente contra os outros modernos, os quais com Nicualo [sic. Nicolau] Copernico afirmão que o Sol fica no meio do mundo e a terra iuntamente com os mais elementos e a lua se moue ao redor della [*sic*, dele] entre o ceo de venus e marte con espacio de hum anno.

Os principais fundamentos desta openião acho que são estes dois. O primeiro he que dizem estes autores que por se escusarem muitas dificuldades, mais facilmente se pode explicar por operacões e mouimentos dos corpos caelestiais. O segundo porque lhe pareçe muito grande encoueniente que corpos tão grandes e perfeitos como são os caelestiais se moue[m] com o mouimento tam aprezado por respeito de huma bolla da terra tão piquena e imperfeita.

Porem nossa conclusão he mais conforme a rezão e sentimento comum de todas as gentes e dos milhores philozophos he [*sic*, e] Astronomos e sobre tudo a Sagrada escritura fala tão claramente nesta maneira que senão pode dizer o contrario pos os Eclesiasticos no 1º capítulo disem terra autem inter medium stat[18] e no salmo 92 se dis firmauit orbem terrae numero commouebitur[19] e no salmo 74 falando da terra diz Ego confirmavit colunas eius[20] como se disera eu estabelesi a terra, a qual se a pusera [f. 43*r*] com colunas firmes. Em o 1º dos palelipomenos [i.e. Paralipomenon] capítulo 16 ipse fundauit orbem imobilem,[21] a ressão Philozophica he porque o mouimento da terra nem he natural nem violento, não he natural porque a terra como corpo simples não tem mais que hum mouimento natural como disem os philosophos com Aristoteles, no 2º capítulo do 1º livro dos Ceos o qual mouimento ha de ser para baixo, e nunqua auemos de comceder que a terra he animada com dis

("e seu autor mesmo se ainda hoie uiuera não ouuera de aproueitar taus coissas pois era bom christão e dedicou [o livro] a[o] Santo Padre Paulo 3º") (Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, f. 64*v*).

18 *Terra autem in aeternum stat. Oritur sol, et occidit sol. Eccle.* 1:4-5.

19 *Etenim firmavit orbem terrae, qui non commovebitur. Ps.* 93 (92):1.

20 *Ego confirmavi columnas eius. Ps.* 75 (74):4.

21 *Ipse enim fundavit orbem immobilem. I Par.* 16:30.

hum destes modernos: nem he violento porque não se acha [causa] extrinsica deste mouimento pois diser que o Sol o he como dis o dito moderno fazendo o Sol dispencario de todos os mouimentos he fingimento, toda a resão e o comum parecer de todos confirma nossa sentença porque este mouimento da terra se seguiria primeiramente huma huma imensidade do firmamento e dos mais caeos, e estrellas fixas e necessariamente ouuera entre o Saturno e estrellas fixas huma distancia imensa sem se saber o proueito nem fim destas grandes e para milhor se entender o argumento se ha de notar primeiramente que cousa he paralaxis que he o dia[metro] [i.e. ângulo] entre o lugar proprio, e aparente, lugar proprio da estrella se chama o em que cae huma linha direita que saindo do centro do mundo passa pello centro da estrella. O lugar apparente he o em que cae huma linha direita ou raiovisual que saindo da superficie da terra ou do olho daquelle que obserua a estrella que passa pello dito centro da estrella como se ue nesta figura que se segue **[fig. 3]**, e por exemplo seia o centro do mundo A, e o olho do obseruador fique na superficie da terra no ponto B, e seia qualquer estrella e pello centro da qual paca a linha direita ACD e outra linha direita BCE que sae do olho G [*sic*, B] e passa pello mesmo centro C o lugar proprio desta estrella fica na linha AD, o lugar apparente fica na linha BE o angulo ECD com diferenca do lugar proprio, e apparente se chama paralaxis, cuio effeito he fazer que a estrella C pareça mais baixa e menos leuantada sobre o orizonte do que he pois a propria altura da altura he o arco GC (ou que he o mesmo) FD mas quem obseruar no lugar B uera que a altura da estrella he o arco FE **[fig. 3]**.

