



Cardinal Bellarmine



Signor Galileo

# Science and Religion

## The Galileo affair

# The Warfare/Conflict Model

- In the 19<sup>th</sup> century many writers (especially John William Draper and Andrew Dickson White) proposed the *warfare model* between science and religion, claiming that science and religion are *essentially* in conflict, due to fundamentally incompatible ways of approaching nature.
- Contemporary historians now reject their arguments for this view as historically inaccurate.

# E.g. Columbus and the flat earth

- For example, these authors claimed that belief in a flat earth was common in the middle ages, including among Church leaders.
- When Columbus proposed to sail west to the Orient, the Church opposed his plan (they said) on the grounds that no such trip is possible on a flat earth.
- In fact, the Church's opposition was based on Columbus under-estimating the length of the voyage. The sailors would starve long before getting there.

# Columbus's Proposed Voyage



**A**

**B**

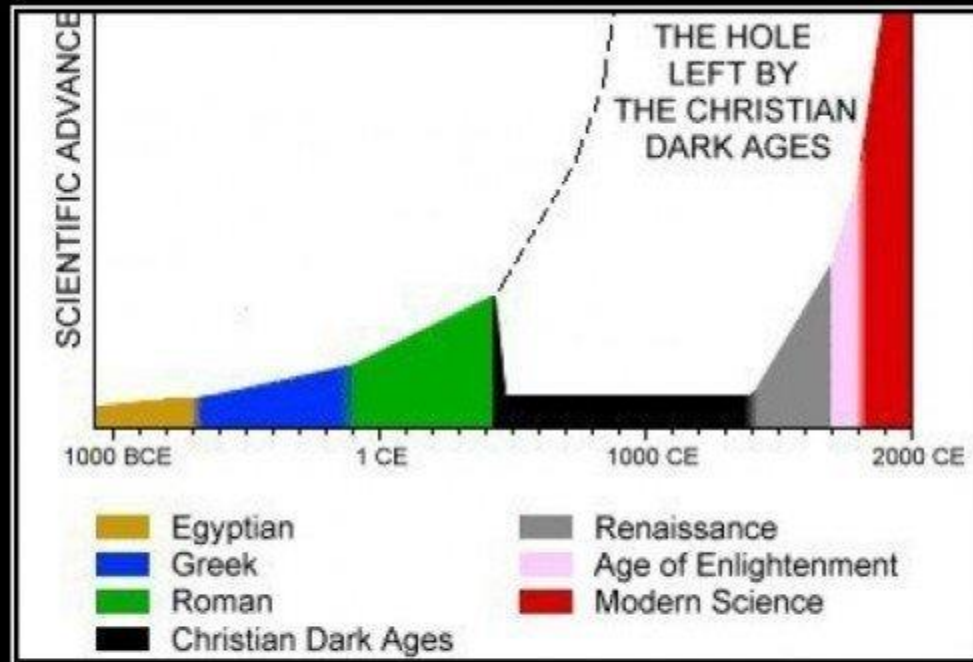


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We could not calculate directions between **Canary Islands, Spain** and **Japan**.

It's 14,000 miles, not 2,800!



# CHRISTIANITY

Just think, we could have been exploring the galaxy by now.

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- The term 'Dark Ages' (referring to Medieval Europe) is now considered a misnomer. It was a period of scientific and philosophical advancement.

# Galileo and the Church

- Similarly, authors like Draper and White distorted the Galileo affair, claiming that the church was opposed to science generally, was not prepared to alter its understanding of scripture in the light of science, that Galileo had clear proof of the earth's motion, etc.

# Geocentric Christian/Jewish scriptures

- “He set the earth on its foundations; it can never be moved.”

(Psalm 104:5, 1 Chronicles 16:20, Psalm 93:1)

- “The sun rises and the sun sets, and hurries back to where it rises.”

(Ecclesiastes 1:5)

# St. Augustine (354-430 AD)

“Often, a non-Christian knows something about the earth, the heavens, and the other parts of the world, about the motions and orbits of the stars and even their sizes and distances, ... and this knowledge he holds with certainty from reason and experience. It is thus offensive and disgraceful for an unbeliever to hear a Christian talk nonsense about such things, claiming that what he is saying is based in Scripture. We should do all we can to avoid such an embarrassing situation, which people see as ignorance in the Christian and laugh to scorn.”

