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CIENCIA E RELIXIÓN: UNHA HISTORIA DE GUERRA?

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É autor, coautor ou editor de 30 libros, entre os que se contan *Galileo's Intellectual Revolution* e *The Magic of Numbers and Motion: The Scientific Career of René Descartes,* e máis de 145 artigos académicos publicados en dez linguas; a súa obra sobre Blaise Pascal, *Designing Experiments & Games of Chance. The Unconventional Science of Blaise Pascal,* gañou o premio da Library Association a un dos libros académicos máis destacados de 2003; *Galileo in Rome: The Rise and Fall of a Troublesome Genius,* escrito con Mariano Artigas (Oxford University Press, 2003), foi traducido ao alemán, o español, o coreano e o xaponés. A súa última obra, *Galileo Observed: Science and the Politics of Belief,* escrito tamén con Mariano Artigas, foi publicado por Science History Publications en outubro de 2006.

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O xuízo e a condena de Galileo constitúen o mellor exemplo do conflito que enfronta a ciencia e relixión? A ciencia, baseada na razón e na experimentación, estaba destinada a chocar coa relixión, fundamentada na autoridade e no dogma? Como é que aínda hoxe hai xente honrada que se pregunta por que a Igrexa tratou de silenciar a Galileo?

Roma resistíase a aceptar a idea de que a que se move é a Terra, non o Sol; porén, esta oposición histórica non foi inevitable. Se os teólogos da época aprendesen a respectar os límites do seu verdadeiro ámbito de competencias (como despois fixeron), podería iniciarse un frutífero diálogo mesmo na época de Galileo. De feito, os pioneiros da revolución científica foron persoas ás que lles importaba a relixión; así, Copérnico non foi ordenado sacerdote, mais si era membro do clero e cóengo da súa diocese, en Polonia. Albergaba a convicción de que o movemento da Terra non resultaba incompatible coa fe cristiá e, non en van, dedicoulle a súa famosa obra *De revolutionibus orbium cœlestium* ('Sobre o movemento das esferas celestiais') ao papa Paulo III. O astrónomo alemán Johannes Kepler, que descubriu as tres leis que describen como se desprazan os planetas arredor do Sol, tiña intención de facerse pastor da Igrexa luterana e víase como intérprete da obra de Deus na natureza. O home de quen xurdiu a idea da gravitación universal, Isaac Newton, pasou máis tempo a comentar as Escrituras que a traballar nos problemas da física e a matemática.

A tensión entre o que a ciencia comezaba a descubrir e o que a Biblia semellaba ensinar pode estudarse desde diversas perspectivas. Unha delas, moi popular, derívase do modelo de guerra que elaboraron dous historiadores decimonónicos: John William Draper e Andrew Dickson White. *History of the Conflict Between Religion and Science* ('Historia dos conflitos entre a relixión e a ciencia'), de Draper, apareceu en 1874, e os dous tomos da *History of the Warfare of Science with Theology in Christendom* ('Historia da guerra da ciencia coa teoloxía na cristiandade'), de White, en 1896; de ambas se publicaron varias edicións e foron traducidas á maioría dos principais idiomas de Occidente. Segundo declaraban os autores, ao depositar un a súa confianza en textos autoritarios e no control eclesiástico, xerábase un modo de pensar que impedía adquirir un auténtico coñecemento da natureza; e, así, a guerra non só era inevitable, senón tamén un deber para todo aquel que amase a verdade.

Por que tal incompatibilidade?

Un dos aspectos máis curiosos do caso Galileo radica nas dificultades que teñen os estudosos para responderen o que parece ser unha pregunta carente de maior complicación: cando se recoñeceu a

incompatibilidade do copernicanismo coas Escrituras? É importante saber a resposta para entender os riscos (se é que algún había) que corría Galileo ao defender a teoría de que a Terra se move, de modo que preguntémonos que textos bíblicos afirman claramente que a Terra está en repouso e o Sol en movemento. A resposta é que ningún. Achamos pasaxes nas Escrituras como «Unha xeración pasa, outra vén; mais a terra sempre subsiste. O sol levántase, o sol ponse; apresúrase a volver ao seu lugar» (Eclesiastés 1, 4-5), mais expresións tales que «o sol levántase» e «o sol ponse» seguen a ser comúns na actualidade, e a ninguén se lle ocorrería prohibilas por moito que saibamos que, en sentido literal, son falsas. A única pasaxe de toda a Biblia da que se podería dicir que afirma o contrario sen ambigüidade é unha de Xosué, «O sol parou no medio do ceo, e non se apurou a se pór polo espazo de case un día enteiro» (Xosué 10, 13). Se Xosué fixo que o sol ficase quedo, daquela debíase de mover!

Hai tempo que chegamos a recoñecer que, se o Sol semella nacer polo leste e pórse polo oeste, non é porque se mova polo ceo, senón porque a Terra xira sobre o seu eixo de oeste a leste. A linguaxe cotiá non debería confundirse coas expresións científicas. Nas Escrituras non se debate sobre astronomía, pois, como expresou un contemporáneo de Galileo, «[a] Biblia ensina como ir ao Ceo, non como van os ceos». Xa nos primeiros séculos, os teólogos interpretaban como xeitos populares de falar, e non como modos de expresión científica, as pasaxes da Biblia que se refiren a sucesos naturais. Así, San Agostiño, o máis famoso dos primeiros Pais da Igrexa, sostiña que os seis días da Creación que aparecen no primeiro capítulo do Xénese non son días naturais, senón unha figura retórica coa que se pretendía transmitir a verdade da Creación cunha linguaxe sinxela e accesible. Agostiño foi aínda máis alá e advertiu de que non se debería apurar de máis a invocar as Escrituras para rexeitar algunha postura da filosofía natural, non fose que a ignorancia dos cristiáns desanimase aqueles que gozan de sólidos coñecementos.