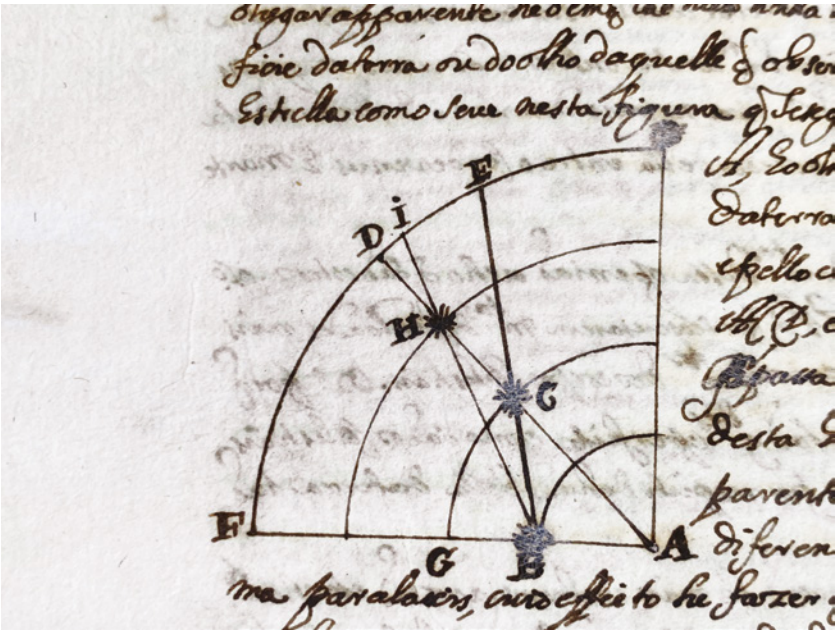

Figure 3 Stellar parallax according to J.C. Gall

Notesse no 2º lugar que o paralaxis das estrellas que distão mais do centro do mundo tem menor paralaxis do que tem as que ficão mais perto, pois fica a estrella H mais apartada do centro [f. 43*v*] que a estrella C e lancesse a linha BI pello centro da dita estrella H, e sera o lugar apparente o ponto I e o paralaxis IHD, o qual prouo que he menor que o paralaxis ECD da estrella C pois o angulo DHI he igual ao angulo CHB polla [preposição] 15 do livro de Euclides, e o angulo ECD he igual ao angulo ACB polla dita proposisão, e o angulo exterior ACB he maior que o angulo interior oposto CHB polla [preposição] 16 do dito livro logo tambem he maior o angulo ECD, he igual o paralaxis da estrella C IHD que he o paralaxis da estrella H maior logo he o paralaxis da estrella inferior ou mais chegado ao centro do mundo do que he o paralaxis da estrella mais afastada do dito centro, e asim pode a distancia ser tão grande que desapareça o paralaxis, enão seia sensiuel quando a distancia da estrella for tão grande que a distancia da largura da obseruacão B, e do centro do mundo A não tenha proporcão sensiuel com a distancia da estrella.

Notesse no 3º lugar que os Astronomos não achão paralaxis sensiuel nas estrellas do firmamento, donde se colhe que a distancia do lugar donde obseruão do centro do mundo não tem proporcão notauel com a distancia ou semidiametro do firmamento, a qual contudo tem como maior distancia do altissimo Planeta Saturno, o qual segundo Copernico dista da terra mais de 9 vesses do que o Sol dista da mesma terra, e a distancia do Sol contem segundo o mesmo Autor 1208 semediametros da terra. Desta doutrina de Copernico, e destas anotacões colige Tyco bray a imencidade do firmamento deste modo a mais alta distancia de Saturno contem na doutrina de Copernico o semediametro da terra 12900 vesses, a qual distancia necessariamente se ha declarar 700 ou 800 vesses para alcançar tanta distancia do firmamento que não aia paralaxis notauel nas estrellas fixas donde sairão 10320000 semediametros da terra e tantos tera o semediametro do firmamento na sentenca de Copernico, e chegara todo o ceo do Sol a ter aquella proporcão com o firmamento qual tem o centro da esphera com a mesma esphera.