[Augustine, *The Literal Interpretation of Genesis*]



# Galileo to Castelli, 1613 (mathematician, Benedictine monk, former student, Copernican)

....As therefore, the Holy Scriptures in many places not only admit but actually require a different explanation from what seems to be the literal one, it seems to me that they ought to be reserved for the last place in mathematical discussions. For they, like nature, owe their origin to the Divine Word; the former is inspired by the Holy Spirit, the latter as the fulfillment of the Divine commands; it was necessary, however in Holy Scripture, in order to *accommodate itself to the understanding of the majority*, to say many things which apparently differ from the precise meaning.

“...As therefore the Bible, although dictated by the Holy Spirit, admits, from the reasons given above, in many passages of an interpretation other than the literal one; and as, moreover, we cannot maintain with certainty that *all* interpreters are inspired by God, I think it would be the part of wisdom not to allow any one to apply passages of Scripture in such a way as to force them to support, as true, conclusions concerning nature the contrary of which may afterwards be revealed by the evidence of our senses or by necessary demonstration.”

- (Note that Galileo was himself a Catholic.)

## Galileo: Letter to the Grand Duchess Christina (1615)

...Hence in expounding the Bible if one were always to confine oneself to the unadorned grammatical meaning, one might fall into error. Not only contradictions and propositions far from true might thus be made to appear in the Bible, but even grave heresies and follies. Thus it would be necessary to assign to God feet, hands, and eyes, as well as corporeal and human affections, such as anger, repentance, hatred, and sometimes even the forgetting of things past and ignorance of those to come. These propositions uttered by the Holy Ghost were set down in that manner by the sacred scribes in order to accommodate them to the capacities of the common people, who are rude and unlearned. ...

# Galileo to Kepler

“I think, my Kepler, we will laugh at the extraordinary stupidity of the multitude. What do you say to the leading philosophers of the faculty here, to whom I have offered a thousand times of my own accord to show my studies, but who with the lazy obstinacy of a serpent who has eaten his fill *have never consented to look at planets, nor moon, nor telescope?* Verily, just as serpents close their ears, so do these men close their eyes to the light of truth. ...

...People of this sort think that philosophy is a kind of book like the Aeneid or the Odyssey, and that the truth is to be sought, not in the universe, not in nature, but (I use their own words) *by comparing texts!* How you would laugh if you heard what things the first philosopher of the faculty at Pisa brought against me in the presence of the Grand Duke, for he tried, now with logical arguments, now with magical adjurations, to tear down and argue the new planets out of heaven.”

# Dispute with Lodovico delle Colombe

- In 1604 a “new star” appeared, bright enough to be seen by day. This threatened to challenge the Aristotelian idea that the heavens are unchanging.
- delle Colombe, an Aristotelian physicist, argued in 1605 that *the star had always been there*, but wasn’t visible until magnified by a small lens-like portion of the crystalline sphere, that moved between the earth and the star.

- In 1606 Galileo published a book (anonymously) ridiculing delle Colombe's position, and calling him "our pigeon". Galileo argued that the star really was new, and that Aristotelian philosophy had no place in astronomy.
- E.g. concerning delle Colombe, Galileo remarked that Aristotle made many blunders, "Though neither so many nor so silly as does this author every time he opens his mouth on the subject." (Ouch!)



# The 'pigeon league'

In 1611 Galileo was warned by a friend:

“I have been told by [the Archbishop of Florence] that a gang of ill-disposed men, who are envious of your virtue and merits, met at the residence of the Archbishop of Florence, and put their heads together in a mad quest for some means by which they could damage you, either with regard to the motion of the Earth or otherwise. One of them asked a preacher [Niccolò Lorini] to state from the pulpit that you were asserting outlandish things. ... I write this that your eyes may be open to the envy and malice of these evildoers.”

# Are the heavens perfect?

- **July 1612.** Galileo wrote to **Cardinal Carlo Conti** suggesting that sun spots are imperfections on the sun's surface. In reply, Conti "states that Scripture did not support the Aristotelian theory of the incorruptibility of the heavens but that, on the contrary, the common opinion of the Fathers of the Church was that the heavens were corruptible"
- Conti further remarks that the motion of the Earth could be accommodated with the Biblical passages if it was supposed that Scripture was written according to the understanding of ordinary persons, not as consisting in exact astronomical information. This, he added, "should not be admitted unless it is really necessary."