Daquela, que é o que pasou? Por que esa repentina rixidez? Parte da resposta atópase no clima da época. A obra de Copérnico *De revolutionibus orbium cœlestium* saíu en 1543, varios anos despois de que Martiño Lutero iniciase a Reforma Protestante que puña en dúbida a autoridade do Papado. Malia a resposta católica ser feble e confusa nun primeiro momento, foi cobrando forza logo do Concilio de Trento, que se celebrou a intervalos entre 1545 e 1563, o ano anterior ao nacemento de Galileo. Desde a Antigüidade, a Igrexa católica subscribía a noción de que as decisións adoptadas polo Colexio episcopal, reunido en concilio ecuménico, eran vinculantes para os fieis e, sobre todo, para os teólogos que ensinaban a doutrina oficial da Igrexa. Ao tempo que o Concilio de Trento insistía nesta crenza, tamén trataba de se enfrontar á crítica que se lles facía aos católicos desde o protestantismo, no sentido de que non veneraban dabondo as Escrituras; por este motivo, os teólogos católicos aplicáronse con dedicación, e por veces cun exceso de celo, no seu desexo de lles demostrar aos protestantes que si tomaban en serio a Palabra de Deus. Ao mesmo tempo, comezaron a recear das teorías astronómicas que semellaban criticar as Sagradas Escrituras. Os protestantes compartían estas preocupacións esexéticas, mais non estaban suxeitos a tanto control; non tiñan nada equivalente á Inquisición e a meirande parte dos países protestantes carecían de competencias para aplicaren veredictos de herexía como facían os católicos, aínda que tamén crían que esta constituía un delito capital polos danos que causaba na sociedade.

Unha oportunidade perdida

Cun pouco de sorte, Galileo podería convencer as autoridades católicas de Roma de que non existía ningunha incompatibilidade radical entre o que dicía a Biblia e o que empezaba a ensinar a nova ciencia. Como deixou escrito Arthur Koestler,

> a menos que creamos no dogma da inevitabilidade histórica —forma de fatalismo marcha atrás—, debemos consideralo un escándalo que se puido evitar, e non resulta difícil imaxinar a Igrexa católica adoptando, logo de experimentar unha transición ticónica, a cosmoloxía copernicana uns douscentos anos antes da data en que finalmente a aceptou. O caso Galileo constituíu un episodio illado e, de feito, bastante atípico na historia das relacións entre ciencia e teoloxía; mais as súas dramáticas circunstancias, desproporcionadamente magnificadas, asentaron a crenza popular de que a ciencia defendía a liberdade e a Igrexa a opresión do pensamento.

Que empuxa a Koestler a ofrecer unha reinterpretación tan categórica do caso Galileo? A resposta áchase na vaidade e a arrogancia de Galileo, que o arrastraron a unha insensata oposición á Igrexa. Mentres que Draper e White vían na condena do astrónomo a consecuencia necesaria do orgullo e a estupidez do clero, Koestler deixa a meirande parte da culpa aos pés de Galileo e protesta contra a «mitografía racionalista» que o transforma en Doncela de Orleáns ou, mellor aínda, no San Xurxo que lle deu morte ao dragón da Inquisición.

No seu afán por restaurar o equilibrio, Koestler inclínase de máis cara a outra banda, e a súa irritación con Galileo xorde da convicción de que a ciencia moderna fai demasiadas afirmacións e dá resultados demasiado escasos. Resulta interesante apreciar que este devastador ditame non procede dun católico descontento, pois Koestler non era nin católico nin relixioso no sentido convencional: nado nunha familia xudía de Budapest en 1905, asistiu á Universidade de Viena, onde se sentiu atraído polo sionismo, e marchou a Palestina en 1926. En Xerusalén traballou para unha publicación periódica editada en alemán antes de retornar a Europa en 1931 e, logo de pasar un ano en París, estableceuse en Berlín, nunha época en que Alemaña estaba a atravesar graves dificultades a resultas da Gran Depresión. Koestler afiliouse ao Partido Comunista e foi enviado á Unión Soviética a compilar información sobre os importantes avances que, segundo se dicía, se estaban a producir no país; mais Koestler descubriu que o prometido Paraíso do Traballador estaba aínda lonxe, e informou, tan fielmente como puido, dos trastornos que presenciara. Isto non lle agradou ao Partido Comunista alemán, que só publicou parte do seu informe; preso da desilusión, Koestler abandonou o Partido en 1938.

Durante a Guerra Civil española, Koestler estivo na fronte como reporteiro. Foi capturado polo exército franquista en Málaga en febreiro de 1937, condenado a morte e enviado a Sevilla para se enfrontar a un pelotón de fusilamento; porén, os ingleses lograron a súa liberación e permitíronlle entrar no Reino Unido, onde traballou para a Intelixencia británica no transcurso da Segunda Guerra Mundial. Adquiriu a cidadanía

británica en 1945 e posteriormente involucrouse de xeito activo na Guerra Fría. Como fe persoal, non parece que o catolicismo lle interesase moito en ningún momento; o principal obxectivo de Koestler non era tanto escribir unha historia da ciencia como explicar como a revolución científica abrira unha fenda entre a procura do coñecemento e a busca de significado.

