

Through the Eye of the Needle

A play in one act

by Robert P. Bauman

Note there are two casts. In the Prologue and Epilogue, three journalists, Dominic, Eduardo, and Frederico (“the public”) meet twice, in an afternoon and evening of 1633, with Cardano. They are a cross-section, not at all unanimous in supporting Galileo.

In the body of the play, (philosophers) Antonio, Battista, and Cardano (and Rudolfo, non-speaking) meet for news of their friend and colleague, Galileo. They meet intermittently, from 1610 to 1633. (Antonio may be substantially younger than Battista or Cardano.)

PROLOGUE

1633. Setting: Afternoon, at a Roman sidewalk café. Frederico, Dominic, and Cardano are seated at a table. Eduardo approaches. Greetings and handshakes and kisses all around.

EDUARDO: Have you heard the latest news from the Holy Office?

FREDERICO: No. Is there news about the trial?

EDUARDO: Yes! I have just come from there.

CARDANO: Sit down and tell us. I believe you all know each other.

[He introduces everyone, anyway: Frederico, Dominic, and Eduardo.]

EDUARDO: Galileo has pleaded guilty! His fate is now in the hands of Pope Urban, who recently has not been in a very good mood.

DOMINIC: I’m not surprised Galileo has run into difficulties. It seems to me there has been a major misunderstanding of the importance of Galileo’s work, and especially his astronomy. He made a number of observations, but they were not of great significance. For example, he detected the moons of Jupiter, he noticed the seasonal variation of motions of sun spots, and he saw what are described as craters and valleys on the Moon, but what do those observations really mean? People have confused his observations with the interpretations given to them.

CARDANO: I’m not sure what you are trying to say.

DOMINIC: Galileo, and his friends, have interpreted these things to mean there are motions in the solar system that are not centered about the Earth, and the surface of the Moon has been taken to cast doubt on the perfection of heavenly bodies, but are those really the correct interpretations? And especially, the sun spot motions — do they really mean the Sun is rotating about an axis that is not even perpendicular to the ecliptic plane? That really seems to me to be a stretch.

FREDERICO: Have you come up with an alternative interpretation of these things? You don’t make claims to being an astronomer, do you?

DOMINIC: No, certainly not. But on the other hand, I guess not being a scientist, or natural philosopher, allows me a broader overview of science and astronomy and where it fits into our civilization.

EDUARDO: I wonder about that. Analysis of these things does seem to involve a lot of mathematics.

DOMINIC: That’s right! The root of this failure lies in the development of science. Kepler and Galileo, for example, put emphasis on mathematics. Science provides not truth but only useful

mathematical fictions.

Science should be challenged on some of its most fundamental preconceptions.

FREDERICO: What preconceptions did you have in mind?

DOMINIC: As science has become more popular, we see an increasing failure of government to put primary emphasis on improving the welfare of the individual. I've noticed that with development of science, people just aren't as good as they used to be.

CARDANO: I daresay they never have been!

DOMINIC: [Ignoring Cardano's comment and expanding on his previous point.] Science often seeks new knowledge, rather than human happiness.

FREDERICO: But isn't it fair to say that the purpose of science is to seek new truth?

DOMINIC: Truth is not to be found in science. Truth is the purview of philosophy and religion. In particular, mathematics could not instruct us because it contains no mention of the good.

Aristotelian science is better, because it is directed toward the good.

Galileo should have followed in the footsteps of Vincenzo, his father. You are probably aware that Vincenzo was one of those who was involved in the development of opera.

But, I suppose Galileo's birth sign determined his personality and development.

FREDERICO: Galileo was the first to explain motion adequately. Aristotle had attempted to do this, but many of Galileo's findings refute Aristotle.

DOMINIC: That is part of the problem. Aristotle had not previously been contradicted. What makes Galileo believe he is better?

EDUARDO: I surely agree that Aristotle was fundamentally correct. What good are all of Galileo's measurements and observations on Earth. Surely we cannot project Earth physics onto the heavens.

Aristotle was careful to distinguish between

a. natural motion, toward the center of the universe (which many people now are calling "gravity"), and

b. forced motion, caused by contact forces, which is sustained by interaction with air. As you probably are aware, an arrow placed in motion in air is sustained by air rushing in behind the arrow, which pushes it forward and keeps it going. Otherwise it would quickly lose its impetus and fall to the ground.

Aristotle showed the cause of motion must be an "immovable object" or an "unmoved mover".

DOMINIC: Equally important, Galileo's astronomy defies the teachings of the Church.

CARDANO: But we must remember that Aristotle had no significant contact with the Scriptures. It was only through Thomas Aquinas that the works of Aristotle became recognized as consistent with the Holy Bible and were consequently incorporated into Church dogma.

FREDERICO: Frankly, I believe Galileo's descriptions are right, but I think it serves him right! Galileo was our primary hope of liberation of thought, and what did he do? He caved in, as soon as the going got rough. Abandoned the whole gang of us – the scientists, the philosophers – everybody but the clergy – may they burn in hell!

[The others look highly alarmed and move to shush Frederico lest his slander be heard.]

EDUARDO: I wouldn't blame this on Galileo! He may not have been right on all his points but he was the victim, not the cause. If the Jesuit astronomers had just stood behind him and worked with him, instead of trying to persecute him, he could have come through with no harm done.

DOMINIC: Oh, no! It was Galileo who turned his back on the Church. He had been such a strong

supporter for all his life and had received full support from the Church. Pope Urban tried hard to help him. Even Cardinal Bellarmino seemed to be his friend. But I heard during the trial, a letter from Bellarmino was the clincher that did him in; a message from the grave. Galileo held out as long as he thought he dared, but he tried to push the Church too far.

He was guilty of having seen that the Earth moves around the Sun. His claims were made without adequate proof.

EDUARDO: On the contrary, it seems that he presented *too much* proof of the motion of the Earth.

DOMINIC: In any case, I suppose, when it came to his beliefs or his life, it is hard to fault any man for holding onto life. He really couldn't have accomplished anything more by holding out any longer.

[Cardano leaves the group and comes downstage, to talk directly with the audience.]

CARDANO: We certainly seem to have some differences of opinion here. Dominic and Frederico blame Galileo, one because he held out too long and the other because he didn't hold out long enough. Eduardo doesn't blame Galileo. He blames the Church for persecuting him. It appears to me there may be some underlying facts we are not all aware of. Perhaps it would help to look back at how this conflict developed.

Let me tell you what *I* know, personally, of the events of the last two decades.