O Padre Christhopho Scaneiro [i.e. Scheiner] nas desquiticões [i.e. *Disquisitiones mathematicae de controversiis et novitatibus* (1614)] colige desta imencidade do firmamento que o diametro do semediametro do firmamento, que o diametro das estrellas de primeira grandeza, conforme [?] esta openião tem mais que três vesses o diametro do ceo do Sol ou do orbe grande, e o diametro das estrellas da terceira grandeza, mais que huma ves o diametro das estrellas da sexta grandeza pouquo mais ou menos, de modo que huma estrella minima que se ue [f. 44*r*] se parece seu centro no centro do mundo enchera quasi todo o que fica debaixo da superficie conuexa do ceo do Sol, e as outras maiores tomarião inda o ceo de Marte e de Iupiter, e por uentura algumas o proprio ceo de Saturno pois serião mais de trinta e três vesses maiores que o ceo do Sol. O mesmo Auctor colige tambem [que] entre o Saturno [no] Apogeo e entre o firmamento ha huma distancia inserta de 700 ou 800 vesses maior do que he a distancia do dito planeta Apogeo da terra, que senão pode entender nem conceder, nem resões urgentissimas quais não são as que os aduersarios trazem.

Pois a facelidade de explicar os mouimentos caelestiais não he tão grande nesta openião como elles imaginão, e ainda que forão não era bastante resão para concederemos tantos inconuenientes quantos se seguem do mouimento da terra, como se uera mais claramente na 2ª conclusão quanto a outro fundamento que parece ter algum geito. Respondo primeiramente que

não he coussa seria a nobreza dos ceos e estrellas moueremse para comonicarem suas virtudes, e enrequiserem a terra e gouernar os mais elementos, antes ficão em esse fundamento mais illustres e grandiosos. Respondo no segundo lugar que o mouimento tão apresado nos corpos caelestiais não mostra menos a omnipotencia do Criador do que o pudera mostrar aquella imensidade fabulosa que elles poem. Respondo no terceiro lugar que os ditos elementos não se fazem particularmente por amor do elemento da terra e dos mais [elementos] senão por amor do homem a quem elles seruem o que he infenitas vesses mais nobre que quaisquer corpos caelestiais.

2ª Conclusão

A terra não se moue com o mouimento circular ao redor de seu proprio centro e eixo. Esta conclusão he tambem [falsa] segundo os ditos Autores que dizem que a terra não somente se moue ao redor do Sol senão tambem ao redor do seu proprio eixo, dando huma volta em espacio de 24 horas e mostrando humas e outras [faces] ao Sol fazendo deste modo dias e noites mas este mouimento he tambem [falso] segundo a comua openião de todos os milhores Philozophos e sabios. Nem se pode afirmar sem fazer força a alguns pacos da Sagrada escritura pois o Eclesiaste 1 no alegado capítulo [5] dis oritur Sol e[t] occidit et ad locum suum revertitur ibique renascens girat per meridiem et flectitur ad aquilonem lustras uniuersam in circuitu. Pergit spirito, et in circulos suos reuertit.[22] E no capitulo de Iosue, se dis que mandou Iosue ao [f. 44*v*] Sol e a lua que paracem e dis a escriptura steteruntque Sol et Luna stetit itaque Sol in medio Caeli et infestinauit occumbere spatio unius diei, non fuit ante, et tam postea longa dies[23] nos quais paços se declara não somente o orto e o ocasso e mouimento do Sol, que fas de Oriente para Occidente, senão tambem o mouimento que fas norte e sul andando pellos doze signos, que os aduersarios explicão pellos mouimentos da terra que refutamos nesta e na 1ª conclusão, e querem que entendamos estes e outros paços da Escriptura as auesas, disendo que a terra nas partes da terra nacem, e se poem, e dão suas voltas pello norte e tornão pello meio dia, e vão lustrando tudo ao redor, e tornão em seus circulos, e tambem querem que digamos que Iosue mandou a terra que paraçe, e a terra parou.

Alem disso he o dito mouimento contrario a muitas experiencias pois vemos que quando huma bolla, pelouro ou se he pedra se lança direitamente para sima torna a cahir no mesmo lugar donde se lancou, o que não podera ser se a terra tiuera o dito mouimento, porque emquanto a dita pedra ou se [?] sobe e dese mouesse o dito lugar da terra para oriente e tanto mais tempo gasta a pedra no subir e no decer se o lugar estiuer debaixo do equinocial mouerseha em hum dia natural 5400 legoas geometricas e em huma hora 225, e em hum menuto da hora legoas e 4 e em hum segundo huma 16ª parte da legoa que he a 4ª parte de huma milha.