A ironía do conto radica en que ambos os dous, Galileo e a Igrexa romana, perderon unha oportunidade. Cando Galileo fixo públicas as súas observacións telescópicas, en 1610, o seu libro, o *Sidereus Nuncius* ('O mensaxeiro sideral'), foi un éxito inmediato en Roma, onde lle brindaron un recibimento triunfal en 1611. O papa, Paulo V, mesmo fixo que se pintase a nova Lúa de Galileo, cos seus montes e os seus cráteres, na cúpula da capela que ordenara levantar en Santa Maria Maggiore, unha das basílicas máis antigas e importantes de Roma.

Que é o que fallou?

Como moitos profesores, Galileo non carecía do seu punto de arrogancia e non aturaba os babecos de bo grao. O problema é que cría que podía demostrar que a Terra se move arredor do Sol, cando o único de que dispuña era unha enxeñosa teoría: o seu famoso argumento de que as mareas serían imposibles se a Terra non rotase sobre o seu eixo facendo un percorrido de vinte e catro horas, ao tempo que completaba un xiro dun ano en torno ao Sol.

Hoxe parece evidente que as autoridades romanas cometeron un erro ao condenaren o copernicanismo. A todos nos educaron no coñecemento de que a Terra xira arredor do Sol, mais a ninguén lle aprendían isto na escola na época de Galileo, e trátase dunha cuestión nada doada de penetrar. Unha cousa é certa: non se achou proba física de que a Terra se move arredor do Sol e xira sobre o seu eixo ata despois da condena de Galileo.

O cardeal Bellarmine, que coñeceu a Galileo en 1616, dixérao con claridade: se se demostrase o movemento da Terra, habería que reinterpretar os textos das Escrituras que semellan negar tal cousa. Persoalmente, Bellarmine tiña moitas dúbidas de que coubese esperar que se achase esa proba algún día, opinión que compartía o papa Urbano VIII, quen aconsellou a Galileo que se servise do copernicanismo por constituír unha cómoda ferramenta matemática, sen aceptar que fose válida. Agora ben, se ninguén admite —como fixo Galileo— que o significado literal das Escrituras debería prevalecer sobre as meras conxecturas das ciencias naturais, daquela pode dicirse que Bellarmine e o papa Urbano VIII tiñan razón; só véndoo en retrospectiva somos quen de afirmar que se enganaban. Con todo, non se pode desculpar de todo a Bellarmine e ao papa se analizamos outros dous aspectos do problema. O primeiro é que Galileo, con axuda de amigos sacerdotes e teólogos, foi capaz de achar en San Agostiño, San Xerónimo e outros eminentes escritores das primeiras épocas, coñecidos como «os Pais da Igrexa», diversas consideracións que lle abrían a porta a un modo de interpretar a Biblia segundo o cal era a Terra a que se movía, e non o Sol. O Concilio de Trento declarara que as Escrituras habían interpretarse de conformidade co consenso ao que chegaran os Pais da Igrexa, mais engadira prudentemente que «en cuestións de fe e de moralidade». O cardeal Bellarmine era consciente do

problema e prevía o argumento que poderían presentar os copernicanos cando lle escribiu a un defensor desta doutrina:

> Non se pode dicir que non se trate dunha cuestión de fe, pois talvez non o sexa no referente ao tema, mais si o é no que atinxe a quen fala. Por este motivo, unha persoa que negase que Abraham tivese dous fillos e Xacob doce sería tan herexe como alguén que negase o nacemento virxinal de Cristo, xa que ambas as cousas foron declaradas polo Espírito Santo por boca dos profetas e os apóstolos.
> O problema, como se ve, era moito máis complicado do que por veces se pensa.

Un segundo aspecto da cuestión é a ameaza que supuña o copernicanismo para aqueles que identificaban a visión xeocéntrica do mundo coa cosmoloxía cristiá, algo que nega rotundamente o historiador vaticano Walter Brandmüller:

> Ao contrario do que se adoita afirmar, as autoridades da Igrexa non viviron con confusión nin angustia o derrubamento da visión do mundo que se viña aceptando ata daquela. O único que lles interesaba era a infalibilidade das Escrituras, que crían, erroneamente, ameazada polo sistema copernicano.

Non se pode pasar por alto á lixeira que había moito máis en xogo. Tanto o cardeal Bellarmine como o papa Paulo V (o antigo cardeal Camillo Borghese) foran membros do Santo Oficio cando Giordano Bruno foi condenado á fogueira en 1600. Malia Bruno non ser astrónomo, servírase do copernicanismo como plataforma desde a que lanzar a súa nova cosmoloxía, segundo a cal as estrelas eran soles rodeados por planetas habitados, e o universo unha manifestación necesaria da infinidade de Deus e, en consecuencia, infindo. O resultado foi unha forma radical de panteísmo que derrubaba os principios básicos da cristiandade. Bruno foi executado en Roma no ano 1600 e resulta improbable que, só dezaseis anos despois, o papa Paulo V e o cardeal Bellarmine xa esquecesen os ecos do seu copernicanismo. O 27 de febreiro de 1615 Giovanni Ciampoli, amigo de Galileo, sondou sobre esta cuestión o cardeal Maffeo Barberini —o posterior papa Urbano VIII—, quen indicou que lle gustaría que se procedese «con maior precaución para non ir máis aló dos argumentos esgrimidos por Ptolomeo e Copérnico» nin «traspasar os límites da física e a matemática». O futuro papa advertiu, así mesmo, do perigo que suporía ampliar o copernicanismo con xuízos errados, pois, como Ciampoli lle explicou a Galileo,

> A vosa opinión sobre o xogo de luces e sombras percibido nas zonas iluminadas e escuras da lúa establece certa analoxía entre o globo lunar e a terra; un vén, amplía esta cuestión e di que poñedes habitantes humanos na lúa; outro dá en cuestionar como eses van poder ser descendentes de Adán, ou como ían poder saír da arca de Noé, e moitas outras extravagancias que vós nunca imaxinarades.

