

J. BRONOWSKI
THE ASCENT OF MAN

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What I present
many years, I
ideas express
his nature.

The Ascent
a full-scale history
from the acclimation
vision series of
mathematician
historian, teacher
College, Cambridge
modern movement

The Ascent
ment of science
special gifts that
have made his
species. Bronowski
intellectual history
great monument
Discoveries from
from the archipelago
are shown to
search to understand
The author's
throughout reaching
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Easter Island
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bra and the civilization
location, Bronowski
of thought and
man first to architecture
and then to engineering
structures about
He writes, "Man
the fullness of
he creates on
the stages in his
and of self."

Whether a
mathematician,
entist, or the
Dr. Bronowski

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world. The wheel as the Greek ideal of perfect motion had become a petrified god, as rigid as the Mayan calendar or the figures carved on Easter Island.

The system of Copernicus seemed unnatural to his age, even though the planets still run in circles. (It was a younger man, Johannes Kepler, working later in Prague, who showed that the paths are really elliptical.) That was not what bothered the man in the street, or in the pulpit. They were committed to the wheel of the heavens: the hosts of heaven must march around the earth. That had become an article of faith, as if the Church had made up its mind that the system of Ptolemy was invented not by a Levantine Greek but by the Almighty Himself. Clearly the issue was not one of doctrine but of authority. The issue did not come to a head until seventy years later, in Venice.

Two great men were born in the year 1564; one was William Shakespeare in England, the other was Galileo Galilei in Italy. When Shakespeare writes about the drama of power in his own age, he twice brings the scene to the Republic of Venice: once in *The Merchant of Venice*, and then in *Othello*. That is because in 1600 the Mediterranean was still the centre of the world, and Venice was the hub of the Mediterranean. And here ambitious men came to work, because they were free to work without restraint: merchants, and adventurers, and intellectuals, a host of artists and artisans crowded these streets, as they do now.

The Venetians had the reputation of being a secret and devious people. Venice was a free port, as we would say, and carried with that some of the conspiratorial air which haunts neutral cities like Lisbon and Tangier. It was in Venice that a false patron trapped Giordano Bruno in 1592 and handed him to the Inquisition, which burned him in Rome eight years later.

Certainly the Venetians were a practical people. Galileo had done deep work in fundamental science at Pisa. But what made the Venetians hire him as their professor of mathematics at Padua was, I suspect, his talent for practical inventions. Some of them survive in the historic collection of the *Accademia Cimento* in Florence, and are exquisitely conceived and executed. There is a
198 convoluted glass apparatus for measuring the expansion of

89

In 1600 the Mediterranean was still the centre of the world, and Venice was the hub of the Mediterranean.
Details of a woodcut of Venice by Jacopo de' Barbari, dated 1500.

liquids, rather like a thermometer; and a delicate hydrostatic balance to find the density of precious objects, on the principle of Archimedes. And there is something which Galileo, who had a knack for salesmanship, called a 'Military Compass', though it is really a calculating instrument not unlike a modern slide-rule. Galileo made and sold them in his own workshop. He wrote a manual for his 'Military Compass' and published it in his own house; it was one of the first works of Galileo to get into print. This was sound, commercial science as the Venetians admired it.

So it is no wonder that when, late in 1608, some spectacle-makers from Flanders invented a primitive form of spyglass, they came to try to sell it to the Republic of Venice. But, of course, the Republic had in its service, in the person of Galileo, a scientist and mathematician immensely more powerful than any in Northern Europe – and a much better publicist who, when he had made a telescope, hustled the Venetian Senate to the top of the Campanile to show it off.

Galileo was a short, square, active man with red hair, and rather more children than a bachelor should have. He was forty-five when he heard the news of the Flemish invention, and it electrified him. He thought it out for himself in one night, and made an instrument about as good, with a magnification of three, which is only about a rather superior opera glass. But before he came to the Campanile in Venice, he stepped the magnification up to eight or ten, and then he had a real telescope. With that, from the top of the Campanile, where the horizon is about twenty miles, you can not only see the ship at sea, you can identify it two hours' sailing and more away. And that was worth a lot of money to the brokers on the Rialto.