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SCENE 1

1610. Seignior Cardano's living room, in Rome.

Antonio enters stage right and is greeted by Cardano.

CARDANO: Bon giorno, Seignior Antonio. I trust all is well with you and your family.

ANTONIO: Si, Seignior Cardano. It is good that the heat of the summer is left behind. I have missed our occasional dinners. Is Seignior Battista expected this evening?

CARDANO: Si, he should be here any moment. When I last talked to him, he had been up in Florence. He had run into our old friend Galileo, and implied he would be bringing news of his latest work.

[Knocking at door. A servant answers the door and Battista enters. He is carrying a long, thin bag, which he deposits in the corner.]

BATTISTA: Bon giorno, Seignior Cardano. Bon giorno, Seignior Antonio. May God shed his grace on you.

CARDANO: Graci, Seignior. Please be seated. Rudolfo is at your service.

[Rudolfo bows and takes orders for drinks, then vanishes.]

ANTONIO: Seignior Battista, I hear you may have some word of Seignior Galileo. I believe you have seen him recently?

BATTISTA: Si, he sent his best wishes to you both. As you may know, he has left Padua and returned to Florence, under the auspices of Count Medici. His latest publication, "On Floating Bodies", has been a sensation. That book was a response to an ill-informed professor from Pisa who claimed that shape was important; he stated that ice was more dense than water but floated because it was a thin plate.

You recall that Archimedes, who was so frustrating to the Roman legions taking the city of Syracuse long ago, also dealt with density of objects and how they float. Galileo has taken up that subject of density and seems to have made very substantial progress. He impressed the Grand

Duchess Christina. At her request, he sent her a copy of his work.

ANTONIO: I recall Archimedes' work on density, although I have never seen the original. I heard it has been lost. But I don't recall how he was involved with the Roman legions.

BATTISTA (laughing generously): He almost drove the sailors batty. As you know, a long lever will give a great force at the shorter end of the beam. It was Archimedes who set up such a lever, with a hook. When the sailors came close to shore, the Greek defenders of Syracuse reached out with their long lever, hooked one end of the ship, and actually lifted it out of the water. *[Antonio and Cardano join in the laughter.]*

CARDANO: I'm sure that really upset the Roman navy, and not just psychologically!

ANTONIO: Was that all he did? I should think the sailors would soon enough learn to keep their distance from the shore.

BATTISTA: Oh, no. He also designed a catapult that threw large rocks out over the sea onto the ships. That tore up the rigging, even when it didn't succeed in actually sinking the ships.

ANTONIO: That must, indeed, have driven the sailors to despair. I can imagine they were looking for revenge by the time they finally took the city.

BATTISTA: The commander of the Roman forces was so impressed he ordered that Archimedes be delivered to him alive. By that time, Archimedes was an old man – he had reached his three score and 10, and a few more, but still active. Unfortunately, one of the legionnaires encountered Archimedes drawing pictures in the sand, trying to solve some sort of mathematics problem. Archimedes always considered that much more important than his war weapons. In fact he never published his ideas for long levers or for the catapults.

ANTONIO: What happened, then, when the legionnaire met up with Archimedes?

CARDANO: Of course, we were not there – that was one and a half millennia ago – but the story is that Archimedes tried to brush him off, telling the soldier he was too busy, in the middle of something.

ANTONIO: Wow! I'll bet that didn't sit too well with the Roman!

BATTISTA: No, it didn't. The soldier drew his sword and “ran him through”.

ANTONIO: That's too bad, but I guess that's what one has to expect in war. *[He shudders.]* But you say Galileo has taken up the studies of density? That sounds like a good problem for him. He and Archimedes are among the best mathematicians we have produced.

CARDANO: It is good to know it has been so well received.

BATTISTA: Perhaps that would be a bit optimistic. It has been very well received by some, but the reaction from others has been quite bitter. It does conflict with some of Aristotle's views.

ANTONIO: I dare say it is wiser to agree with Archimedes than with Aristotle on such an issue.

BATTISTA: His friend Cardinal Bellarmino may or may not agree with you on that. The Cardinal is committed to the ancient views of Thomas Aquinas, who raised up the work of the pagan Aristotle as if it were part of the Holy Scriptures.

ANTONIO: But I hear that Cardinal Bellarmino is, himself, somewhat on the hot seat so far as the French are concerned. They were quite unsympathetic with his recent treatise in which he declared that the Pope took precedence over all secular rulers.

CARDANO: I can understand their discomfort with that point of view. It would be nice if it were that easy for the Pope to assume control, at least while we had a good man on the Papal throne. Other times, perhaps I should be found in agreement with the French.

[Rudolfo returns with drinks.]

BATTISTA [*who has been looking at books on Cardano's shelves*] You have managed to accumulate a goodly collection of books, Seignior Cardano. What a marvelous addition to knowledge and understanding the printing press has proven to be.

CARDANO: Yes, indeed. When Guttenberg first introduced the invention of movable type, many felt it would be of little help. The experience of a century and a half has shown that it has greatly multiplied the works available to us. We now can acquire copies of the ancient Greeks -- not only Aristotle but Plato, Pythagoras, and many others, as well as new publications such as those of Copernicus and our own friend Galileo. With his recent books he has firmly established himself as the leading scientist of Italy and indeed of all Europe, and hence of the world. The Pope has acknowledged him as the official Catholic scientist.

BATTISTA: Speaking of Copernicus, you may be aware that Galileo has recently become convinced that the idea proposed by Copernicus is essentially correct. Thus Galileo no longer teaches the astronomy given to us by Aristotle.

ANTONIO: That could ruffle a few feathers in Rome.

BATTISTA: Undoubtedly it has already done that. Of course, we should keep in mind that the idea was certainly not new with Copernicus. When we look at the writings of the ancient Greeks, we find them split. Some argued for the conventional geocentered universe, with the Sun and planets circling the Earth. Some, such as Aristarchus, argued for a heliocentric universe, with the Earth and planets circling the Sun. Copernicus simply chose the second model because he thought it fit better with the observations, and because it appeared to be a simpler model.

One can understand why the Council of Trent, last century, did not look favorably on the flood of new books reaching the masses. I believe the exact wording was, "Books are the vehicles of heretical infestation in Catholic countries."

ANTONIO: Such language does not bode well for the new intellectual freedom we have experienced in recent years under Pope Paul. But the Tridentine conference was 50 years ago. Surely there has been no effort to stop the publication of books, provided they stay away from interpretation of the Holy Scriptures.