Nós chegamos a ver o noso planeta Terra como un máis de entre un amplo número de astros que orbitan en

torno ao seu propio sol, e xa resulta habitual facer suposicións sobre a existencia de vida noutros planetas; mais este non era o caso no século XVII. Cando Benedetto Castelli, o máis íntimo colaborador de Galileo, sacou a colación o movemento da Terra no transcurso dunha conversación co cardeal Francesco Barberini, sobriño do papa Urbano VIII, recibiu a resposta de que, se de verdade a Terra se movía, «habería que a considerar planeta, o cal, segundo parece, entra en gran contradición cos postulados da teoloxía». A isto Castelli replicou que Galileo pretendía demostrar que a Terra non era un planeta, e o cardeal retrucou que certamente debería facelo.

Tiña razón a Igrexa no referido á ciencia?

En tempos de Galileo o copernicanismo era unha conxectura pendente de confirmación. Se este astrónomo non fose tan dogmático, podería evitar un enfrontamento coa Igrexa e, como conclúe Brandmüller,

> [p]olo tanto, velaquí un feito tan grotesco como que a Igrexa, á que tan a miúdo se acusa de se trabucar neste caso, tiña razón, e precisamente nun terreo que non era o seu —o da ciencia natural—, cando lle solicitou a Galileo que tratase o sistema copernicano como mera hipótese.

Con todo, Brandmüller esaxera: os cregos que, de acordo coa metodoloxía da época, sostiñan que os modelos astronómicos constituían simples construtos hipotéticos tiñan dereito a lle recomendaren a Galileo que se referise ao copernicanismo como conxectura, mais podían esixirllo? Ao lle imporen a Galileo o deber de falar hipoteticamente ou gardar silencio, eses cregos actuaban como teólogos, non como científicos. Cando o papa Urbano VIII declarou que os camiños do Señor son inescrutables que e El puido deseñar o mundo dun modo que escapa por completo á nosa aprehensión, baseaba este argumento na omnipotencia de Deus; o cal implicaba, sen dar apenas lugar a confusión, que cuestionar tal aserto equivalía a negar a Súa omnipotencia. Naquela época non había quen se decatase de que estaba a nacer unha nova ciencia e ninguén imaxinaba que ía resultar ser extremadamente poderosa. A postura de Bellarmine e do papa Urbano VIII era razoable, mais en sentido limitado: o cardeal e o papa eran homes do seu tempo, non heraldos do futuro. Véndoo en retrospectiva, sabemos que a ruta que conduciu ata a ciencia moderna se abriu ao longo do carreiro que seguía Galileo, e non da estrada convencional que algúns se encargaban de sinalizar.

Están subdeterminadas as teorías?

Por veces sorprende que o argumento do papa Urbano VIII sobre a omnipotencia de Deus teña ecos en disquisicións contemporáneas da filosofía da ciencia, e pode considerarse unha versión teolóxica da tese referida á subdeterminación das teorías. Como explica Larry Laudan nunha entrada da *Routledge Encyclopedia of Philosophy,*

> Co termo «subdeterminación» denomínase unha ampla familia de argumentos referidos ás relacións que existen entre a teoría e a evidencia, todos os cales comparten a conclusión de

> que a evidencia se ve, en maior ou menor medida, impotente á hora de nos orientar nas escollas entre teorías ou hipóteses contrarias. Baixo un aspecto ou outro, a subdeterminación probablemente sexa a idea más rotunda e persuasiva das que alimentan as diversas formas de escepticismo e relativismo epistemolóxico do século XX.

A subdeterminación ten tras de si unha longa historia. Na Antigüidade e na Idade Media, cando o home se apercibiu de que se pode dar conta dos mesmos datos usando teorías diferentes, xerouse un concepto «instrumentalista» das explicacións científicas, perspectiva segundo a cal os sistemas astronómicos teñen por obxectivo «gardar as aparencias», concretamente fornecendo instrumentos matemáticos con que determinar a posición e o tamaño ou velocidade que semellan ter os corpos celestiais. Deste xeito, unha boa teoría astronómica pode servir para predicir eclipses, mais non debería tomarse como unha descrición fidedigna do modo en que os planetas se moven na realidade. Para coñecer a verdadeira natureza do mundo facía falta outra clase de ciencia: unha ciencia demostrativa, como pretendía ser a filosofía aristotélica, coa cal se investigasen as causas reais dos feitos observados. Esta dicotomía de achegamentos á cosmoloxía tivo importantes consecuencias institucionais, xa que dun profesor de astronomía se esperaba que ensinase a «gardar as aparencias», non o que as ocasionaba, pois xa se encargaban os profesores de filosofía natural de estudar o que había detrás dos fenómenos ou máis aló deles. Galileo en Padua non ensinaba filosofía, senón matemáticas, e había lidar con profesores daquela disciplina que non tiñan nin idea de que as matemáticas podían aprenderlles algo sobre o mundo real. Esta división de tarefas tamén tiña implicacións económicas: un profesor de filosofía podía cobrar o séxtuplo do soldo dun colega que ensinase matemáticas. De aí o moito que lle insistiu Galileo ao Gran Duque, cando foi chamado de novo a Florencia en 1610, para que o nomeasen non só matemático, senón tamén filósofo.