Galileo described the events to his brother-in-law in Florence in a letter that he dated 29 August 1609:

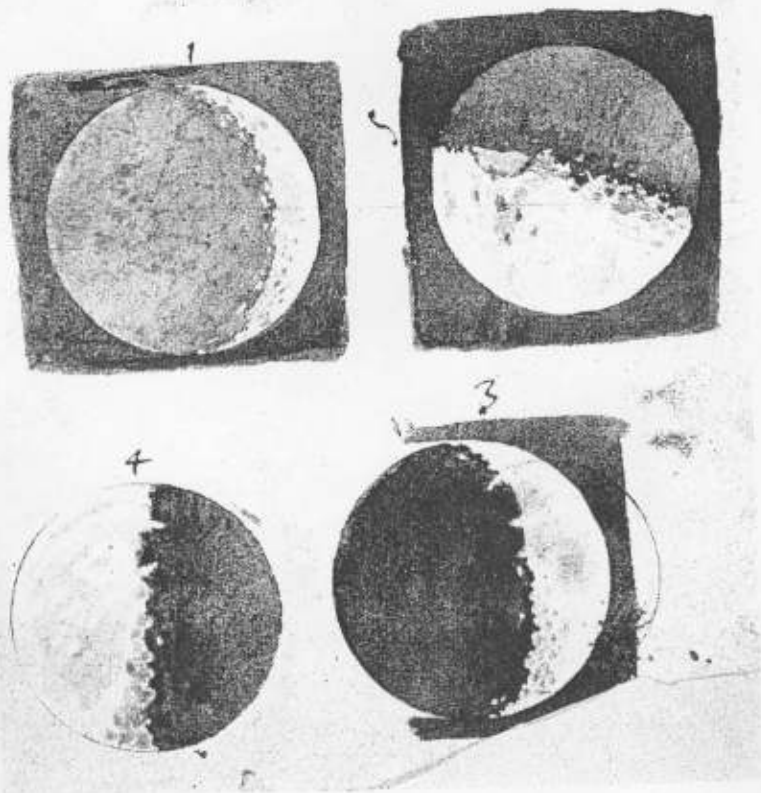
You must know, then, that it is nearly two months since news was spread here that in Flanders there had been presented to Count Maurice a spy-glass, made in such a way that very distant things are made by it to look quite close, so that a man two miles away can be distinctly seen. This seemed to me so marvellous an effect that it gave me occasion for thought; and as it appeared to me that it must be founded on the science of perspective, I undertook to think about its fabrication; which I finally found, and so perfectly that one which I made far surpassed the reputation of the Flemish one. And word



An instrument of the sort Galileo made: a delicate hydrostatic balance to find the density of precious objects on the principle of Archimedes.

having reached Venice that I had made one, it is six days since I was called by the Signoria, to which I had to show it together with the entire Senate, to the infinite amazement of all; and there have been numerous gentlemen and senators who, though old, have more than once scaled the stairs of the highest campaniles in Venice to observe at sea sails and vessels so far away that, coming under full sail to port, two hours or more were required before they could be seen without my spy-glass. For in fact the effect of this instrument is to represent an object that is, for example, fifty miles away, as large and near as if it were only five.

Galileo is the creator of the modern scientific method. And he did that in the six months following his triumph on the Campanile, which would have been enough for anyone else. It occurred to him then that it was not enough to turn the Flanders toy into an instrument of navigation. It could also be turned into an instrument of research, an idea which was altogether new to



92

The Flanders toy could also be turned into an instrument of research. Mural from the attic of the house of a member of the Lincean Society in Rome showing the vogue for telescopic observation that Galileo's demonstrations set in train.

93

'It is a most beautiful and delightful sight to behold the body of the moon.' Galileo's own wash drawings of the phases of the moon as seen through one of his telescopes of 1610.

that age. He stepped up the magnification of the telescope to thirty, and he turned it on the stars. In that way he really did for the first time what we think of as practical science: build the apparatus, do the experiment, publish the results. And that he did between September of 1609 and March of 1610, when he published in Venice the splendid book *Sidereus Nuncius*, *The Starry Messenger*, which gave an illustrated account of his new astronomical observations. What did it say?