CARDANO: That certainly is an area to avoid. Cardinal Bellarmino has felt the need to specifically caution Galileo to avoid exegesis.

BATTISTA: Exegesis, or interpretation of Scripture, is a particular problem for Galileo. We know that Galileo never took the orders but he was trained in seminary up to the point of taking the vows at age 15. He feels he has a solid grounding in such matters and is often tempted to support his science with his readings of Scripture.

ANTONIO: What made him change his mind about holy orders?

BATTISTA: His father, Vincenzo Galilei, arrived at the seminary in the nick of time to prevent it. His excuse was that Galileo had an eye infection that was not properly being treated, so he pulled him out and brought him back to Florence and put him to work in the family wool trading business, but shortly afterward he sent Galileo off to the university in Pisa, near home, for training in medicine.

ANTONIO: I wasn't aware that Galileo became a physician.

BATTISTA: Oh, he didn't. After a short time, he found mathematics more interesting and changed to that field. By that time his father could no longer control his choices. You may recall, it was while he was at the University that he sat in the cathedral, watching a chandelier swing back and forth, back and forth, and realized that the time of each swing — the period of the pendulum — was constant,

independent of the amplitude of the motion. When the wind increased the range of the motion, the pendulum had farther to go, but it swung faster, and got there in the same time. He probably was comparing it with his pulse rate, although he could well have simply sung a tune to himself; he is, after all, quite an accomplished musician, like his father.

Recalling that he started toward a career in medicine, it is not too surprising that he communicated his findings to a physician friend, Santorio, who devised the pulsilogium, to turn the problem around and measure a pulse rate with a pendulum.

ANTONIO: Then did he graduate from Pisa in mathematics?

BATTISTA: He finished four years, then left. He didn't actually graduate. That probably didn't help when he applied for a teaching position, first at the University of Siena, then back at Pisa, at Padua, and Bologna, and at Florence. He did get hired, though, at Pisa, but only at 160 scudi per year. For a man with Galileo's tastes for the good life, and with the debts thrown upon him, that was scarcely enough.

CARDANO: As I recall, those debts were not really of his own making.

BATTISTA: That's right. Within two or three years his father died, and Galileo was left to pay off the large marriage endowment his father had bestowed on Galileo's sister, Virginia, when she was betrothed to Luca Landucci.

It didn't help, either, that Galileo had a younger sister, Livia, who was married a dozen years later, with a dowry of 1800 ducats. Galileo's brother, Michelangelo, was responsible for paying half of that, but he always begged off, saying he didn't have any money. And indeed, Michelangelo has proved to be a continuing expense, rather than an aid, to Galileo.

ANTONIO: But Galileo has had children of his own, has he not? How does he support a family and pay off debts on 160 scudi per year?

BATTISTA: The answer seems to be that he never has done much to support Marina Gamba (whom he apparently still regards as his housekeeper), although he does support the children; two girls. But he is very industrious. He offers many private lessons. I've heard of lessons on Euclid, which he studied on his own in Florence while enrolled at Pisa, as well as lessons in arithmetic, surveying, and optics. Also, he has invented devices such as his geometric and military compass, for which he has written manuals and provided instruction, always for a fee. The reproduction of the compass he farms out to master technicians. And, I should add, he did get a raise, to 320 ducats per year, but the dowry alone would take more than five years of such a salary, even if he had no other expenses. He approached the Duke of Mantua, hoping for patronage, but was turned down. Since then, of course, he has developed a relationship with the Medici family, which has been quite beneficial.

CARDANO: But enough of Galileo's financial problems. He is a clever fellow, who undoubtedly will scrape through, one way or another. What of his scientific studies?

BATTISTA: To summarize, you probably recall his early studies dealt with floating and buoyancy, including properties of the center of mass, which actually went beyond what Archimedes had accomplished. *[The listeners are impressed.]*

Then he began his studies of falling bodies, although he wisely limited his experiments to balls rolling down inclined planes. Two important ideas came out of that. First of all, Aristotle had expressed quite clearly that the heavier a body, the faster it will fall. Recently, several people have expressed doubt on that. Even Archimedes had argued that it is not the weight, but the density, that determines how fast a body will fall. Now Galileo believes he has shown that *all* bodies gain speed

at the same rate, except of course very light bodies such as leaves or a piece of parchment, which almost float in air. [*Great interest and surprise.*] If I drop a maple ball and an iron ball, from the same height at the same time, will there be a difference in when they hit the floor?

ANTONIO: From what you were just saying, it would seem not, although I find it hard to believe the iron, which weighs roughly ten times as much, would not arrive first.

[*Battista pulls two balls, one of wood and the other of iron (or steel), from a pocket of his cloak and drops them simultaneously. They strike at essentially the same instant.*]

CARDANO: I would not have predicted such a tie in that race, even though I have been hearing reports of equal falling times.

BATTISTA: Second, it seemed apparent that if a ball gains a certain amount of speed in one cubit, it will gain a similar amount of speed in a second cubit. [*The others are nodding in agreement.*]

But, on the contrary, Galileo found that it is the gain in speed *per second* that is important. [*Surprise.*]

That means, because there is a certain gain per second, which adds to the previous gains per second, the *distance* traveled increases as the *square* of the time. That is a totally new result.

I can show you the effect of this result. [*He retrieves his thin bag from the corner.*]

You see that there are little shelves along this stick at lengths of one, two-squared = four, three-squared = nine, and four-squared = 16. I put a small iron ball on each shelf and cover them with another piece of wood. Now, if I hold the whole assembly vertical [*demonstrated*] and then slide the cover away, it will take one unit of time for the lowest ball to strike the floor; two units of time for the second ball; three units of time for the next; and four units of time for the highest ball to reach the floor. So I remove the cover [*demonstrated*] and the balls strike at regular time intervals [*which the audience can hear*]. [*General applause, surprise, delight; comments: "that was impressive," etc.*]

ANTONIO: It would be hard to top that as a simple demonstration of the new theorem. Has Galileo been working on anything else?

BATTISTA: He has shown the path of projectiles is quite different than previously supposed. It is a figure known in geometry as a *parabola*. I have a drawing of one [*which had been wrapped around the long sticks in his bag, and is now produced*]. For many years, the trajectory of a shell has been depicted as quite asymmetric, coming down faster than it went up. Galileo has argued that a better description is the parabola, as drawn here.

And, what may seem more impressive, he has recently been studying lodestones. He prepared a lodestone that can pick up more than twice its own weight of iron. He has given that to Cosimo de' Medici. [*Amazement*]

And one other hot item. I can't tell you much about it yet, but I understand Galileo has received word from Holland of a new device that allows one to see distant objects as if they were close. It will be of interest to see what that device is, and what Galileo can make of it.