22 *Oritur sol et, occidit sol et ad locum suum anhelat ibique renascitur. Gyrat per meridiem et flectitur ad aquilonem, lustrans universa in circuitu pergit spiritus et in circulos suos revertitur. Eccle.* 1:5-6.

23 *Steterunt sol et luna, donec ulcisceretur se gens de inimicis suius. Nonne scriptum est hoc in libro Iusti? Stetit itaque sol in medio caeli et non festinavit occumbere spatio unius fere die. Non fuit antea et postea sicut dies illa. Ios.* 10:13.

Notasse no segundo lugar que as aues, nuues, fumos etc as vesses parão em sima de hum lugar não pouquo tempo sem se apartarem delle, o que tambem não pudera ser se o lugar se mouera com tanta presa. No terceiro lugar as aues voão com a mesma pressa para oriente e occidente, o que tambem não puderão fazer se a terra tiuera o dito mouimento. Pois a aue que voa para Occidente voa contra o mouimento [?] da terra, e asim encontra grande parte della: e a outra que voa para oriente voa com o dito mouimento da terra, o qual so não pode alcansar necessario he que fique atras, e ao contrario a outra parecera ser voada para oriente sendo asim que voa para occidente de modo que se ambas voarem huma hora inteira debaixo do equinocial ficara a primeira adiantada mais de 225 legoas pois tanto espacio da terra lhe encontrou, e ainda o que responde o que o proprio mouimento, e a segunda ficara trazeira ou mais occidental do que estaua quando comesou a voar porque não pode alcancar o mouimento da parte donde se alcansou. O mesmo se dira de huma pessa de artelharia que tanto espacio alcança para oriente quanto para occidente, o que tambem não podera estar com dito mouimento da terra. [f. 45*r*]

3ª Conclusão

A terra não tem outro mouimento circular pois se o tiuera fora o terceiro de copernico a que chamão mouimento de inclinacão, com que explicão como o eixo da terra em qualquer parte do orbe grande fiqua na mesma postura emdireitada para a mesma parte do Ceo mas como não ha aquelle mouimento no orbe grande não ha resão para afirmarmos o terceiro mouimento.

4ª Conclusão

A terra não se moue com o mouimento direito, a rezão notauel he porque se se mouera, mouerasse para sima, o que he contra sua natural: nem ha cousa [*sic*, causa] motiua extrincica que lhe faça tanta violencia. Dise notauel porque he prouauel mouersse a terra quasi continuamente (como tocamos na 1ª conclusão do capítulo 2º) por resão do Centro grauitatis, que continuamente se muda e acresentandose qualquer pesso em huma parte da terra se tira da outra parte, e pareçe dificultoso diser que qualquer destes pezos sempre se poem outro pezo. Porem como todos estes pezos que se acrescentão, e se tirão não tem proporcão com o pezo de toda esta terra não pode ser notauel o mouimento que por elle se causa, e este mouimento não se dis aos passos Sagrada Escriptura, que alegamos na 1ª conclusão, a qual não se mede nestas miudessas philozophicas, que tem pouquo proueito, e não sentem.

Corolario

Destas conclusões se colige qual he a quietação desta bolla da terra pois [carece ?] todos os mouimentos circulares e todos os direitos notaueis.

5ª Conclusão

A dita quietação desta bolla em que fica sentada no meio do mundo elemental não tem outra coussa [i.e. causa] senão a grauidade com que ve que todas as suas partes se enclinão e chegão quanto podem ao centro do mundo, e se conseruão no meio delle; pois não se pode dar outra resão natural; então devemos de imaginar milagres nestas cousas ordinarias, e naturais, as quais o criador deu seus instrumentos e meios naturais para alcancarem o que lhes conuem; e esta grauidade se significa por aquella estabelidade sogre [*sic*, sobre] a qual Nosso Senhor fundou a terra Salmo 103 como tambem por aquellas colunas do Salmo 74 de que dissemos na 1ª conclusão. [f. 45*v*]

Document III

Chapter IV

English translation. On the motion and rest of the Earth's and water's globe [1625]. Johann Chrysostomus Gall, *Tratado sobre a e*[*s*]*phera*, BNP, cod. 1869, ff. 43*r*-45*v*

In these chapters, we shall not deal with the motion of each of these elements in particular, with which, once removed from their natural places, they return to them through their gravity, but explain first whether this whole globe composed of both elements has some motion of its own or whether it stands still, in what sense and from where does it stem.

