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The Legend of Galileo, Icon of Modernity

Writing in *Le Monde* in February 2007, Serge Galam, a physicist of CNRS (Centre National de la Recherche Scientifique) and member of the Center for Research in Applied Epistemology of the École Polytechnique, discussed scientific arguments concerning the role of human beings in global warming. In what is all too frequent in contemporary analyses of science, ethics, and public policy, Galam invoked the image of Galileo and his opponents in the seventeenth century. He noted that, when Galileo concluded that "the Earth was round, the unanimous consensus against him was that the Earth was flat," and this despite the fact that Galileo "had demonstrated his conclusion." Galam then brought his point closer to our own day: "in a similar way," the Nazis rejected the theory of relativity because it was put forth by Einstein and was, accordingly, a Jewish and, hence, "degenerate theory." It is quite something to think that it is was the sphericity of the Earth which Galileo was defending. After all, as one letter-writer to Le Monde pointed out, that the Earth was a sphere was widely accepted in educated circles from Antiquity through the Middle Ages. Perhaps even more extraordinary than the claim about the shape of the Earth, was Galam's comparison (*de façon similaire*) of the Catholic Church to the Third Reich.

Even the person who wrote to chastise Galam was not entirely immune to the mythology which surrounds Galileo, for he argued that what, in fact, Galileo "had demonstrated" was the double movement (diurnal and annual) of the Earth. Galileo, however, did not think that his astronomical observations, impressive as they were, provided evidence for a demonstration that the Earth moved, although he thought they offered good reasons to question the truth of the geocentric astronomies of Ptolemy and Aristotle. He hoped to offer a demonstration for the motion of the Earth by arguing from the effect of the ocean tides, but in this endeavor he was ultimately unsuccessful. Galileo shared with Aristotle and Aquinas, and with major figures of the Inquisition, the view that science deals with the truth of things. Scientific knowledge in the Aristotelian tradition is knowledge of what is necessarily so, that is, cannot be otherwise, because it is based on the discovery of the causes that make things be what they are. Such sure, certain knowledge is quite different from the product of probable or conjectural reasoning: reasoning which lacks certitude because it falls short of identifying true and proper causes. Galileo, despite his disagreements with many seventeenth century Aristotelians, never departed

from Aristotle's ideal of science as sure, certain knowledge. As William Wallace has shown, whether Galileo was arguing about the movement of the Earth or about laws that govern the motion of falling bodies, his goal was to achieve true, scientific demonstrations. When he wrote his *Two New Sciences*, near the end of his life, he argued that he deserved credit for establishing new sciences because his arguments employed "necessary demonstrations" which proceed from "unquestionable foundations."

There are many instances of the failure to recognize that Galileo did not claim that he proved that the Earth was moving. Hans Küng, for example, in *The Beginning of All Things*, his recent book on science and religion, states that Galileo's astronomical observations offered "irrefutable confirmation" that the Earth revolves around the sun. We find an associated legend in Küng's claim that "the Galileo case was followed by an almost silent emigration of scientists from the Catholic Church and a permanent conflict between science and the dominant theology. . . [such that] Italy and Spain, under the lash of the Inquisition, had no scientists worth mentioning until the twentieth century."

We may accept or reject Galileo's view of what science involves, but if we want to understand Galileo's encounter with the Inquisition we must recognize the notion of science which Galileo and the Inquisition shared. In the early seventeenth century, neither Galileo nor the Inquisition thought that there was a demonstration for the motion of the Earth. Galileo expected, even anticipated, such a demonstration; the theologians of the Inquisition did not.

In 1616 the Inquisition ordered Galileo not to hold, teach, or defend Copernican astronomy. However ill-advised this private injunction to Galileo was, the Inquisition did not think that it was requiring Galileo to choose between science and faith, since there was at the time no such scientific knowledge to be rejected. The theological consultants, whose conclusions were accepted by the cardinals of the Inquisition, thought that heliocentric astronomy was obviously false, and on the basis of this faulty judgment they thought that biblical passages had to be interpreted accordingly. Hence, to affirm that the Earth moves would call into question, so the theologians thought, the truth of the Bible. In an important sense, the theologians subordinated biblical interpretation to a particular astronomical theory (geocentrism): just the opposite of what is commonly thought. The single public act of 1616 was the decree of the Index of Forbidden Books prohibiting the publication of books which claimed that the new astronomy was true or which suggested that the Bible could be interpreted as being consistent with this astronomy.