Galileo e o catolicismo na actualidade

O papa Xoán Paulo II tiña moito interese en propiciar un diálogo entre ciencia e relixión, e coidaba que non se podía comezar a conversar honradamente sen antes recoñecer as achegas de Galileo. No transcurso dunha alocución dirixida á Academia Pontificia das Ciencias en 1979, manifestou:

> Permítanme, señores, que chame a súa atención sobre algunhas cuestións que me parecen relevantes para entender o caso Galileo na súa correcta perspectiva. As coincidencias que amosaba entre relixión e ciencia eran máis numerosas e, sobre todo, máis importantes que o malentendido que desembocou nun conflito amargo e doloroso.

O papa mencionou tres puntos de coincidencia. O primeiro foi que Galileo estaba convencido de que a ciencia e a fe non poden discrepar e, referíndose á carta que Galileo lle enviou a Benedetto Castelli o 21 de decembro de 1613, o papa declarou que o Segundo Concilio Vaticano non expresara o contrario. O segundo punto foi que Galileo cría que Deus ilumina aqueles que tratan de comprender a Súa creación; a humildade e unha mente aberta constitúen, segundo subliñou o Papa, as condicións necesarias para que teña lugar un intercambio frutífero entre científicos e crentes. O terceiro punto de coincidencia estaba en que Galileo

recoñecera que na Biblia existen diferentes estilos literarios. E o papa concluíu:

> As diversas coincidencias que citei non resolven por si mesmas todos os problemas que presenta o caso Galileo, mais si contribúen a fixar un punto de partida que propicie unha solución digna, unha mentalidade que conduza a solucionar leal e honradamente as vellas oposicións.

Poida que a teoloxía católica contemporánea se puxese ao nivel da esexese galilea, mais aínda así o lector quererá ter unha idea de que clase de cristián era Galileo. Non podemos penetrar os seus pensamentos máis íntimos, pero el sentía, verdadeiramente, que formaba parte da Igrexa. No século XVII, o matemático e filósofo do Gran Duque da Toscana tiña que ser católico romano, mesmo se a súa adhesión era puramente formal, mais Galileo non afirmaba o seu compromiso coa boca pequena. Por exemplo, sabemos que consideraba importante facer peregrinacións e votos; non sería un apaixonado viaxeiro, e, con todo, en 1618 fixo a viaxe de Florencia a Loreto (uns douscentos quilómetros) co fin de visitar a chamada Casa da Nosa Señora, moi popular na súa época. Dez anos despois pensaba volver, mais disuadiuno a súa mala saúde.

O que nos chama a atención é que Galileo cría que Deus o elixira a el para que fixese todos aqueles descubrimentos astronómicos, e que lle concedera a el, e só a el, o privilexio de facer as descubertas telescópicas. O 30 de xaneiro de 1610 escribiulle ao Secretario de Estado toscano: «Estoulle infinitamente agradecido a Deus por ter a ben concederme ser a única persoa que fixo as primeiras observacións de cousas admirables desde sempre ignoradas». No *Sidereus Nuncius* que apareceu en marzo de 1610, Galileo engadiu que «o Facedor das Estrelas [lle dixera] claramente que lles puxese aos satélites de Xúpiter o nome do Gran Duque». Varios anos despois, nos seus comentarios a un libro do xesuíta Orazio Grassi, Galileo foi aínda máis lonxe: «Que lle vas facer —dille ao seu rival— se se me concedeu a min, e a ninguén máis, facer todos os descubrimentos celestiais». Esa crenza na singularidade do seu destino que albergaba Galileo non garda ningunha relación particular coa persoa de Cristo, nome que nunca achamos nos seus escritos. Mais, xaora, o compromiso relixioso dun ser humano non constitúe unha calidade observable, e non resulta posible inspeccionar a cara máis fonda da fe de Galileo.

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SCIENCE AND RELIGION: A STORY OF WARFARE?

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CONSELLO DA CULTURA GALEGA

SCIENCE AND RELIGION: A STORY OF WARFARE?

William Shea

Is Galileo's trial and condemnation the prime example of the conflict between science and religion? Was science, which is based on reason and experiment, bound to clash with religion, which relies on authority and dogma? How is it that honest inquirers still ask, Why did the Church try to silence Galileo?

Rome resisted the idea that it is the Earth and not the Sun that is in motion. Yet this historical opposition was not inevitable. If theologians had learned to respect their proper field of competence (as they later did), a fruitful dialogue might have been initiated in Galileo's own day. The pioneers of the Scientific Revolution were people for whom religion mattered. Copernicus was not an ordained priest, but he was a member of the clergy and a canon of his diocese in Poland. He was convinced that the motion of the Earth was not incompatible with the Christian Faith, and he dedicated his famous work, *On the Revolutions of the Heavenly Spheres*, to Pope Paul III. The German astronomer, Johannes Kepler, who discovered the three laws that describe how planets move around the sun, wanted to become a pastor in the Lutheran Church, and he saw himself as an interpreter of God's works in nature. The man who had the idea of universal gravitation, Isaac Newton, spent more time commenting on Scripture than working on problems of physics and mathematics.

The tension between what science was beginning to discover and what the Bible appeared to teach can be studied from a variety of viewpoints. A popular one is the warfare model that was developed by two nineteenth-century historians: John William Draper, and Andrew Dickson White. Draper's *History of the Conflict Between Religion and Science* appeared in 1874, and White's two-volume *History of the Warfare of Science with Theology in Christendom* in 1896. These works went through several editions and were translated into most major languages of the West. Reliance on authoritative texts and ecclesiastical control, they declared, produced a mind-set that precluded genuine knowledge of nature. War was not only inevitable; it was a duty for anyone who loved truth.