[I have seen] stars in myriads, which have never been seen before, and which surpass the old, previously known, stars in number more than ten times.

But that which will excite the greatest astonishment by far, and which indeed especially moved me to call the attention of all astronomers and philosophers, is this, namely, that I have discovered four planets, neither known nor observed by any one of the astronomers before my time.

These were the satellites of Jupiter. *The Starry Messenger* also tells how he turned the telescope on the moon herself. Galileo was the first man to publish maps of the moon. We have his original water-colours.

It is a most beautiful and delightful sight to behold the body of the moon . . . [It] certainly does not possess a smooth and polished surface, but one rough and uneven, and, just like the face of the earth itself, is everywhere full of vast protuberances, deep chasms, and sinuosities.

The British ambassador to the Doge's court in Venice, Sir Henry Wotton, reported to his superiors in England on the day that *The Starry Messenger* came out:

The mathematical professor at Padua hath . . . discovered four new planets rolling about the sphere of Jupiter, besides many other unknown fixed stars; likewise . . . that the moon is not spherical, but endued with many prominences . . . The author runneth a fortune to be either exceeding famous or exceeding ridiculous. By the next ship your lordship shall receive from me one of the [optical] instruments, as it is bettered by this man.

The news was sensational. It made a reputation larger even than the triumph among the trading community. And yet it was not altogether welcome, because what Galileo saw in the sky, and revealed to everyone who was willing to look, was that the Ptolemaic heaven simply would not work. Copernicus's powerful guess had been right, and now stood open and revealed. And like many more recent scientific results, that did not at all please the prejudice of the establishment of his day.



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per hora
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ora 600

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Johann
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Gal.
occlion
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OBSERVAT. SIDEREAE



Stella occidentalis maior, ambae tamen valde conficuntur, ac splendide vira qua debitas à four occupant, et primum dicitur terra quoque Stella apparet copulata vera prae miseri compedita, qua ex parte orientali lumen fieri tangens, etaque admodum e-signa. Quam fieri in eadem recta, et secundum Eclipticam longitudo ordinantur.

Die dominica prima à me quatuor conficte fuerunt Stella in hoc ad lucem confinitur. Erant autem occidentales, et una orientalis, hanc proximè



redam confinitur, nulla enim occidentem positionem à recta Septentrionem velle debet. Abest orientalis à luce minus duo respiciunt, et sua interceptio estur singula vasa sanum m-nati. Stelle amplexus per se habent magnitudinem, et hoc signum, luciditas tamen oritur, ac hinc eadem magnitudo longitudo ordinantur.

Die dominica prima à me quatuor conficte fuerunt Stella in hoc ad lucem confinitur. Erant autem occidentales, et una orientalis, hanc proximè



occlusiones omnes: ac in eadem proxim. certa linea disposita, qua etiam recta à luce numerantur. pag. 100

Galileo thought that all he had to do was to show that Copernicus was right, and everybody would listen. That was his first mistake: the mistake of being naïve about people's motives which scientists make all the time. He also thought that his reputation was now large enough for him to be able to go back to his native Florence, leave the rather dreary teaching at Padua which had become burdensome to him, and leave the protection of this essentially anti-clerical, safe Republic of Venice. That was his second and, in the end, fatal mistake.

The successes of the Protestant Reformation in the sixteenth century had caused the Roman Catholic Church to mount a fierce Counter-Reformation. The reaction against Luther was in full cry; the struggle in Europe was for authority. In 1618 the Thirty Years War began. In 1622 Rome created the institution for the propagation of the faith from which we still derive the word *propaganda*. Catholics and Protestants were embattled in what we should now call a cold war, in which, if Galileo had only known it, no quarter was given to a great man or small. The judgment was very simple on both sides: whoever is not for us is — a heretic. Even so unworldly an interpreter of faith as Cardinal Bellarmine had found the astronomical speculations of Giordano Bruno intolerable, and had sent him to the stake. The Church was a great temporal power, and in that bitter time it was fighting a political crusade in which all means were justified by the end — the ethics of the police state.