# The 'pigeon league' acts ...

- **21 Dec 1614.** A Dominican preacher and pigeon league member Tommaso Caccini denounced Galileo from the pulpit. "Men of Galilee, why do ye stand here looking into the sky?" (Acts 1:11). (Tommaso's boss quickly apologized to Galileo: "Unfortunately, I have to answer for all the idiocies that thirty or forty thousand brothers may and do actually commit.")
- **In 1615** Niccolò Lorini, also a Dominican and pigeon league member, sent the Roman Inquisition a copy of Galileo's letter to Castelli.

# Lorini's cover letter to Cardinal Sfondrati of the Roman Inquisition

All our fathers of this devout convent of St. Mark are of the opinion that the letter contains many propositions which appear to be suspicious or presumptuous, as when it asserts that the language of Holy Scripture does not mean what it seems to mean; that in discussions about natural phenomena the last and lowest place ought to be given to the authority of the sacred text; that its commentators have very often erred in their interpretation; that the Holy Scriptures should not be mixed up with anything except matters of religion....

... they [the 'Galileists'] expounded the Holy Scriptures according to their private lights and in a manner different from that of the common interpretation of the Fathers of the Church...

.... that they strove to defend an opinion which appeared to be quite **contrary to the sacred text**; that they spoke in slighting terms of the ancient Fathers and of St. Thomas Aquinas; that they were **treading underfoot the entire philosophy of Aristotle** which has been of such service to Scholastic theology; and, in fine, that to show their cleverness they were airing and scattering broadcast in our steadfast Catholic city a thousand saucy and irreverent surmises; when, I say, I became aware of all this, I made up my mind to acquaint your Lordship with the state of affairs, that you in our holy zeal for the Faith may, in conjunction with your most illustrious colleagues, provide such remedies as will appear advisable....

# Cardinal Bellarmino to Father Foscarini, 1615

(Foscarini has also written a book defending Copernicanism and suggesting new ways to interpret scripture)

First, I say it seems to me that your Reverence and Signor Galileo act prudently when you content yourselves with speaking hypothetically and not absolutely, as I have always understood that Copernicus spoke. *For to say that the assumptions that the Earth moves and the Sun stands still saves all the celestial appearances better than do eccentrics and epicycles is to speak with excellent good sense and to run no risk whatever. Such a manner of speaking suffices for a mathematician.* But to want to affirm that the Sun, in very truth, is at the centre of the universe and only rotates on its axis without traveling from east to west, and that the Earth is situated in the third sphere and revolves very swiftly around the Sun, is a very dangerous attitude and one calculated not only to arouse all Scholastic philosophers and theologians but also to injure our holy faith by contradicting the Scriptures....

... Third, I say that, **if there were a real proof** that the Sun is in the centre of the universe, that the Earth is in the third sphere, and that the Sun does not go round the Earth but the Earth round the Sun, then we should have to proceed with great circumspection in explaining passages of Scripture which appear to teach the contrary, and we should rather have to say that **we did not understand them than declare an opinion to be false which is proved to be true.**

(Same as Augustine)

... But I do not think there is any such proof *since none has been shown to me*. To demonstrate that the appearances are saved by assuming the sun at the centre and the earth in the heavens is not the same thing as to demonstrate that *in fact* the sun is in the centre and the earth is in the heavens. I believe that the *first demonstration may exist, but I have very grave doubts about the second*; and **in case of doubt one may not abandon the Holy Scriptures as expounded by the holy Fathers...**”



# The Qualifiers

- In 1616 a panel of theologians ruled that the Copernican theory was formally heretical, but this wasn't binding on the church.
- On the Pope's orders, Galileo was summoned for a meeting with Cardinal Bellarmine to advise him of the decision, and order him not to hold or defend the Copernican theory, but not to issue a formal injunction to stop defending Copernicanism unless Galileo was rebellious.
  - (Whether the injunction was given is unclear. The minutes of the meeting say that it was, but the document was quite likely falsified by an enemy of Galileo.)