CARDANO: We must get together again in a few months and hear what comes of these new developments.

SCENE 2

1611. As in Scene 1. Seignior Cardano's living room.

Antonio enters stage right and is greeted by Cardano.

CARDANO: It has been a long time since we last met. As you know, I have been traveling abroad. I am expecting Senor Battista shortly.

ANTONIO: Very good. He offered promising news before, and from rumors I have heard, Galileo has more than fulfilled expectations.

Knock on the door, answered by Rudolfo, who admits Battista, who is greeted by Cardano and Antonio.

BATTISTA: Bon giorno, Seignior Cardano. Bon giorno, Seignior Antonio. May God shed his grace on you.

CARDANO: Graci, Seignior. Please be seated. Rudolfo is at your service.

[Rudolfo bows and takes orders for drinks, then vanishes.]

BATTISTA: Yes, I do, indeed, have news of our friend, Galileo.

ANTONIO: Have you actually seen one of the new optical devices? I believe they are now called *telescopes*.

BATTISTA: That's right. Yes, Galileo has been very open about showing his telescopes to friends — and, I might add, to some who are less than friendly. You would have enjoyed seeing the reaction of Seignior Montavi. He acted as if it would devour him if he touched it; he refused to look through it or come close to it.

Galileo has made several versions, and has given some away. A beautiful 8-power telescope was given to the Venetian Senate. That makes an object appear to be only one-eighth as far away! In turn, they doubled his salary at the University of Padua, and offered him life-time tenure, but the fine print was enough to make Galileo realize they were not doing him much of a favor! *[Laughter.]*

ANTONIO: I have heard reports that he has put such instruments to good use in examining heavenly bodies.

BATTISTA: Indeed he has, although he was not the first to point one upward. Thomas Harriot, in London, has reported examination of the surface of the Moon with a 6-power telescope. He tells us the surface is not smooth. Galileo has now confirmed that fact. The Moon is no smoother than the Earth!

CARDANO: That certainly conflicts with the “ancient wisdom” that told us the heavens are perfect and unchanging.

ANTONIO: The unchanging part was already knocked down by the new star that appeared in the skies in 1604. You will recall that Galileo offered three lectures at the University of Padua, after he had actually seen the star himself and had shown, by measurements of parallax, that the star is much farther away from Earth than the Moon.

CARDANO: Yes, that was a shocker at the time.

BATTISTA: But the biggest news, of which you have undoubtedly heard rumors, at least, is that when Galileo turned his telescope to the planet Jupiter, he observed small moons in the vicinity. As he continued to watch over days and weeks, he could see that the four moons circled the planet much as the Moon circles the Earth.

CARDANO: But that is precisely the kind of information needed to show that the Copernican system is a better description of the motions of heavenly bodies than is the model of Aristotle, as employed

by Ptolemy in his calculations. No one can argue any longer that every body must go around the Earth, because the Earth is the center of the universe.

ANTONIO: That is, indeed, striking news.

BATTISTA: And, if that were not enough, Galileo then showed there is some evidence of such small moons encircling Saturn. And, to clinch the argument, at least for many astronomers, when Venus is observed through the telescope, it is clear that it has phases like the phases of the Moon.

ANTONIO: I'm afraid that escapes me. What causes those phases, and why does that confirm the Copernican model?

BATTISTA: I could draw a diagram for you, but if we may turn down the room lights, with just a little imagination, you can imagine that the light from a lantern is many times brighter than a normal lantern.

CARDANO: Rudolfo: Please turn down the lights in the room. Now, Seignior Battista, we will exercise our imaginations. The light from the lantern we will consider to be very bright, and we may imagine the globe, over here, to be the Moon, or Venus. Show us the effect you had in mind.

BATTISTA: *[Downstage, with a lantern containing a bright flashlight, such as an LED, shining onto the globe from 10 ft away:]* Consider this light as coming from the Sun. Then if we observe the planet or moon from the direction of the Sun, we will see the entire body illuminated, as for a full Moon. If you move to the side, so the illuminated body is viewed from a direction at right angles to the sunshine, you will see only half of the body illuminated, as for a half Moon. *[Battista, moves stage left, so Cardano and Antonio can remain in place, downstage, and they, and the audience, will see the changing appearance of the Moon or planet.]*

ANTONIO: Why, yes, indeed. We see such every month. From where I stand, the right half is illuminated, as for a first-quarter Moon, but I realize if I were over on the other side, I would see the left half illuminated, as for a last-quarter Moon.

BATTISTA: Exactly. And if you are on the side opposite the Sun, the Moon will appear dark, as is a New Moon. *[Battista moves upstage, so the observers are looking past the globe toward the lantern.]*

CARDANO: Yes, that clarifies my thinking about the phases of the Moon. And it seems clear that phases of Venus are just what we would expect if Venus is going around the Sun, closer to the Sun than is the Earth.

ANTONIO: I can also see that Mars and Jupiter and Saturn, because they are farther from the Sun than the Earth, will always appear to us to be fully illuminated. Therefore they will not show phases.

So it is really the difference in appearance of Venus as compared to Mars and the other outer planets that provides such striking evidence of the Copernican model, in which all the planets circle about the Sun, rather than the Sun moving about the Earth as it appears to us.

[Rudolfo returns with drinks.]

ANTONIO: It would seem that Bellarmine and the Pope, and especially other astronomers, would surely be convinced by this new evidence. If moons are moving about Jupiter, then the motions of bodies in the heavens are not as trivially simple as we had thought, and if Venus shows phases like the Moon, that is indeed strong evidence.

BATTISTA: I certainly agree with that, as would Galileo. But you should know that Bellarmine is himself something of an amateur astronomer, at least in spirit. We can see, from his writings, that he suspects Galileo and Copernicus are right, but he doesn't want to go out on a limb until he believes

there is iron-clad proof of the new theory. It would not seem fitting for the head of the Inquisition to jump to conclusions that upset Church tradition — even those that are not embedded in Church doctrine.

CARDANO: Yes, you have a point, there. I recall when Bruno was burned at the stake, Bruno made it clear that he was not simply supporting Copernicus but was arguing about virtually every bit of Church teachings about the heavens and Earth. Bellarmino had little choice in selecting the appropriate punishment for him in his ravings.

BATTISTA: That is encouraging, because I would not wish to see Galileo similarly persecuted!