Galileo seems to me to have been strangely innocent about the world of politics, and most innocent in thinking that he could outwit it because he was clever. For twenty years and more he moved along a path that led inevitably to his condemnation. It took a long time to undermine him; but there was never any doubt that Galileo would be silenced, because the division between him and those in authority was absolute. They believed that faith should dominate; and Galileo believed that truth should persuade.

That clash of principles and, of course, of personalities came into the open at his trial in 1633. But every political trial has a long hidden history of what went on behind the scenes. And the

94
 'The mathematical professor at Padua hath discovered four new planets rolling about the sphere of Jupiter.'
 Page from 'The Starry Messenger' showing the orbital positions of the moons of Jupiter.

Title-pages of some of the works of science that Galileo published between 1606 and 1630 in Venice, Padua, Florence and Rome. 'Il Saggiatore' was dedicated to the new Pope, Urban VIII.

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95
There is one modest safe in which the Vatican keeps what it regards as the crucial documents. The author in the Vatican Secret Archives examining the documents of the Galileo trial.

96
In 1623, an intellectual Cardinal was elected Pope: Maffeo Barberini. Bust of the new Pope by the sculptor and architect he most esteemed, Gianlorenzo Bernini, who started work on the embellishment of St Peter's in 1626.

underground history of what came before the trial lies in the locked Secret Archives of the Vatican. Among all these corridors of documents, there is one modest safe in which the Vatican keeps what it regards as the crucial documents. Here, for example, is the application of Henry VIII for divorce – the refusal of which brought the Reformation to England, and ended the tie to Rome. The trial of Giordano Bruno has not left many documents, for the bulk were destroyed; but what exists is here.

And there is the famous Codex 1181, *Proceedings Against Galileo Galilei*. The trial was in 1633. And the first remarkable thing is that the documents begin – when? In 1611, at the moment of Galileo's triumph in Venice, in Florence, and here in Rome, secret information was being laid against Galileo before the Holy Office of the Inquisition. The evidence of the earliest document, not in this file, is that Cardinal Bellarmine instigated inquiries against him. Reports are filed in 1613, 1614, and 1615. By then Galileo himself becomes alarmed. Unbidden, he goes to Rome in order to persuade his friends among the Cardinals not to prohibit the Copernican world system.

But it is too late. In February of 1616, here are the formal words as they stand in draft in the Codex, freely translated:

Propositions to be forbidden:
that the sun is immovable at the centre of the heaven;
that the earth is not at the centre of the heaven, and is not immovable, but moves by a double motion.

Galileo seems to have escaped any severe censure himself. At any rate, he is called before the great Cardinal Bellarmine and he is convinced, and has a letter from Bellarmine to say, that he must not hold or defend the Copernican World System – but there the document stops. Unhappily, there is a document here in the record which goes further, and on which the trial is going to turn. But that is all seventeen years in the future.

Meanwhile Galileo goes back to Florence, and he knows two things. One is that the time to defend Copernicus in public is not yet. And the second, that he thinks that there will be such a time. About the first he is right; about the second, no. However, Galileo bided his time, until – when? Until an intellectual Cardinal should be elected Pope: Maffeo Barberini.

That happened in 1623, when Maffeo Barberini became Pope Urban VIII. The new Pope was a lover of the arts. He loved music; he commissioned the composer Gregorio Allegri to write a *Miserere* for nine voices, which long afterwards was reserved for the Vatican. The new Pope loved architecture. He wanted to make St Peter's the centre of Rome. He put the sculptor and architect, Gianlorenzo Bernini, in charge of completing the interior of St Peter's, and Bernini boldly designed the tall Baldacchino (the canopy over the Papal throne), which is the only worthy addition to Michelangelo's original design. In his younger days the intellectual Pope had also written poems, one of which was a sonnet of compliments to Galileo on his astronomical writing.

Pope Urban VIII thought of himself as an innovator. He had a confident, impatient turn of mind:

I know better than all the cardinals put together! The sentence of a living Pope is worth more than all the decrees of a hundred dead ones,

he said imperiously. But in fact, Barberini as Pope turned out to be pure baroque: a lavish nepotist, extravagant, domineering, restless in his schemes, and absolutely tone-deaf to the ideas of others. He even had the birds killed in the Vatican gardens because they disturbed him.