As a result of Galileo's publication of *The Dialogue Concerning the Two Chief World Systems* in 1632, the Inquisition concluded that Galileo had disobeyed its previous order, and Galileo was required in 1633 formally to renounce the view that the Earth moves, and he was ordered to remain in his villa outside Florence under a kind of house arrest. From beginning to end, the actions of the Inquisition and the Index of Forbidden books, in 1616 and 1633, were disciplinary not dogmatic. It was not a matter of Church doctrine that the Earth did not move. However much disciplinary acts serve teaching functions, such teaching ought not to be confused with formal magisterial pronouncements.

Another feature of the widely accepted story of Galileo and the Inquisition is that Galileo's understanding of the relationship between science and Scripture anticipates the modern view that the Bible is essentially a religious text and ought to play no role in disputes about the natural world. We might recall, in this regard, Galileo's reference to the words of Cardinal Baronius: "The Bible teaches us how to go to heaven, not how the heavens go." In various places in his famous "Letter to the Grand Duchess Christina," Galileo argues that in disputes about natural phenomena one ought not to begin with biblical passages. Giorgio di Santillana, in his influential book, *The Crime of Galileo* (1955), offered effusive praise for Galileo the theologian: "In his concern with enduring things, in his confessional simplicity, Galileo spans the centuries... The elaborate baroque formulas of submissiveness do not prevent the reader from feeling that here is someone like Ambrose, Augustine, or Bonaventure, reprehending sleepy shepherds and degenerate epigones. He speaks in the name of the community of the faithful which joins the ancient dead to the yet unborn... [H]e deserves heeding no less than Aquinas himself."

Mauro Pesce, who has provided the most detailed analysis of Galileo's principles of biblical exegesis, thinks that Galileo represents a missed opportunity for the Catholic Church in the seventeenth century to discover a *modus vivendi* between modernity and religion [*una convivenza tra modernità e religione*]. According to Pesce, it was not until Pope Leo XIII's encyclical, *Providentissimus Deus* (1893), that the Church would accept, even in an attenuated form, the principles enunciated by Galileo. For Pesce, the fundamental issue from 1616 to 1893 was not really the acceptance of Copernican astronomy, but rather the unwillingness of the Church to accept Galileo's hermeneutical principle that the truth of Scripture is religious and not scientific. Pesce claims that it was this distinction between science and religion which constituted the core of Galileo's understanding of the Bible, and, furthermore, that it was the rejection of this distinction which lies behind the condemnation of heliocentric astronomy.

It seems to me that Galileo the theologian does not anticipate some modern distinction between the religious character of the Bible and the claims of science; rather, he embraces ancient traditions of Catholic theology and also affirms principles of biblical exegesis characteristic of Counter Reformation Catholicism. In his writings on science and Scripture, Galileo often cites Augustine. He also, like Augustine and Aquinas, distinguishes between the literal meaning of the Bible, with all its metaphors and similes, which he thinks is always true, and the "surface meaning of the words" (e.g., the attribution of bodily features to God) which could lead us away from the truth. Particular passages from his letters have been used to support what has come to be accepted as a characteristically modern understanding of the autonomy of the natural sciences with respect to the Bible. As I noted above, he thinks that, in discussing questions of nature one ought not to begin with biblical passages. But he also argues that, in the absence of scientific demonstrations one ought to adhere to the knowledge of nature found in the Bible, and, furthermore, that "wise theologians" ought to use scientific knowledge to discover the true

sense of those scriptural passages which do indeed describe natural phenomena.[1]

In *Retrying Galileo: 1633-1992*, published in 2005, Maurice Finocchiaro traced the development of a defensive reaction to the celebration of Galileo's fighting to emancipate science from the control of the Church. There is a kind of counter-legend according to which the Inquisition was seen as trying to protect Galileo from his own unjustified claims about what his discoveries disclosed. We can see variations of this theme in the works of Paul Feyerabend and Walter Brandmüller, among others. Feyerabend praises the Inquisition for its caution and sees its position as being similar to contemporary attempts "to temper the totalitarian and dehumanizing tendencies of modern scientific objectivism." Brandmüller's views, found in *Galilei und die Kirche: oder das Recht auf Irrtum* (Galileo and the Church: Or the Right to be Wrong), have been especially influential in contemporary Vatican circles. He argues that there is a grand irony in Galileo's encounter with the Inquisition: Galileo was right in matters of biblical interpretation; the Inquisitors were right in matters of science. Often this judgment is based on the view that, when Cardinal Bellarmino wrote in 1615 that Galileo should restrict his arguments to hypothetical claims about the new astronomy, the cardinal was wisely avoiding an absolutist view of science. On the contrary, however, Bellarmino was employing a well-established distinction between the hypothetical nature of mathematical astronomy (in which geometric devices such as equants and epicycles are used to describe observed phenomena) and true scientific knowledge of what the heavens were really like. Although the cardinal did not think there would ever be a scientific demonstration for the motion of the Earth, he did not rule out the possibility, nor did he reject Aristotelian canons for what science means.