1st Conclusion

The Earth's and water's globe does not move around the Sun. This conclusion goes against some ancient philosophers and especially some modern authors who claim, with Nicholas Copernicus, that the Sun stands in the middle of the world and the Earth, together with the other elements, and the Moon moves around it in a year, between the heaven of Venus and that of Mars.

I believe that the main foundations of this opinion are the following two. In the first argument, these authors claim that it is easier to explain [the appearances] through the operations and movements of the celestial bodies because this solution cut many difficulties out. In the second place, those authors consider it highly inconvenient that such large and perfect bodies, like the celestial bodies, move with such a fast movement because of such a small and imperfect globe as the Earth.

Nevertheless, our assumption is more in keeping with the common reason and the understanding of all the people and the best philosophers and astronomers. Furthermore, the Sacred Scripture speaks so clearly in this way that one cannot say the opposite, for the *Ecclesiastics*, in the first chapter, state *Terra autem inter medium stat*[24] and, in *Psalm* 92, it is mentioned *firmauit orbem Terrae numero commovebitur*[25] and, in *Psalm* 74, referring to the Earth, it is said *Ego confirmavit columns eius*,[26] meaning 'I establish the Earth, which had been laid [f. 43*r*] upon firm columns'. In the first [book] of the *Paralipomenon*, chapter 16, [it states] *ipse fundauit orbem imobilem*.[27] The philosophical reason is that the movement of the Earth is neither natural nor violent. It is not natural because the Earth, which as a simple body, has but one natural movement, which, as the philosophers say with Aristotle, in the second chapter of the first book *On the Heaven*, must be downwards. Furthermore, we shall never recognise that the Earth is animated, as one of these modern argues. Nor is it a violent movement because there is no extrinsic cause to this movement. It is a trick to make the Sun responsible for all the celestial motions, as the above-mentioned modern [author] does.

24 *Terra autem in aeternum stat. Oritur sol, et occidit sol. Eccle.* 1:4-5.

25 *Etenim firmavit orbem Terrae, qui non commovebitur. Ps.* 93 (92):1.

26 *Ego confirmavi columnas eius. Ps.* 75 (74):4.

27 *Ipse enim fundavit orbem immobilem. I Par.* 16:30.

All the arguments and the common opinion of scholars confirm our sentence because, if the Earth moved, it would follow that the Firmament, the planetary heavens and the heaven of the fixed stars would be an immense space. There would also be a massive distance between Saturn and the heaven of fixed stars, with no reason or purpose for such a spatial immensity. To better understand this point, let us see what the parallax is. It is the dia[meter] [i.e. the angle] between the celestial body's true position and its apparent position. The star's true position is the point in which a straight line drawn from the centre of the world and passing through the centre of the star falls. The apparent position is the point in which a right line or visual radius drawn from the Earth's surface or the observer's eye, passing through the centre of that star, falls – as one can see in the figure **[fig. 3]**. For example, be it A the centre of the world; B the eye of the observer on the Earth's surface; the right line ACD a line [drawn from the centre of the world] through the centre of a certain star; and the right line BCE that is originated in the eye G [*sic*, B] and passes through the centre of that same star C. Thus, the true position of this star is in line AD while the apparent position is in line BE. The angle ECD with the difference between the true position and the apparent position is called parallax. Because of the parallax, the star C appears to be in a lower position and not so much raised from the horizon as it really is. Thus, although the star's true height corresponds to the arc GC (which is the same as FD), whoever observes it from place B will perceive the star's height as corresponding to the arch FE **[fig. 3]**.

In the second place, note that stars that are farther away have a smaller parallax than the closer stars. Thus, the star H is further away from the centre of the world [f. 43*v*] than the star C. Let the line BI be drawn through the centre of the star H, so the point I will correspond to its apparent position and its parallax to [the angle] IHD. This angle is smaller than that of the parallax ECD corresponding to the star C because the angle DHI is equal to the angle CHB by [preposition] 15 of Euclid's book, the angle ECD is equal to the angle ACB by the same preposition, and the external angle ACB is larger than the opposite internal angle CHB by [preposition] 16 of the same book. Therefore, the angle ECD, which corresponds to the parallax of star C, is also greater than the angle IHD, which corresponds to the parallax of star H. Therefore, the parallax of the lower star or those nearer to the centre of the world is greater than the parallax of the star that is farthest away from the centre of the world. And so, the distance may be so great that the star parallax disappears, or it is no longer perceptible because the interval between the observer's place B and the centre of the world A is not proportional to the great distance of the star.