Galileo optimistically came to Rome in 1624, and had six long talks in the gardens with the newly elected Pope. He hoped that the intellectual Pope would withdraw, or at least by-pass, the prohibition of 1616 of the world picture of Copernicus. It turned out that Urban VIII would not consider that. But Galileo still hoped – and the officials of the Papal court expected – that Urban VIII would let the new scientific ideas flow quietly into the Church until, imperceptibly, they replaced the old. After all, that was how the heathen ideas of Ptolemy and Aristotle had become Christian doctrine in the first place. So Galileo went on believing that the Pope was on his side, within the limits set by his office, until it came to the testing time. And then he turned out to be most profoundly mistaken.

208 Their views had really been intellectually irreconcilable from the beginning. Galileo had always held that the ultimate test of

a theory must be found in nature.

I think that in discussions of physical problems we ought to begin not from the authority of scriptural passages, but from sense-experiences and necessary demonstrations . . . Nor is God any less excellently revealed in Nature's actions than in the sacred statements of the Bible.

Urban VIII objected that there can be no ultimate test of God's design, and insisted that Galileo must say that in his book.

It would be an extravagant boldness for anyone to go about to limit and confine the Divine power and wisdom to some one particular conjecture of his own.

This proviso was particularly dear to the Pope. In effect, it blocked Galileo from stating any definite conclusion (even the negative conclusion that Ptolemy was wrong), because it would infringe the right of God to run the universe by miracle, rather than by natural law.

The testing time came in 1632 when Galileo finally got his book, the *Dialogue on the Great World Systems*, into print. Urban VIII was outraged.

Your Galileo has ventured to meddle with things that he ought not to and with the most important and dangerous subjects which can be stirred up in these days,

he wrote to the Tuscan ambassador on 4 September of that year. In the same month came the fateful order:

His Holiness charges the Inquisitor at Florence to inform Galileo, in the name of the Holy Office, that he is to appear as soon as possible in the course of the month of October at Rome before the Commissary-General of the Holy Office.

The Pope, Maffeo Barberini the friend, Urban VIII, has personally delivered him into the hands of the Holy Office of the Inquisition, whose process is irreversible.

The Dominican cloister of Santa Maria Sopra Minerva was where the Holy Roman and Universal Inquisition proceeded against those whose allegiance was in question. It had been created by Pope Paul III in 1542 to stem the spread of Reformation doctrines, being specially constituted 'against heretical depravity throughout the whole Christian Commonwealth'. After 1571 it had also been given the power to judge written doctrine, and had

instituted the Index of Prohibited Books. The rules of procedure were strict and exact. They had been formalised in 1588 and they were, of course, not the rules of a court. The prisoner did not have a copy either of the charges or of the evidence; he had no counsel to defend him.

There were ten judges at the trial of Galileo: all Cardinals and all Dominicans. One of them was the Pope's brother and another was the Pope's nephew. The trial was conducted by the Commissar-General of the Inquisition. The hall in which Galileo was tried is now part of the Post Office of Rome, but we know what it looked like in 1633: a ghostly committee room in a club for gentlemen.

We also know exactly the steps by which Galileo came to this pass. It had begun on those walks in the garden with the new Pope in 1624. It was clear that the Pope would not allow the Copernican doctrine to be avowed openly. But there was another way, and the next year Galileo began to write, in Italian, the *Dialogue on the Great World Systems*, in which one speaker put objections to the theory, and the two other speakers, who were rather cleverer, answered them.

Because, of course, the theory of Copernicus is not self-evident. It is not clear how the earth can fly round the sun once a year, or spin on its own axis once a day, and we not fly off. It is not clear how a weight can be dropped from a high tower and fall vertically to a spinning earth. These objections Galileo answered, as it were, on behalf of Copernicus, long dead. We must never forget that Galileo defied the holy establishment in 1616 and in 1633 in defence of a theory not his own, but a dead man's, because he believed it true.