ANTONIO: But it appears there is no unanimity forming among astronomers. Are the Jesuits still fighting everything Galileo has been saying?

BATTISTA: Oh, there are definite signs of softening, but also some serious clouds in the sky. Kepler has written a letter in support of Galileo, although that is little comfort, coming from a Lutheran apostate. But Galileo has recently been appointed “Chief Mathematician of the University of Pisa and Philosopher and Mathematician to the Grand Duke” of Tuscany. That is an appointment for life. The observations of the moons of Jupiter have been confirmed by the Jesuit mathematicians of the Collegio Romano, including the senior professor, Father Christopher Clavius. I have heard on good authority that the mathematicians of the Collegio Romano are planning to honor Galileo at a banquet.

On the other hand, there are ominous warnings. Our English friend Thomas Harriot has observed spots on the Sun, which Father Christoff Scheiner and Galileo have confirmed — which of course, are further evidence of imperfection in the heavens — but Scheiner does not agree with Galileo on some aspects of the sunspots and has privately expressed *great* anger with Galileo over their differences.

ANTONIO: But has Galileo not pursued some of his other interests?

BATTISTA: Oh, that he has.

CARDANO: Didn't I hear, also, something about studies of “cold light”? Whatever that might be.

ANTONIO: How can that be? We know that heat and light are the same thing. How can there be light without heat?

BATTISTA: Galileo has been carrying around with him a rock. He calls it the *Bologna rock*. He got it from some alchemists in Bologna, and has been amazing crowds with it. He leaves it in the sun for awhile. Then when he takes it indoors, or even into deep shade, it actually glows. Yet it remains cool to the touch. It has been called “separating the light.”

ANTONIO: That does sound quite amazing. I would like to see that for myself. It just doesn't seem possible you could get light from something that isn't even warm! Has he found any explanation for cold light?

CARDANO: There seems to be no question but that Galileo is a true genius. He has developed a theory about matter and heat and light, which I'm sure I don't really understand. He says everything is made up of really small particles, which he calls *minims*, or *atomies*. Perhaps if he comes to Rome soon he will be able to explain what he has in mind. He says different shapes of the tiny particles determine their properties, but I can't explain much of anything beyond that. Galileo has suggested that heat and light are really different phenomena and the Bologna rock is strong evidence for corpuscular properties of light. Is it not true that more of his time is being devoted to corpuscular qualities than before?

ANTONIO: I fear I do not yet understand why Galileo has ventured into this speculation about atoms, or what model he advocates.

BATTISTA: The model is surely quite hazy, yet. One path that has led to such speculation is the consideration of densities of solids, but another path has been the frustration of attempting to understand what heat and light might be. If you will permit some ambiguity, I have undertaken to follow the arguments of Galileo and others on this topic, but must admit some gaps in understanding. Sometimes it is not clear whether the gaps are solely of my own creation, or inherent in the models as they are discussed.

[*Reading*] To begin with, if solids and, especially, liquids are going to be able to move internally, we must accept that there are empty interstices between the bits of matter. Those interstices are very likely occupied by atoms. The difficulty is that if the bits of matter are *not* in contact, then they will not be bound to each other, for we know that to exert a force, there must be contact. Yet, on the other hand, if we assume the particles *are* in contact, then how can we explain condensation, contraction, and shrinkage. As Galileo has stated, in *The Assayer*, “The phenomena of condensation and rarefaction are among the most recondite and difficult problems in nature.”

Surely heat can be explained as the movement of corpuscles of a substance agitated by homogeneous and all-pervasive fire atoms. From the Bologna rock, we are led to interpret light as corpuscles different in nature from heat. The philosophy of nature is written in the book of the universe, and the characters of the book are geometric figures. Yet we have not been able to determine which are the precise figures for the various kinds of particles. Nor can we be certain what forces hold together the atoms and other microscopic components of matter.

And though we know little enough about heat, we do recognize that the fiery minims are capable of penetrating the pores of the skin, generally with a pleasing effect. [*end reading*]

As I feared, I have not given a very clear presentation of Galileo’s theory. He does make it sound quite rational, but I have not been able to fill in the gaps.

CARDANO: You must be commended on your good efforts. Perhaps it is not yet given to us to understand these deeper questions of matter and light.

As for Galileo, we might say that at least his studies of solids, of mechanics, and of heat and light keep him occupied, decreasing the probability of stepping into a pothole in his quest for convincing arguments for Copernicanism.

BATTISTA: That’s exactly right. But that carries a hidden danger, I fear. The Jesuits, especially at the Collegio Romano, have a semi-suppressed agenda of squelching any talk of corpuscular properties, or as they are often called, atomistic properties, of matter or light. There could be more difficulties coming. Cardinal Bellarmino has just brought in a young man, Grassi, who is studying for Jesuit orders and seems to be a stickler for doctrine.

CARDANO: Yes, I have heard of Grassi. He appears to be quite skilled in architecture. Perhaps he will stick to that field.

BATTISTA: I have already heard a rumor that Seignior Grassi is upset about the fiery minims, even more than a moving Earth. He ties it to the rulings from the Tridentine conference. Recall they came down very hard on the question of the Eucharist. The conference insisted there was a real transubstantiation of bread and wine to flesh and blood. And I’m sure I need not remind you that the interpretation of the Eucharist is, according to the Council of Trent, at the highest level of Church doctrine.

ANTONIO: Would that conflict with Galileo's little particles?

CARDANO: Most certainly. The holy fathers find it much more difficult to accept transubstantiation of bread and wine into flesh and blood if there are residual particles involved that are carried over. Unless one changes the atoms, themselves, one could not then change bread and wine to flesh and blood.

The problem goes back to how you define a "repeatable miracle". We need no further reminder of the importance to the Church of the doctrine of transubstantiation. That is a topic on which no heresy is accepted.

BATTISTA: I'll go along with that, my friend. I still remember what happened to Bruno. He raised a number of issues, any one of which could have led to severe punishment by the Inquisition, but one of the major charges that Cardinal Bellarmino brought against Bruno was his advocacy of atomism. I won't say that Bruno made a pretty fire, but it surely was spectacular.

ANTONIO: That is not a pretty thought!

CARDANO: Let us trust, and pray, that Galileo does not get caught in those deep and treacherous waters.

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SCENE 3

1616. As in Scene 1. Seignior Cardano's living room.

[A knock at the door. Rudolfo answers. Antonio enters and is greeted by Cardano.]

CARDANO: Welcome, Seignior Antonio. We are expecting Seignior Battista shortly. As you know, he tends to be a few minutes late.