Why Incompatibility?

One of the curious aspects of the Galileo Affair is the difficulty scholars experience in answering what would appear to be an easy question: When was the incompatibility of Copernicanism with Scripture recognized? The answer is important if we are to understand the risks (if any) that Galileo was taking when he embraced the theory that the Earth moves. So let us inquire about the biblical texts that clearly state that the Earth is at rest and the Sun in motion. The answer is that there are none. We find scriptural passages such as: “Generations come and generations go, but the Earth remains forever. The Sun rises and the sun sets, and hurries back to where it rises” (*Ecclesiastes* 1, 4-5), but expressions like “the Sun rises” or “the Sun sets” are still common

today, and no one would think of banning them although we know that they are literally false. The only passage in the whole Bible that could be said to make an unambiguous statement to the contrary is one from Joshua, "The Sun stood in the middle of the sky and delayed its setting for almost a full day" (*Joshua* 10,13). If Joshua made the Sun stand still, it must have been moving!

We have long come to recognize that if the Sun appears to rise in the east and set in the west this is not because the Sun moves in the sky but because the Earth turns on its axis from west to east. Everyday language should not be confused with scientific utterances. Astronomy is not discussed in Scripture for, as a contemporary of Galileo put it, "The Bible teaches how to go to Heaven, not how the heavens go." Already in the first centuries theologians interpreted passages in the Bible that refer to natural events as popular rather than scientific ways of speaking. St. Augustine, the most famous of the early Church Fathers, maintained that the six days of creation in the first chapter of *Genesis* are not natural days but a figure of speech intended to convey the truth of creation in simple and accessible language. Augustine went even further and warned against invoking Scripture too quickly to refute positions in natural philosophy, lest the ignorance of Christians put off those who have solid knowledge.

So what went wrong? Why the sudden rigidity? Part of the answer lies in the climate of the age. Copernicus's book *On the Revolutions of the Heavenly Spheres* appeared in 1543, a few years after Martin Luther had initiated the Protestant Reformation that challenged the authority of the Papacy. The Catholic response was initially weak and confused but it gained momentum after the Council of Trent, which met at intervals between 1545 and 1563, the year before Galileo's birth. Since Antiquity, the Catholic Church had subscribed to the notion that decisions made by the College of bishops, sitting in an ecumenical council, were binding on the faithful, and especially on theologians who taught the official doctrine of the Church. While the Council of Trent emphasized this belief, it also tried to face up to Protestant criticism that Catholics lacked reverence for Scripture, and Catholics theologians became eager, and sometimes over zealous, in their desire to show Protestants that they took the Word of God seriously. They also became wary of astronomical theories that appeared to criticize Holy Writ. Protestants shared these exegetical concerns with Catholics but they were subject to less control. They had nothing corresponding to the Inquisition, and most Protestant countries did not have the power to enforce judgements of heresy as the Catholics did, although they also believed that heresy as a capital crime because of its harmful effects on society.

An Opportunity Missed

With some luck, Galileo could have convinced the Catholic authorities in Rome that there was no radical incompatibility between what the Bible says and what the new science was beginning to teach. As Arthur Koestler writes:

> unless one believes in the dogma of historic inevitability—this form of fatalism in reverse gear—one must regard it as a scandal which could have been avoided, and it is not difficult to imagine the Catholic Church adopting after a Tychonic transition

> the Copernican cosmology some two hundred years earlier than she eventually did. The Galileo Affair was an isolated and in fact quite untypical episode in the history of the relations between science and theology. But its dramatic circumstances, magnified out of all proportion created a popular belief that science stood for freedom, the Church for oppression of thought.

What prompts Koestler to offer such a radical reinterpretation of the Galileo Affair? The answer is the conceit and arrogance of Galileo that brought him into senseless opposition with the Church. Whereas Draper and White saw Galileo's condemnation as the necessary consequence of clerical pride and stupidity, Koestler lays most of the blame at Galileo's feet, and he protests against the "rationalist mythography" that sees him as the Maid of Orleans or, better still, the St George who slew the dragon of the Inquisition.

In his determination to restore the balance, Koestler leans too heavily on the other side. His irritation with Galileo stems from his belief that modern science claims too much and delivers too little. It is interesting to note that this devastating opinion does not come from a disgruntled Catholic, for Koestler was neither a Catholic nor a religious person in the conventional sense. Born into a Jewish family in Budapest in 1905, he attended the University of Vienna, where he was attracted by Zionism and left for Palestine in 1926. He worked in Jerusalem for a German-language periodical before returning to Europe in 1931. After spending a year in Paris, he settled in Berlin at a time when Germany was struggling in the aftermath of the Great Depression. He joined the Communist Party and was sent to the Soviet Union to gather information about the great strides forward that were said to be happening in that country. The Worker's Paradise, as Koestler discovered, was still a distant promise, and he reported as faithfully as he could on the difficulties that he had witnessed. The German Communist Party was not pleased and only published part of his report. Disillusioned, Koestler left the Party in 1938.

During the Spanish civil war, Koestler went to the front as a reporter. He was captured by the army of Franco in Malaga in February 1937, condemned to death, and sent to Seville to face a firing squad. The English secured his release, and allowed him into the U.K., where he worked with British Intelligence during the Second World War. He became a British citizen in 1945 and subsequently played an active role in the Cold War. Catholicism as a personal faith seems at no time to have interested him. Koestler's main goal was not so much to write a history of science as to explain how the Scientific Revolution drove a wedge between the quest for knowledge and the search for meaning.