But on his own behalf Galileo put into the book that sense that all his science gives us from the time that, as a young man in Pisa, he had first put his hand on his pulse and watched a pendulum. It is the sense that the laws here on earth reach out into the universe and burst right through the crystal spheres. The forces in the sky are of the same kind as those on earth, that is what Galileo asserts; so that mechanical experiments that we perform here can give us information about the stars. By turning his telescope on the moon, on Jupiter, and on the sunspots, he put an end to

97

Barberini as Pope turned out to be pure baroque: a lavish nepotist, extravagant, domineering, restless in his schemes.

One of the ceilings of the Palazzo Barberini, painted 1629-33

by Andrea Sacchi. The allegorical themes illustrate a passage from the *Wisdom of Solomon*: 'If your delight be then in thrones and sceptres, honour wisdom, that ye may reign forever.'

The tranquil handmaids of *Wisdom* are marked with the constellations. On *Wisdom's* breastplate can be discerned the uncertain figure of the sun.



the classical belief that the heavens are perfect and unchanging, and only the earth is subject to the laws of change.

The book was finished by 1630, and Galileo did not find it easy to get it licensed. The censors were sympathetic, but it soon became clear that there were powerful forces against the book. However, in the end Galileo collected no fewer than four imprimaturs, and early in 1632 the book was published in Florence. It was an instant success, and for Galileo an instant disaster. Almost at once from Rome the thunder came: Stop the presses. Buy back all the copies – which by then had been sold out. Galileo must come to Rome to answer for it. And nothing that he said could countermand that: his age (he was now nearly seventy), his illness (which was genuine), the patronage of the Grand Duke of Tuscany, nothing counted. He must come to Rome.

It was clear that the Pope himself had taken great umbrage at the book. He had found at least one passage which he had insisted on, put in the book in the mouth of the man who really makes rather the impression of a simpleton. The Preparatory Commission for the trial says so in black and white: that the proviso I have quoted which was so dear to the Pope has been put 'in bocca di un sciocco' – the defender of tradition whom Galileo had named

98

There were ten judges. One of them was the Pope's brother and another the Pope's nephew. Goucho of Urban VIII giving the blessing. His brother Antonio is holding the candle for him. The third cardinal is his nephew Francesco, who abstained from voting at Galileo's trial.

'Simplicius'. It may be that the Pope felt Simplicius to be a caricature of himself; certainly he felt insulted. He believed that Galileo had hoodwinked him, and that his own censors had let him down.

So, on 12 April 1633, Galileo was brought into this room, sat at this table, and answered the questions from the Inquisitor. The questions were addressed to him courteously in the intellectual atmosphere which reigned in the Inquisition – in Latin, in the third person. How was he brought to Rome? Is this his book? How did he come to write it? What is in his book? All these questions Galileo expected; he expected to defend the book. But then came a question which he did not expect.

Inquisitor: Was he in Rome, particularly in the year 1616, and for what purpose?

Galileo: I was in Rome in the year 1616 because, hearing doubts expressed on the opinions of Nicolaus Copernicus, I came to find out what views it was suitable to hold.

Inquisitor: Let him say what was decided and made known to him then.

Galileo: In the month of February 1616 Cardinal Bellarmine said to me that to hold the opinion of Copernicus as a proven fact was contrary to the Sacred Scriptures. Therefore it could be neither held nor defended; but it could be taken and used as an hypothesis. In confirmation of this I have a certificate from Cardinal Bellarmine, given on 26 May 1616.

Inquisitor: Whether at that time any other precept was given him by someone else?

Galileo: I do not remember anything else that was said or enjoined upon me.

Inquisitor: If it is stated to him that, in the presence of witnesses, there is the instruction that he must not hold or defend the said opinion, or teach it in any way whatsoever, let him now say whether he remembers.

Galileo: I remember that the instruction was that I was neither to hold nor to defend the said opinion. The other two particulars, that is, neither to teach, nor consider in any way whatsoever, they are not stated in the certificate on which I rely.

Inquisitor: After the aforesaid precept, did he obtain permission to write the book?

Galileo: I did not seek permission to write this book because I consider that I did not disobey the instruction I had been given.