[Knock at the door, answered by Rudolfo. Battista enters and is greeted by Cardano and Antonio.]

CARDANO: Welcome, Seignior Battista. We were afraid you might have been delayed. I believe Antonio has some news concerning Galileo, to which you may be able to add something, as well.

ANTONIO: The news is mixed. In the first place, the serious flap about sunspots appears to have blown over, although not without scars. The Lincean Academy, sponsored and funded by Federico Cesi here in Rome, published Galileo's writings on sunspots, and along with them, the writings of Scheiner. Father Scheiner is still bitter about being upstaged by Galileo, and it is feared he may seek later revenge.

You will recall at an earlier meeting Battista had told us of a letter Galileo wrote to the Grand Duchess Christina, and a parallel letter to Castelli, who was carrying the good word for Galileo. The letter to the Duchess has now been circulated in manuscript form, reaching as far as the Netherlands, where it is planned it will be published in Latin.

Tommaso Caccini, a Dominican friar, preached a sermon in Florence in which he attacked Galileo and other mathematicians who subscribe to the Copernican view. Caccini declares such beliefs to be heresy. On the other hand, his own superior has apologized, in writing, to Galileo for Caccini's uncontrolled outburst. Caccini, in turn, has gone to the Inquisition, but apparently nothing has come of it.

Friar Foscarini, a Carmelite, has published a book presenting the Copernican heliocentric model and detailed justification of the viewpoint on the basis of the scriptures, although, as might be expected, Cardinal Bellarmino has chastised Foscarini for seeming to present Copernicanism as fact, rather than only as hypothesis.

BATTISTA: Going along with what Antonio has told us of the warning to Foscarini, Bellarmino has summoned Galileo to his residence to discuss Copernicanism. In particular, Cardinal Bellarmino has cautioned Galileo again against exegesis. Galileo always wants to defend his statements by showing that they are consistent with the Holy Scriptures. Bellarmino insists that Galileo has no authority to draw such conclusions. But that wasn't the primary issue this time.

CARDANO: If not that, then what?

BATTISTA: The question at issue is more subtle. Ptolemy's view of astronomy, as advocated by Aristotle – that is, a geocentric universe – has never been specified as Church doctrine, so it cannot be heresy to talk about it. Bellarmino has simply insisted that Galileo *never* talk about a heliocentric universe *as if* it has been accepted. That, you remember, was the point he made in the communication to Friar Foscarini.

CARDANO: That shouldn't be too hard to avoid. But surely Bellarmino is aware that a formal Church doctrine against a heliocentric universe could be quite dangerous. What would then happen if astronomers find proof that the universe *is* centered about the Sun, rather than the Earth?

BATTISTA: Oh, he is very much aware of that problem. In fact, he told Galileo: “*When* there shall be a real demonstration that the Sun stands in the center of the universe, and that the Earth revolves around it, it will then be necessary to proceed with great caution in exploring those passages of Scripture which appear contrary to this.” Notice he didn't even say “*If*”; he said “*When*”, as if he expects such proof to follow.

CARDANO: That does appear to be significant. We had suspected that Bellarmino was sympathetic to the Copernican view, but this seems more than we could have expected at this time.

ANTONIO: I also heard, through the grapevine, that the deeper concern was with the method of “discovery”, if you can call it that. Galileo advocates “reading from the book of nature”, which, of course, was written by God. But others argue against this approach. If one can apply “reason” to a problem in astronomy and come up with a correct answer, then who is to say that one cannot apply reason to other questions and come up with correct answers, even when those answers disagree with authority. The Church fathers insist that authority must be the ultimate test in any such matter. After all, that is the barred gate against Protestantism.

BATTISTA: Bellarmino has already asked the mathematicians of the Collegio Romano for their opinions on the matter. Father Clavius, the elder statesman of the faculty, convened a committee. They confirmed the very great number of stars recently reported by astronomers with their telescopes. They were uncertain about reports of satellites of Saturn. They agreed that the surface of the Moon is highly irregular, rather than “perfect”, although they tried to explain that away. But they strongly affirmed the existence of moons about Jupiter and the phases of Venus, which to the astronomers were the most convincing evidence of the Sun lying in the center. It would have been very difficult for Bellarmino to turn against his own astronomers and deny the clear possibility that Aristarchus and Copernicus were correct.

CARDANO: It seems quite clear that the questions raised by Copernicus are neither new, nor will they be decided by the writings or speeches of Galileo. These are timeless issues to be answered by the telescopes of astronomers, a process well underway already.

ANTONIO: But what has the Pope to say about this?

BATTISTA: Pope Paul has been very supportive, while encouraging Galileo to not push the issue. The Pope received Galileo with honor and promised his “unwavering support”. His statement, in

fact, was that Galileo was still considered the “official scientist” of the Church, and need have no concerns so long as Pope Paul lived.

CARDANO: It does appear the news is very good, taken all in all. But you had expressed some reservations, Antonio. If Bellarmino and Pope Paul are supportive, what can go wrong now?

ANTONIO: The news I have heard, which is strictly off the record, is that the Holy Office has begun proceedings against Galileo. Rumor has it that Father Lorini has brought charges against him.

CARDANO: [*Very disturbed.*] That is surely bad news. What complaint can the Inquisition have against Galileo? It seems to me he has been suitably discrete recently about his Copernican advocacy.

ANTONIO: It is not really that. The charges brought by Father Lorini are more dangerous, for they deal with the incipient advocacy of atomism in Galileo’s other writings.

BATTISTA: Apparently those charges have already been taken care of. With the Pope’s blessing, Cardinal Bellarmino turned the problem over to a fellow Cardinal who looked at all the evidence and declared there was no problem. So it appears the matter has ended there.

CARDANO: For that we may be thankful, but we must surely be alert. This is a field where life after death is a reality. Matters laid to rest are often later resurrected, to the peril of those involved.

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SCENE 4

1619. Cardano’s apartment.

[Battista arrives, followed almost immediately by Antonio. Usual greetings.]

CARDANO: You look as if you have some news to share, Seignior Battista.

BATTISTA: Yes, indeed! You have heard, of course, of the recent book on comets, published – if we may believe the title page – by Lotario Sarsi.

[The others nod in agreement.]

CARDANO: Yes, but of course, that “Sarsi” we know was really our old “friend” Grassi, or I should now say Father Grassi. He took his vows last year. As I have said before, he really should stick to his architecture.

BATTISTA: Well, Galileo really stuck it to him this time in an answering book called “The Assayer”. He goes along with the “Sarsi” *nom de plume*. He even addresses his reply to Sarsi.