The irony of the story is that both Galileo and the Roman Church missed an opportunity. When Galileo published his telescopic observations in 1610, his book, the *Sidereus Nuncius*, was an immediate success in Rome where he was given a triumphal welcome in 1611. The Pope, Paul V, even had Galileo's new Moon with its mountains and craters painted on the dome of the Chapel he was having erected in Santa Maria Maggiore, one of the most ancient and important basilicas in Rome.

What Went Wrong?

Galileo, like many professors, was not without a touch of arrogance and he did not suffer fools gladly. The problem is that Galileo believed he could prove that the Earth moves around the Sun when all he had was a clever theory. This is his famous argument that the motion of the tide would be impossible if the Earth did not rotate on its axis in twenty-four hours while it revolved around the Sun in one year.

It seems evident nowadays that the Roman authorities made a mistake when they condemned Copernicanism. We were all brought up in the knowledge that the Earth goes around the Sun, but no one learned about this in school in Galileo's day, and it is by no means straightforward. One thing is certain: a physical proof that the Earth moves around the Sun and rotates on its axis was only found after Galileo's condemnation.

Cardinal Bellarmine who met Galileo in 1616 had been clear: if the motion of the Earth were proved, then scriptural texts that appear to deny this would have to be reinterpreted. Personally, Bellarmine very much doubted that such a proof would ever be forthcoming. Pope Urban VIII held the same view, and he advised Galileo to use Copernicanism as a convenient mathematical tool without assuming that it was true. Now if one admits, as Galileo did, that the literal meaning of Scripture should prevail against mere conjectures in the natural sciences, then Bellarmine and Pope Urban VIII may be said to have been right. It is only with the advantage of hindsight that we can say that they were wrong. But Bellarmine and Pope Urban VIII cannot be completely excused if we consider two other aspects of the problem. The first is that Galileo, helped by friends who were priests and theologians, was able to find in Saint Augustine, Saint Jerome, and other eminent early writers known as the “Church Fathers,” a number of considerations that opened the door to interpreting the Bible in a way that allowed the Earth and not the Sun to be in motion. The Council of Trent had declared that Scripture should .be interpreted in conformity with the consensus reached by the Church Fathers, but had cautiously added “in matters of faith and morality.” Cardinal Bellarmine was aware of the problem and anticipated an argument that Copernicans might make when he wrote to a advocate of Copernicanism. “You cannot say that this is not a matter of faith, for it might not be so with regard to the subject matter, but it is with regard to the speaker. Thus someone who denied that Abraham had two sons and Jacob twelve, would be just as much a heretic as one who denied the virgin birth of Christ, for both are declared by the Holy Ghost through the mouths of the prophets and apostles.” The issue was therefore more complex than is sometimes believed.

A second aspect of the question is the threat that Copernicanism posed for those who identified the geocentric worldview with Christian cosmology. This is something that the Vatican historian, Walter Brandm¸ller vigorously denies: “There was not, as often has been said, any confusion or distress in the authorities of the Church facing the collapse of the world view accepted until that moment. They were only interested in the inerrancy of the Scriptures that they mistakenly thought was compromised by the Copernican system.” That there was more at stake cannot be so lightly dismissed. Cardinal Bellarmine and Pope Paul V (the former Cardinal Camillo Borghese) had both been members of the Holy Office when Giordano Bruno was condemned to the stake in 1600. Although Bruno was not an astronomer, he had used Copernicanism as a platform from which to launch his new cosmology, in which stars are suns surrounded by inhabited planets, and the universe a necessary manifestation of the infinity of God and, hence, boundless. The outcome was a radical form of pantheism that

overturned the basic tenets of Christianity. Bruno was executed in Rome in 1600 and it is unlikely that only sixteen years later Pope Paul V and Cardinal Bellarmine would have forgotten the overtones of Bruno's Copernicanism. On 27 February 1615, Galileo's friend Giovanni Ciampoli sounded Cardinal Maffeo Barberini, the future Pope Urban VIII, on the issue. The Cardinal said that he would like "greater caution in not going beyond the arguments used by Ptolemy and Copernicus," and "in not overstepping the limits of physics and mathematics." The future Pope also warned about the danger of misguided extensions of Copernicanism. As Ciampoli explained to Galileo,

> Your opinion regarding the play of light and shadow in the bright and dark spots of the moon creates some analogy between the lunar globe and the earth; somebody expands on this, and says that you place human inhabitants on the moon; the next fellow starts to dispute how these can be descended from Adam, or how they can have come off Noah's ark, and many other extravagances you never dreamed of.

We have come to see our planet Earth as one among a vast number that circle their own Sun, and speculation on life on other planets has become common. Such was not the case in the seventeenth century. When Benedetto Castelli, Galileo's closest collaborator, mentioned the motion of the Earth in a conversation with Cardinal Francesco Barberini, Pope Urban VIII's nephew, he was told that if the Earth really moved, "it would have to be considered a planet, something that seems too much at variance with theology." To which Castelli replied that Galileo intended to prove that the Earth was not a planet, and the Cardinal rejoined that indeed he should.

Was the Church Right about Science?