Inquisitor: When he asked permission to print the book, did he disclose the command of the Sacred Congregation of which we spoke?

Galileo: I said nothing when I sought permission to publish, not having in the book either held or defended the opinion.

Galileo has a signed document which says that he was forbidden only to hold or defend the theory of Copernicus, which means as if it were a proven matter of fact. That was a prohibition

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laid on every Catholic at the time. The Inquisition claims that there is a document which prohibits Galileo, and Galileo alone, to teach it in any way whatsoever – that is, even by way of discussion or speculation or as a hypothesis. The Inquisition does not have to produce this document. That is not part of the rules of procedure. But we have the document; it is in the Secret Archives, and it is manifestly a forgery – or, at the most charitable, a draft for some suggested meeting which was rejected. It is not signed by Cardinal Bellarmine. It is not signed by the witnesses. It is not signed by the notary. It is not signed by Galileo to show that he received it.

Did the Inquisition really have to stoop to the use of legal quibbles between 'hold or defend', or 'teach in any way whatsoever', in the face of documents which could not have stood up in any court of law? Yes, it did. There was nothing else to do. The book had been published; it had been passed by several censors. The Pope could rage at the censors now – he ruined his own Secretary because he had been helpful to Galileo. But some remarkable public display had to be made to show that the book was to be condemned (it was on the Index for two hundred years) because of some deceit practised by Galileo. This was why the trial avoided any matters of substance, either in the book or in Copernicus, and was bent on juggling with formulae and documents. Galileo was to appear deliberately to have tricked the censors, and to have acted not only defiantly but dishonestly.

The court did not meet again; the trial ended here, to our surprise. That is to say, Galileo was twice more brought into this room and allowed to testify on his own behalf; but no questions were asked of him. The verdict was reached at a meeting of the Congregation of the Holy Office over which the Pope presided, which laid down absolutely what was to be done. The dissident scientist was to be humiliated; authority was to be shown large not only in action but in intention. Galileo was to retract; and he was to be shown the instruments of torture as if they were to be used.

214 What that threat meant to a man who had started life as a doctor we can judge from the testimony of a contemporary who

99

Galileo optimistically had six long talks in the garden with the newly elected Pope.

Mural showing a Cardinal strolling beside the Triton Fountain built by Bernini, and quoting from a holy text to a penitent academic. The mural, in a private house in Rome, may date from the period 1620-30 when the outcome of Galileo's advocacy of the Copernican theory was not yet decided.

The Ascent of Man

had actually suffered the rack and survived it. That was William Lithgow, an Englishman who had been racked in 1620 by the Spanish Inquisition.

I was brought to the rack, then mounted on the top of it. My legs were drawn through the two sides of the three-planked rack. A chord was tied about my ankles. As the levers bent forward, the main force of my knees against the two planks burst asunder the sinews of my hams, and the lids of my knees were crushed. My eyes began to startle, my mouth to foam and froth, and my teeth to chatter like the doubling of a drummer's sticks. My lips were shivering, my groans were vehement, and blood sprang from my arms, broken sinews, hands and knees. Being loosed from these pinnacles of pain, I was hand-fast set on the floor, with this incessant imploration: 'Confess! Confess!'

Galileo was not tortured. He was only threatened with torture, twice. His imagination could do the rest. That was the object of the trial, to show men of imagination that they were not immune from the process of primitive, animal fear that was irreversible. But he had already agreed to recant.

I, Galileo Galilei, son of the late Vincenzo Galilei, Florentine, aged seventy years, arraigned personally before this tribunal, and kneeling before you, most Eminent and Reverend Lord Cardinals, Inquisitors general against heretical depravity throughout the whole Christian Republic, having before my eyes and touching with my hands, the holy Gospels – swear that I have always believed, do now believe, and by God's help will for the future believe, all that is held, preached, and taught by the Holy Catholic and Apostolic Roman Church. But whereas – after an injunction had been judicially intimated to me by this Holy Office, to the effect that I must altogether abandon the false opinion that the sun is the centre of the world and immovable, and that the earth is not the centre of the world, and moves, and that I must not hold, defend, or teach in any way whatsoever, verbally or in writing, the said doctrine, and after it had been notified to me that the said doctrine was contrary to Holy Scripture – I wrote and printed a book in which I discuss this doctrine already condemned, and adduce arguments of great cogency in its favour, without presenting any solution of these; and for this cause I have been pronounced by the Holy Office to be vehemently suspected of heresy, that is to say, of having held and believed that the sun is the centre of the world and immovable, and that the earth is not the centre and moves:

Therefore, desiring to remove from the minds of your Eminences, and of all faithful Christians, this strong suspicion, reasonably conceived against me, with sincere heart and unfeigned faith I abjure, curse, and detest the aforesaid errors and heresies, and generally every other error and sect whatsoever contrary to the said Holy Church; and I swear that in future I will never again say or assert, verbally or in writing, anything that might furnish occasion for a similar suspicion regarding me; but that should I know any heretic, or person suspected of heresy, I will denounce him to this Holy Office,

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The trial avoided any matters of substance, either in the book or in Copernicus, and was bent on juggling with formulae and documents. The document on which the Inquisition's case against Galileo was based. It purports to record a prohibition laid on Galileo in the presence of Cardinal Bellarmine and witnesses on 26 February 1616, but is not signed by them. Galileo produced a less restrictive letter written and signed by Bellarmine on 26 May 1616.

or to the Inquisitor and ordinary of the place where I may be. Further, I swear and promise to fulfil and observe in their integrity all penances that have been, or that shall be, imposed upon me by this Holy Office. And, in the event of my contravening, (which God forbid!) any of these my promises, protestations, and oaths, I submit myself to all the pains and penalties imposed and promulgated in the sacred canons and other constitutions, general and particular, against such delinquents. So help me God, and these His holy Gospels, which I touch with my hands.

I, the said Galileo Galilei, have abjured, sworn, promised, and bound myself as above; and in witness of the truth thereof I have with my own hand subscribed the present document of my abjuration, and recited it word for word at Rome, in the Convent of Minerva, this twenty-second day of June, 1633.

I, Galileo Galilei, have abjured as above with my own hand.

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Handwritten Latin text, likely a transcription of the abjuration document. The text is written in a cursive hand and is somewhat faded. It begins with "In nomine domini Amen" and continues with a formal declaration of faith and abjuration.

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Galileo was confined for the rest of his life in his villa in Arcetri at some distance from Florence, under strict house arrest. The Pope was implacable. Nothing was to be published. The forbidden doctrine was not to be discussed. Galileo was not even to talk to Protestants. The result was silence among Catholic scientists everywhere from then on. Galileo's greatest contemporary, René Descartes, stopped publishing in France and finally went to Sweden.

Galileo made up his mind to do one thing. He was going to write the book that the trial had interrupted: the book on the *New Sciences*, by which he meant physics, not in the stars, but concerning matter here on earth. He finished it in 1636, that is, three years after the trial, an old man of seventy-two. Of course he could not get it published, until finally some Protestants in Leyden in the Netherlands printed it two years later. By that time Galileo was totally blind. He writes of himself:

Alas . . . Galileo, your devoted friend and servant, has been for a month totally and incurably blind; so that this heaven, this earth, this universe, which by my remarkable observations and clear demonstrations I have enlarged a hundred, nay, a thousand fold beyond the limits universally accepted by the learned men of all previous ages, are now shrivelled up for me into such a narrow compass as is filled by my own bodily sensations.

Among those who came to see Galileo at Arcetri was the young poet John Milton from England preparing for his life's work, an epic poem that he planned. It is ironic that by the time Milton came to write the great poem, thirty years later, he was totally blind, and he also was dependent on his children to help him finish it.

Milton at the end of his life identified himself with Samson Agonistes, Samson among the Philistines,

Eyeless in Gaza at the Mill with slaves,

who destroyed the Philistine empire at the moment of his death. And that is what Galileo did, against his own will. The effect of the trial and of the imprisonment was to put a total stop to the scientific tradition in the Mediterranean. From now on the Scientific Revolution moved to Northern Europe. Galileo died, still a prisoner in his house, in 1642. On Christmas Day of the same year, in England, Isaac Newton was born.