# Letter from Cardinal Barberini, 1620

Most Honorable Sir,[T]he esteem I have always had of Your Lordship and your talents provided me with the subject matter of the poem I am enclosing. In case you find it wanting of any parts that might suit it, please consider only my affection, so long as I intend to dignify it [the poem] with your name. Whence, without anymore lingering in further apologies (I pass on them, given the familiarity I have with Your Lordship), I ask you accept the little demonstration of goodwill I show to you. And by sending my heartfelt regards, I beg God might grant whatever wish you may have.

Rome, 28 August 1620

As the brother of Your Lordship, Galileo Galilei,  
Cardinal Maffeo Barberini

# Maffeo's 1620 poem

That which outwardly radiates heavenly brightness is not always  
Growing bright within: We gaze at blackness  
In the Sun (who'd believe it?) faults laid bare  
By your art, Galileo.

*Non semper, extra quod radiat jubar,  
Splendescit intra: respicimus nigras  
In Sole (quis credat?) resectas  
Arte tua, Galilaeae, labes.*

# Maffeo becomes Pope

- Galileo kept out of trouble for the next few years, and in 1623 Maffeo Barberini was elected Pope (Urban VIII).
- With the new Pope's encouragement, Galileo started to work on a book, *Dialogue Concerning the Two Chief World Systems*, that was supposed to be an impartial examination of the arguments on both sides.
- (The two systems were those of Ptolemy and Copernicus, and so Tycho's model was left out of the discussion.)
- The book was published in 1632.

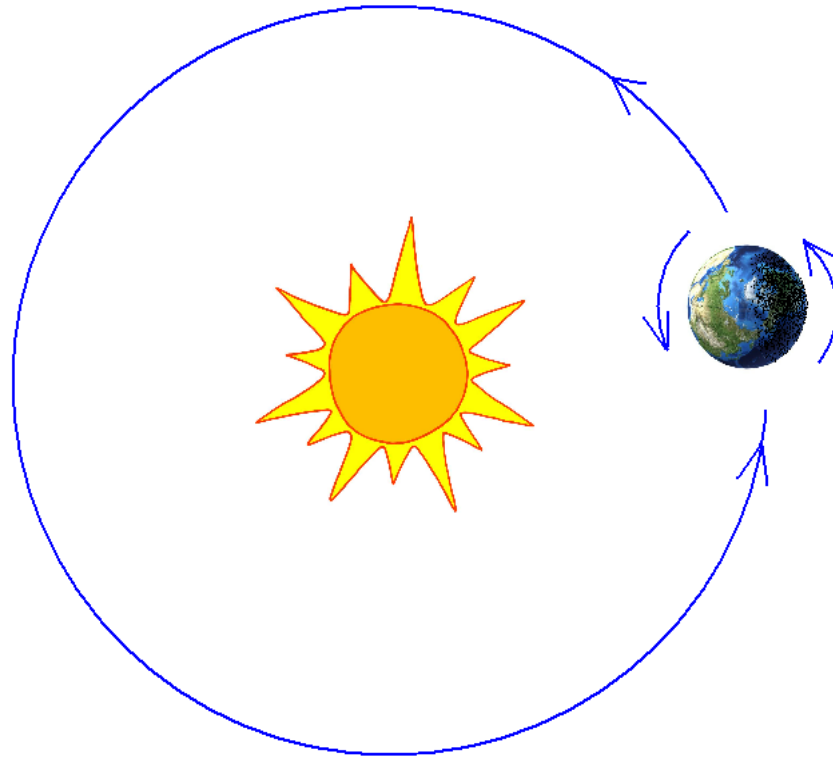
# It didn't go well!

- The book wasn't what the Pope had asked for: it was very one-sided, and a clear defense of Copernicanism.
- The book also appeared to ridicule the Pope, by placing the Pope's own arguments in the mouth of "Simplicio", the Aristotelian scholar in the dialogue.
  - Apart from being roundly trounced in the dialogue by the Copernican "Salviati", "Simplicio" can be read as meaning "simpleton".
- The 1616 injunction (real or not) meant that there was little alternative to putting Galileo in prison.

- Consequently Galileo (at the age of 70) was found suspect of heresy, forced to renounce his view, and sentenced to house arrest (for the rest of his life). He was forbidden to discuss Copernican ideas, and the *Dialogue* was banned.
- But he kept doing science, on less controversial topics, and continued to publish.