In third place, note that astronomers do not find a sensible parallax in the stars of the Firmament, which means that there is no remarkable proportion between the distance of the observer to the centre of the world and the space or the semidiameter of the Firmament. There is, however, a great distance with respect to the very high planet Saturn, which is, in the opinion of Copernicus, more than nine times distant from the Earth than the Earth is from the Sun. According to the same author, the Sun is 1,208 terrestrial semidiameters away from the Earth. Based on this doctrine of Copernicus and these figures, Tycho Brahe establishes the immensity of the Firmament. Thus, the distance between Saturn, when it is further away from the Earth, and the Earth's surface, corresponds, according to Copernicus's doctrine, to 12,900 times the semidiameter of the Earth. We must

multiply 700 or 800 times that figure to reach the large interval that exists between the Firmament and the Earth's surface. Accordingly, there is no sensible parallax in the fixed stars that are 10,320,000 semidiameters away from the Earth. This distance corresponds to the semidiameter of the Firmament according to Copernicus's doctrine. And the proportion between the whole heaven of the Sun and the Firmament would be the same as that between the centre of the sphere and the same sphere.

In *Disquisitiones* [*mathematicae de controversiis et novitatibus* (1614)], father Christoph Scheiner estimated from the Firmament's immensity that the diameter of the semidiameter of the Firmament, the diameter of the first magnitude stars, according to this opinion, would be over three times bigger the size of the Sun's heaven's diameter or that of the big orb; third magnitude stars' diameter would be over one time bigger than the size of [Sun's heaven's diameter]; and the sixth magnitude stars would be more or less the size of [the diameter of the Sun's heaven]. If this were the case, a minimum star, whose centre was observed from the centre of the world [f. 44*r*], would fill almost the entire space under the convex surface of the Sun's heaven, and the larger ones would even occupy the heavens of Mars and Jupiter, and perhaps that of Saturn, for they would be over thirty-three times larger than the heaven of the Sun. The same author also estimates [that] the space lying between Saturn [at the] apogee and the Firmament is some 700 or 800 times greater than the distance between that planet [at the] apogee and the Earth, which can be neither understood nor conceded, nor even are there any imperative reasons for that, as those adversaries claim.

The ease of explaining the celestial movements following this opinion is not as great as those authors envisage. And, even if it were the case, there would be not enough reason to accept it because of the several inconveniences that result from admitting the Earth's movement, as shall be discussed in more detail in the second conclusion. As for the other argument, which seems to make some sense, in the first place, I reply that the fact that they move to communicate their virtues, enrich the Earth and govern the other elements does not affect the nobility of the heavens and stars. On the contrary, by doing that, they are provided with a more illustrious and superb function. In the second place, I answer that the heavenly bodies' fast motion shows no less the omnipotence of the Creator than that incredible immensity that they put forward. In the third place, I reply that those elements [i.e. the celestial bodies] are not made particularly for the love of the Earth and the other elements but for the love of man whom they serve and who is infinitely nobler than any heavenly body.

2nd Conclusion

The Earth does not move with a circular motion around its own centre and axis. This theory is also false in the opinion of those authors who claim that the Earth not only moves around the Sun but also shifts around its axis, turning around within 24 hours and showing its different faces to the Sun, thus producing the days and nights. But this theory is also false, according to the common opinion of all the best philosophers and wise men. Nor can it be affirmed without forcing the interpretation of some parts of the Sacred Scripture such as when *Ecclesiastes* 1 in the above-mentioned chapter [5] affirms *oritur Sol e*[*t*] *occidit et ad locum suum revertitur ibique renascens girat per meridiem et flectitur ad aquilonem lustras uniuersam in circuitu. Pergit spir-*

ito, et in circulos suos reuertit,[28] or when it is refereed in Joshua's chapter that Joshua ordered [f. 44*v*] the Sun and Moon to stop, and the Scripture says *steteruntque stetit itaque Sol in medio Caeli et infestinauit occumbere spatio unius diei, non fuit ante, et tam postea longa dies*. [29] This excerpt refers not only to sunrise and sunset and the Sun's movement from the East to the West but also to its northwards and southwards motion through the twelve signs of the Zodiac. The adversaries explain these phenomena by attributing the movements to the Earth, which we refute in these conclusions. Furthermore, they want us to understand these and other parts of the Scripture in the wrong way, meaning that the Earth and its parts rise and set, revolving around the North pole, providing every part of it with light. They also want us to recognise that Joshua ordered the Earth to stop, and the Earth did stop.