CARDANO: That should make Father Grassi squirm.

BATTISTA: Yes, indeed. Let me read you a sample passage. Sarsi has tried to explain heat by talking about the cooking of eggs. Galileo’s reply is (and I quote):

If Sarsi wants me to believe ... that the Babylonians cooked eggs by whirling them rapidly in slings, I shall do so; but I must say that the cause of this effect is very far from that which he attributes to it. To discover the truth I shall reason thus: ‘If we do not achieve an effect which others formerly achieved, it must be that in our operations we lack something which was the cause of this effect succeeding, and if we lack but one single thing, then this alone can be the cause. Now we do not lack eggs, or slings, or sturdy fellows to whirl them; and still they do not cook, but rather they cool down faster if hot. And since nothing is lacking to us except being Babylonians, then being Babylonians is the cause of the eggs hardening.’ And this is what I wished to determine.¹

ANTONIO: Oh, that’s great! I’d like to see Grassi’s face when he reads that!

CARDANO: Exceedingly clever. But I fear we are not likely to see a truce in the near future between our friend Galileo and the architect.

BATTISTA: Surely Galileo does not need Father Grassi as a friend.

CARDANO: [*Slightly ominous tone:*] In time of need, a friend may be of much greater benefit than another enemy.

[*Blackout*]

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SCENE 5

1633. Cardano's apartment. Battista and Cardano are seated, talking.

BATTISTA: It does not look at all good, Seignior Cardano. The Pope insisted the matter go to trial. We had been so hopeful when Maffeo Barberini became Pope Urban VIII. It moved the papacy from the Jesuits back to Dominicans, and to the Barberini family who had been so liberal, encouraging science and the arts. Indeed, Maffeo Barberini and Galileo had been friends for many years before Maffeo was elevated to the papacy.

CARDANO: Yes, it looks dark, but as they say, "It looks darkest just before the dawn". I have some information that encourages me to believe things will turn out well in the end. It has been a tough time for Galileo, but it has also been a very trying time for the Pope. You have been attending the trial, I believe. Tell me what you have observed.

BATTISTA: I cannot share your sympathy for the Pope, when he has dragged Galileo before the Inquisition. It could be Galileo's very life. He is no longer a young man, as you well know. He is only a year short of his biblical three score and ten years, and his health is no better than usual, which for Galileo is not encouraging. He may, indeed, be a chronic hypochondriac; and it may be, as it so often seems, that he takes advantages of his illnesses when it is to his advantage; but the man does have many serious health problems.

As you well know, the proceedings of the Holy Office are closely guarded. The penalty for revealing those secrets would likely be no less than excommunication, and could well be death! The whispers among those closest to the action indicate that the initial indictment brought against Galileo was for his publication, in "The Assayer" and elsewhere, of atomism. That charge had been squelched, previously, but it came back and, for reasons I do not fully understand, the Pope felt it necessary to take stronger action this time. I hear the charges were referred to a special commission, which did not include any scientists.

CARDANO: Yes; what the Pope did was to appoint a commission to look at the charges against Galileo. He named two of his trusted buddies who were experts in the subject of transubstantiation and the Eucharist. Then as a third member he threw in a Jesuit who was violently anti-Copernican and who was already, himself, under charges by the Holy Office. The third member clearly had no chance. He was outnumbered, outflanked, and generally in an impossible situation.

BATTISTA: That explains some of the subsequent events! Apparently the commission, which met at least five times, decided to drop the atomism charge. The charge against Galileo appeared it would be his advocacy of the Copernican theory, but the legal minds got together and decided that wouldn't hold water. Geocentrism has never been adopted as Church doctrine, so advocating Copernicanism would be a crime without a punishment.

CARDANO: I can understand that. What, then, did they charge him with?

BATTISTA: Remember when Cardinal Bellarmino, may he rest in peace, called Galileo in to tell him

not to openly push Copernicanism. At the time, he indicated it was because no one had *yet* proved it to be valid.

Galileo was properly cautious and requested something in writing, which Bellarmino supplied. Galileo kept the signed copy of that letter. Of course, Cardinal Bellarmino is no longer alive, so he cannot confirm what was said. That left Galileo to rely on his copy of the signed document.

But the prosecutor produced another letter, unsigned, which stated that Galileo was enjoined from even *talking about* Copernicanism! When the trial opened, Galileo found he was charged with violating that letter from Bellarmino, which Galileo claimed not to have even seen. There is not the slightest indication of help from the Pope on this. In fact, rather than joining in the defense, he has attributed crimes to Galileo so extreme he will not specify what they are. His description to the Florence ambassador was that Galileo's errors were "perverse in the extreme", more serious than those of Luther and Calvin.

CARDANO: That does seem strange, for Pope Urban has made the statement that the Church had neither condemned nor ever would condemn the doctrine of Copernicanism as heretical, but only as rash. It seems clear that he did have *something* quite different in mind with which Galileo would be, or could be, charged.

BATTISTA: Galileo is in terrible shape. The trial session was adjourned yesterday and is to resume today. The last I heard, yesterday afternoon, the trial judge had requested a private meeting with Galileo, a meeting with no lawyers and no witnesses. Heaven knows what he wanted to discuss. It surely was a highly unorthodox extrajudicial procedure.

CARDANO: Has Galileo been mistreated in any way, other than verbal threats?

BATTISTA: No, I must say he has been given royal treatment, in the best sense. He was housed in the Medici apartments before the trial started, which are certainly luxurious. Then, when the trial began, he was moved to the Vatican, but the Pope moved the prosecutor out of his fancy apartment and put Galileo in there. He has had the freedom of the halls and the gardens of the Vatican, and has had a manservant available at all times to meet his needs. But he is still confined!

CARDANO: That is encouraging. Perhaps someone is looking out for him after all. Before I tell you the additional information I have recently acquired, let's quickly review what has happened to Pope Urban VIII recently. Recall he has been under tremendous pressure from the Spaniards, who want him to be far more strict in curbing free thought. The Jesuits, also, have been on his back.

You recall the big flap a few years ago when "The Assayer" was published by Galileo. He was very careful to get permission from the Vatican for it, including the Pope's coat of arms. There was no mention of Copernicanism in the book, although some have charged that it advocated heliocentrism. On the other hand:

1. It treated, in some detail, Galileo's model of matter and heat and light as particles.

2. It antagonized, in just about every way possible, Father Grassi and his support of Aristotle. Its approach to properties of matter was diametrically opposite to that of Aristotle, and hence Grassi. From the private information I have received, Father Grassi tried once more to accuse Galileo of atomism. This was the third attempt to bring such charges against him.