In Galileo's time, Copernicanism was a conjecture that awaited confirmation. If Galileo had been less dogmatic, he could have avoided a clash with the Church. "Therefore," concludes Brandm¸ller, "we face the grotesque fact that the Church, so often accused of error in this affair, was right precisely in the ambit that was not her own, namely that of the natural science, when she required Galileo that he treat the Copernican system only as a hypothesis." Brandm¸ller overstates his case. The churchmen who held, in agreement with current methodology, that astronomical models were merely hypothetical constructions were entitled to advise Galileo to discuss Copernicanism as a conjecture. But could they demand this of him? When they laid upon Galileo the duty to speak hypothetically or to hold his peace, they were talking as theologians, not as scientists. When Pope Urban VIII declared that God's ways are inscrutable and that He could have designed the world after a fashion that escapes us entirely, he was basing his argument on God's omnipotence. The implication, only thinly disguised, was that to query this was tantamount to a denial of His omnipotence. At the time, it was not realized that a new science was emerging and no one guessed that it would prove extremely powerful. The position of Bellarmine and Pope Urban VIII was reasonable, but it was a reasonableness of a limited kind. The Cardinal and the Pope were men of their time, not heralds of the future. We know, in retrospect, that the road to modern science lay along the path that Galileo was following, not along the conventional highway that they were busy signposting.

Are Theories Underdetermined?

It sometimes comes as a surprise that the argument of Pope Urban VIII from the omnipotence of God resonates with contemporary accounts in the philosophy of science, and can be considered a theological version of version of the thesis concerning the underdetermination of theories. As Larry Laudan explains in an entry in the *Routledge Encyclopedia of Philosophy*:

> The term underdetermination refers to a broad family of arguments about the relations between theory and evidence. All share the conclusion that evidence is more or less impotent to guide choice between rival theories or hypotheses. In one or other of its guises, underdetermination has probably been the most potent and most persuasive idea driving twentieth-century forms of scepticism and epistemological relativism.

Underdetermination has a long pre-history. In Antiquity and the middle Ages, the realization that we can account for the same data using different theories led to an "instrumentalist" notion of scientific explanation. On this view, an astronomical system aims at "saving the appearances," namely at providing mathematical instruments to compute the position and apparent size or speed of celestial bodies. A good astronomical theory can be used to predict eclipses but should not be taken as a true account of how the planets actually move. In order to know the real nature of the world, another kind of science was required, a demonstrative science, like Aristotelian philosophy purported to be, where the real causes of observed facts were investigated. This dichotomous approach to cosmology had important institutional consequences. The professor of astronomy was expected to teach how to "save the appearances," not what caused them. It was the job of the professor of natural philosophy to look behind or beyond the phenomena. Galileo taught mathematics, not philosophy at Padua, and he had to deal with professors of philosophy who had no clue that mathematics could teach them something about the real world. This division of tasks also had financial implications. A professor of philosophy could be paid four to six times the salary of his colleague who taught mathematics. Hence Galileo's insistence that he be made not only mathematician but also philosopher to the Grand Duke when summoned back to Florence in 1610.

Galileo and Catholicism Today

Pope John Paul II was anxious to foster a dialogue between science and religion, and he felt that an honest conversation could not begin without recognizing Galileo's contribution. In an address to the Pontifical Academy of Sciences in 1979, he said, "Allow me, gentlemen, to submit to your attention some points that seem to me important to set the Galileo Affair in its true light. In this affair the agreements between religion and science were more numerous and, above all, more important than the misunderstanding that led to a bitter and painful conflict."

The Pope mentioned three points of agreement. The first is Galileo's conviction that science and Faith call never be at odds. Referring to Galileo's Letter to Benedetto Castelli of 21 December 1613, the Pope declared that the Second Vatican Council did not express itself differently. The second point is Galileo's belief that God enlightens those who try to understand his creation. Humility and open-mindedness, the Pope stressed, are the necessary conditions for a fruitful exchange between scientists and religious believers. The third point of agreement is Galileo's recognition that there are different literary styles in the Bible, "The various agreements that I have mentioned," the Pope concluded, "do not in themselves solve all the problems of the Galileo Affair, but they contribute to the creation of a starting point favourable to their honourable solution, a state of mind conducive to the honest and loyal resolution of old oppositions."

Contemporary Catholic theology may have caught up with Galilean exegesis, but the reader will still want to have an idea of what kind of Christian Galileo was. We cannot know his inmost thoughts, but he genuinely felt himself part of the Church. In the seventeenth century, the Mathematician and Philosopher of the Grand Duke of Tuscany had to be a Roman Catholic even if his adherence was purely formal, but Galileo's commitment went beyond lip service. For instance, we know that he considered pilgrimages and vows important. Never an avid traveller, he nonetheless made the journey from Florence to Loreto (some two hundred kilometres) in 1618 in order to visit the so-called House of our Lady that was very popular in his day. Ten years later he planned to go back on a second pilgrimage but was deterred by poor health.

What is curious for us, it that Galileo believed that God had singled him out to make all the new astronomical discoveries, and that God had granted him, and him alone, the privilege of making the telescopic ones. On 30 January 1610, he wrote to the Tuscan Secretary of State; "I am infinitely grateful to God that it should have pleased him to grant me to be the only person to make the first observations of admirable things unknown from all ages." In the *Sidereus Nuncius* that appeared in March 1610, Galileo added that "the Maker of the Stars clearly told him to give the satellites of Jupiter the name of the Grand Duke." Several years later, when commenting on a book by the Jesuit Orazio Grassi, Galileo went even further, "What can you do," he says to his rival, "if it was only given to me and to no one else to make all the celestial discoveries." Galileo's belief in the singularity of his destiny is not particularly linked to the person of Christ, a name that we never find under his pen. Of course, the religious commitment of a human being is not an observable quality and the deeper side of Galileo's faith is not open to inspection.