# Galileo and the tides

- It is worth noting that the main argument for the motion of the earth in Galileo's *Dialogue* was that the earth's motion is the only way to explain ocean tides.
- Think of a cruise ship with a swimming pool on the top deck. If the ship stops suddenly, then the water will move toward the front of the ship, then slosh back again, etc.



- Some parts of earth (benighted) are moving faster than other parts (daylit). So there will be changes of speed, sloshing of the oceans, etc.
- (But doesn't this conclusion conflict with Galileo's own theory of horizontal motion being neutral?)



- This explanation of the tides is quite wrong, we now know. (Actually Kepler had it right, but couldn't prove it.)
- But the important point is that Galileo's arguments (in the fourth day of the *Dialogue*) are not too convincing. His critics rightly judged that he had failed to prove the earth's motion.

# Conclusions

- In this case there is a (soft) conflict between a religious belief system and a scientific hypothesis. (It was possible to reinterpret those few Bible verses.)
- Copernicans were initially weakly suppressed, in not being allowed to *defend* their view, but merely *offer arguments* pro and con.
- Galileo carelessly (or recklessly?) provoked the authorities. In the absence of such provocation, Galileo would probably have been allowed to continue arguing for his views.

# Part 2

General thoughts about science and religion

# Is religion opposed to science?

- In thinking about the relation between science and religion (especially theistic religion) one has to bear in mind that virtually all early scientists were theists.
  - Copernicus was a Catholic priest. Galileo was Catholic. Kepler was a Lutheran, etc. Plato and Aristotle were theists of some kind. Ibn ash-Shatir, Alhazen and Avicenna were Muslims, etc.
- A common idea among such early scientists was that humans are able to understand the world, because the world is a product of God's mind, and human minds are patterned after the divine mind.
- Also nature was described as a 'book', written by God, that stands alongside the book of scripture (also written by God). Hence the study of nature is as pious as the study of scripture.

- “The chief aim of all investigations of the external world should be to discover the rational order and harmony which has been imposed on it by God and which He revealed to us in the language of mathematics.”

(Kepler, Johannes, *De Fundamentis Astrologiae Certioribus*, Thesis XX, 1601.)

“I was merely thinking God’s thoughts after him. Since we astronomers are priests of the highest God in regard to the book of nature it befits us to be thoughtful, not of the glory of our minds, but rather, above all else, of the glory of God.”

- The “two books” (scripture and nature) are assumed to be consistent. Apparent contradictions between scripture and science shouldn’t cause alarm, therefore.
- The conflict between theism and *evolutionary theory* in biology is much more serious (and long-lasting) than the case of Copernican astronomy. (More about this later.)

# Different views of the relation between science and religion

- **Conflict.** (Science and religion are essentially opposed, and incompatible.)
- **Independence.** (Science and religion deal with entirely separate, non-overlapping domains.)
- **Limited interaction.** (Science and religion have some areas of overlap, and so may interact, with either mutual benefit or harm.)
- **Integration.** (Science and religion are closely entwined, and need to be done together.)

# Ronald Numbers, historian, interviewed in Salon.com, Jan 2, 2007

**Can you put the current battles over evolution in some historical context? If we take this history back to the scientific revolution -- back to Newton and Galileo -- was there a war between science and religion then?**

There were conflicts at times. But there was no inevitable war. Just think about it. Most of the contributors to the so-called scientific revolution were believers. They were theists. They didn't see any inherent conflict between what they were doing and their religious beliefs.



**These were the giants -- Newton, Galileo, Boyle, Kepler. Weren't they all devout Christians?**

Well, Newton was a little lax at times, though he was certainly a theist. Boyle was a good sound Christian. I think Galileo was a true believer in the church. And Copernicus was a canon in the Catholic Church. Kepler was a deep believer in God. So yeah, these people were believers. Occasionally, there were problems -- for instance, between Galileo and the pope. But Galileo had gone out of his way to insult the pope, who had previously supported him. He put the pope's favorite argument against heliocentrism into the mouth of the character Simplicio -- the simple-minded person.