BATTISTA: That sounds serious. Much worse than charges of Copernicanism or, especially, ignoring a warning. What can be done about that?

CARDANO: Remember also the sermon by Father Grassi last Good Friday. He took it upon himself to excoriate the Pope, whom the Spanish wing of the Church had already threatened, in open session,

to depose. They charged the Pope with failure to avoid
first: the recent eruption of Mt. Vesuvius;
second: the plague that swept large parts of Europe; and
third: the military successes of Sweden, moving its Protestant armies down through Poland against Austria and Italy.

BATTISTA: And they were serious?

CARDANO: Yes, and now they were beginning to charge, in chorus, that the Pope had harbored and encouraged heretics, making it clear that Galileo was the principal culprit.

They really believe they have the Pope pinned down this time. For Urban to escape will be like passing through the eye of the needle. If he dispenses with Galileo, he loses a trusted friend of at least two decades and he will still be charged with admittedly having harbored Galileo as a known heretic. If he tries to defend Galileo against the heresy charges, very likely both will lose — Galileo and the Pope will go down together. The report is that Galileo is on trial *only* as a means of undermining Urban VIII.

BATTISTA: I was only partially aware of all this going on in the background, although we had, of course, heard about the open attack on Urban by Cardinal Borgia and the Spanish delegation before the consistory last March, where the Pope was actually threatened with deposition for heresy. It would seem that Galileo, now, also faces the challenge of passing through the eye of the needle.

CARDANO: Indeed, it appears it would be a miracle, probably *not* repeatable, if two such large figures could simultaneously escape through the same needle's eye at the same time.

BATTISTA: It sounds serious, and explains why the Pope has appeared so irritable and on edge in recent weeks, and why Galileo, also, has lost the supreme self confidence with which he entered the trial. Little did he know that, behind the scenes, the rules had been changed and he would be secretly charged with atomism. Believing the charge was simply advocacy of Copernicanism, he thought with Bellarmino's letter in his pocket, he could convince the Inquisitors that he was blameless. Has he found a means of escape from the new charge without exposing himself to the more serious charges?

CARDANO: It appears the Pope is still his friend, although much less obviously so. The commission reported the charges to the Holy Office as violating a direct order, which is a procedural heresy, only. There was no mention of the atomism.

BATTISTA [*looking much relieved*]: I guess, with all that going on, Galileo would be well advised to concede the procedure charge.

CARDANO: Although there have been no leaks to confirm it, I would wager that is precisely the point the trial judge made with Galileo in their private session yesterday.

BATTISTA: What penalty do you suppose will be handed down?

CARDANO: That, of course, is up to the Pope. I am in no position to anticipate what it may be. But of one thing we may be sure. Those of us who know Galileo know full well that he will hold true to his principles, come what may. Galileo will not withhold a favor for his friends, nor will he hesitate to attack verbally one he considers to be his enemy, but Galileo could never become involved in an endeavor that would compromise his soul.

There may come a day when men will think only of what can happen to them, or to their loved ones, in this life. That day, thankfully, is not here for men of Galileo's character. He is among those who are concerned about the judgement of God and for the eternity after this life, those who are concerned lest they spend eternity in the fires of Hell for their lapses in this brief life on Earth.

[A loud knocking is heard at the door, which Rudolfo quickly answers, admitting Antonio.]

ANTONIO *[after very brief greetings]*: Terrible news! Galileo confessed guilt before the court! Yesterday it looked as if he could beat the charges placed against him, but today he walked into court and confessed to violating the explicit orders of the late Cardinal Bellarmino. The rumor is that he will be sentenced to home confinement for the rest of his life!

CARDANO: *[to Battista]*: I think we may forget about some of the details we were considering, Seignior Battista. This certainly puts a new face on the problem. Thank you, Seignior Antonio, for your report. We will wait for more information on what the Pope decides.

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EPILOGUE

1633. Setting: Evening at a Roman sidewalk café. Frederico and Cardano are seated at a table. Dominic and Eduardo approach. Greetings and handshakes and kisses all around.

DOMINIC: I guess you have all heard the outcome of Galileo's trial. He has been sentenced to home confinement for life. It seems kind of rough for someone of his age, but he brought it on himself with his insatiable curiosity. Curiosity is not *always* a bad thing, but it surely must be kept in check. I consider it a symptom of unrest and dissatisfaction.

FREDERICO: I marvel only that the sentence was so mild.

EDUARDO: With the continuing plague in Tuscany, even that could be a problem. Will they really send a man of Galileo's age into so dangerous a situation?

DOMINIC: I understand they have quietly allowed for a temporary stop-off in Siena at the palace of the archbishop. He will likely return to Arcetri near the end of the year if the plague has then receded from that area.

FREDERICO: It was just like Galileo to give in totally. Imagine, breaking down with a full confession.

EDUARDO: They didn't call Bellarmino "The Hammer" for nothing. Even from the grave he reached out and snagged Galileo, who did little different from what each of us does day to day.

[Cardano again leaves the group to come downstage and talk directly with the audience.]

CARDANO: It is of interest that Father Grassi, who officially was not a party to the proceedings, has been sent abroad. He was removed from his position as architect of St. Ignacius Church, of the Collegio Romano, and as Father General of Mathematics at the Collegio Romano. We may question the report of the commission that led to Galileo's trial, but I note that Father Oreggi, who served on that commission, has been named Cardinal. A couple of others, who seemed to have little to do directly with the trial, have also been banished.

At least we will know where to find Galileo Galilei. He will be at his home, called "The Jewel", probably busy at work on his physics.

Galileo was 69 at the time of the trial. He lived to the age of 77, in 1642, suffering blindness in his last years as a consequence of an eye infection. Galileo never undertook to explain the causes of motion, or better, the causes of changes of motion. During his "home confinement" he completed and published, abroad, by far his most important and original work, laying the basis for kinematics, or the description of motions, that was required for the work of Isaac Newton, born little more than

a year after Galileo's death.

Urban VIII presided over the papacy until his peaceful death in 1645.

Father Grassi returned to Rome in 1645, but never published again, as Grassi or as Sarsi.

Near the end of the 17th century, a generally-ignored official document from the Church established that Galileo was condemned, not for advocacy of Copernicanism, but for atomism. In 1992, in a weak public relations effort, the Vatican officially overturned the 1633 condemnation with regard to motion of the Earth, in a concession to modern evidence.

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