Furthermore, the said movement [i.e. Earth's rotation] is contrary to many experiences, for we see that when a ball or stone is thrown straight up, it falls back in the same place. This effect could not occur if the Earth moved with a [rotation] movement because as the stone went up and down, the position on the Earth would move eastwards. And if the place were under the equinox, the stone would spend more time going up and down. It would move 5,400 geometric leagues in a natural day; 225 [leagues] in an hour; 4 leagues in a minute; and a 16th part of the league in a second which corresponds to the fourth part of a mile.

In the second place, birds, clouds, fumes, etc., are seen to occasionally stop for long above a specific location without moving away from it. This effect likewise could not occur if the place moved quickly. In the third place, the birds fly with the same speed Eastwards and Westwards, which they could not do if the Earth moved with such motion. If it were the case, the bird flying to the West would fly against the Earth's movement, thus having to cross a greater distance, while the other bird that flies Eastwards would fly following the Earth's fast motion. Since this second bird cannot reach the same velocity as the Earth, it would remain necessarily behind. Thus, this bird would appear to have flown eastward, even if it actually flew westward. Therefore, if both birds flew an entire hour under the equinox, the first would be over 225 leagues ahead while the second, incapable of reaching the same velocity as the Earth's motion, would be back or in a more western position than it initially was when it began flying. The same holds true for an artillery piece that reaches the same distance eastwards and westwards, which could not occur if such Earth's movement occurred. [f. 45*r*]

3rd Conclusion

The Earth has no other circular movement because if it had it, it would be the Copernicus' third [movement], which they call inclination movement (*movimento de inclinação*). They use this motion to explain why the axis of the Earth always points to the same part of heaven. Nevertheless, since that movement does not occur in the big orb, there is no reason to admit the third movement.

28 *Oritur sol et, occidit sol et ad locum suum anhelat ibique renascitur. Gyrat per meridiem et flectitur ad aquilonem, lustrans universa in circuitu pergit spiritus et in circulos suos revertitur. Eccle.* 1:5-6.

29 *Steterunt sol et luna, donec ulcisceretur se gens de inimicis suius. Nonne scriptum est hoc in libro Iusti? Stetit itaque sol in medio caeli et non festinavit occumbere spatio unius fere die. Non fuit antea et postea sicut dies illa. Ios.* 10:13.

4th Conclusion

The Earth does not move with a straight movement. The notable reason is that if it moved this way, it would move upwards, which is against its nature. Furthermore, there is no extrinsic cause to push it with such violence. I said notable [reason] because it is probable that the Earth moves almost continuously (as we shall discuss in the first conclusion of chapter 2) because of its centre of gravity (*centro gravitatis*). By adding some weight to one part of the Earth and pulling another from the other part, the Earth's centre of gravity moves continually, for it seems difficult to admit that there is always a balance between these weights. However, this motion is not perceptible because no relationship exists between all these weights (which are constantly added and removed) and that of the whole Earth. Furthermore, this motion is not discussed in the mentioned excerpts of the Sacred Scripture, whose aim is not to analyse these philosophical details with such a small use.

Corollary

Based on these reasons, one can conclude that the Earth sphere stands still because it lacks [?] all the circular and straight movements.

5th Conclusion

The so-called stillness of this sphere, with which it stands in the middle of the elemental world, has no other cause than the gravity that makes [sees, in Portuguese] all its parts tend, as much as they can, towards the centre and kept in the middle of it. Since there is no other natural reason, we must not imagine miracles to explain these ordinary phenomena. The Creator has provided them with the tools and natural means to reach the goals that are convenient to them. This gravity is meant, in *Psalm* 103, by that stability upon which our Lord established the Earth, as well as by those pillars of *Psalm* 74, which we have discussed in the first conclusion. [f. 45*v*]