# Religious ideas can be a source of hypotheses

- Where do hypotheses come from? How did the scientist originally have that idea?
- *Sometimes* the idea comes from a religious world view.
- (Scientific hypotheses can come from virtually anywhere, even dreams! E.g. Kekulé and the structure of benzene.)



Atoms were gamboling before my eyes, twisting and twining in snakelike motion. But look! One of the snakes had seized its own tail ... (Kekulé 1865)

# Kepler's neo-Platonism

"a fountain of light, rich in fruitful heat, most fair, limpid, and pure to the sight, the source of vision, portrayer of all colors, though himself empty of color, called king of the planets for his motion, heart of the world for his power, its eye for his beauty, and which alone we should judge worthy of the Most High God, should he be pleased with a material domicile and choose a place in which to dwell with the blessed angels."

# Compare to Plato, *Republic*, 509b

“And [the sun] is he whom I call the child of the good, whom the good begat in his own likeness, to be in the visible world, in relation to sight and the things of sight, what the good is in the intellectual world in relation to mind and the things of mind.”

# Copernicus

"In the middle of all is the seat of the Sun. For who in this most beautiful of temples would put this lamp in any other or better place than the one from which it can illuminate everything at the same time? Aptly indeed is he named by some the lantern of the universe, by others the mind, by others the ruler. Trismegistus called him the visible God, Sophocles' Electra, the watcher over all things. Thus indeed the Sun as if seated on a royal throne governs his household of Stars as they circle round him."

# Big Bang Theory

- The “Big Bang” theory -- the idea that the universe began as a very tiny, hot object that expanded rapidly – was first proposed by Georges Lemaitre, a mathematician and Catholic priest.
- Was Lemaitre’s model inspired by his theology? The fit is certainly good. Yet he denied this, claiming that he was pushed in that direction by the mathematics of General Relativity.
- Other scientists (naturalists) were biased *against* the Big Bang theory, on account of its theological flavour.

The most radical ideas are those that are perceived to support religion, specifically Judaism and Christianity. When I was a student at MIT in the late 1960s, I audited a course in cosmology from the physics Nobelist Steven Weinberg. He told his class that of the theories of cosmology, he preferred the Steady State Theory because “it least resembled the account in Genesis”

Frank Tipler, “Refereed Journals: Do They Insure Quality or Enforce Orthodoxy?”



“It belongs analytically to the concept of the cosmological singularity that it is not the effect of prior physical events. The definition of a singularity ... entails that it is impossible to extend the spacetime manifold beyond the singularity”

- Quentin Smith, “The Uncaused Beginning of the Universe”, 1993.

- "The beginning seems to present insuperable difficulties unless we agree to look on it as frankly supernatural."
- Arthur Eddington, *The Expanding Universe*, 1933.

- It's not only religious scientists who carry philosophical assumptions into their scientific work.
- In biology, for example, religious scientists seem to be *less* constrained by their philosophy than naturalists are.
- Many Christians in biology, for example, accept the Darwinian paradigm (e.g. Theodosius Dobzhansky, Francis Collins, Ken Miller, R. J. Berry). But they have other options, consistent with their theology.
- But naturalists in biology cannot accept anything else, it appears. (With rare exceptions.)

- Rice University scientist Jim Tour recently made Thomson Reuters' list of the top 10 most-cited and most-published chemists.

“I don’t find any overt attacks on my because of my faith. These people would be too careful and that would get them into big trouble. But it’s questions about the fact that I can’t buy into macroevolution, that bothers me...

I understand better than most people how molecules come together, what they can and cannot do. Very few people understand this better than me. I don’t understand how macroevolution occurs. I understand how small changes occur. But I don’t understand how you go to gross development of organs that are very different than they were previously. Intelligent design is not satisfying to me. It’s not an explanation to me. I’m looking for something that's more tangible. I believe fundamentally that God created us all, but as a scientific argument that isn’t satisfying. It’s satisfying as far as my faith goes.”

“So when appointments are not made. When fellowships are not granted on this basis, that hurts. That hurts...

I have been told right to my face, “You can’t be here.” And I say, “My credentials are stronger than lots of people who are getting in.” And they say, “There’s no doubt about that.”

Tour claims on his web site that he’s being ostracized (e.g. not made a member of the NAS) because he doubts that the Darwinian paradigm in evolutionary theory is viable.

Is this in any way similar to Galileo’s situation?