Galileo and Popes John Paul II and Benedict XVI

Throughout his pontificate, John Paul II expressed a lively interest in the relationship between science and faith. A medal struck by the Vatican in 2003 to commemorate the four-hundredth anniversary of the founding of the Pontifical Academy of Sciences is instructive in this regard. The Pontifical Academy traces its provenance to the Lincean Academy, founded in 1603; Galileo was its most famous member. The commemorative medal depicts Pope John Paul in conversation with Galileo. Next to Galileo there is a representation of the universe as he described it, with six planets revolving about the Sun. On the obverse of the medal we find the words from the opening of Genesis referring to God's creation of light (and an artistic representation of this act) as well as the phrase, "fidei rationisque," calling to mind the Pope's famous encyclical, *Fides et Ratio*.

[1] For an analysis of Galileo and the interpretation of the Bible, see my essay: "Galileo and Biblical Exegesis" in *Largo campo di filosofare: Eurosymposium Galileo 2001*, edited by José Montesinos and Carlos Solís (Orotava, España: Fundación Canaria Orotava de Historia de la Ciencia, 2001), pp. 677-691. For the general theme of Galileo, scientist and theologian, see my essay: "Galileo and the Myth of Heterodoxy" in *Heterodoxy in Early Modern Science and Religion*, edited by Ian Maclean and John Brooke (Oxford University Press, 2005), pp. 115-144.

Eleven years before the appearance of the medal, in October 1992, John Paul II appeared before the Pontifical Academy of Sciences to accept formally the findings of a commission of historical, scientific, and theological inquiry into the treatment of Galileo by the Inquisition: a commission which he established in the early 1980s. The Pope noted that the theologians of the Inquisition who condemned Galileo failed to distinguish properly between particular interpretations of the Bible and questions which in fact pertained to scientific investigation.

The Pope also observed that one of the unfortunate consequences of the condemnation of Galileo was that it has been used to reinforce the myth of an incompatibility between faith and science. That such a myth was alive and well was immediately apparent in the way the press described the event in the Vatican. The headline on the front page of *The New York Times* was representative: "After 350 Years, Vatican Says Galileo Was Right: It Moves." The story referred to "one of the Church's most infamous wrongs – the persecution of the Italian astronomer and physicist for proving the Earth moves about the Sun." The story also claimed that "the dispute between the Church and Galileo has long stood as one of history's great emblems of conflict between reason and dogma, science and faith."

It is not surprising that *The New York Times* would perpetuate one of the more persistent myths concerning Galileo and the Inquisition. Celebrations of the values of modernity are characteristic of much of the secular media, and the legend of Galileo is surely one of the constitutive myths of the modern world. Indeed, there are few images of the modern world more powerful than that of the humbled Galileo, kneeling before the cardinals of the Inquisition, being forced to admit that the Earth did not move. The story is a familiar one: that Galileo represents science's fighting to free itself from the clutches of blind faith, biblical literalism, and superstition. It is a story which has come to characterize our understanding of the origins of modernity. In particular, the specter of the Catholic Church's condemnation of Galileo continues to occupy a prominent place in the modern world's understanding of the relationship between religion and science. A related feature of the legend, which makes it even more persuasive, is the view of Galileo the scientist as breaking with the scientific views of Aristotle and thereby helping to lay the foundations of modern science.

The events of 1992 had a strange echo in Rome in January 2008 when Pope Benedict XVI cancelled his planned speech at the University of Rome's La Sapienza campus. A group of faculty members and students protested the invitation to the Pope to speak, at first because of the need, so it was argued, to keep faith and religion out of the halls of the academy, and then, more specifically, because of remarks the Pope had made in a speech in 1990 about the Galileo Affair. In reporting on these events in Britain, BBC contrasted Pope John Paul's admission that the Church had erred in her treatment of Galileo with then Cardinal Ratzinger's speech in which he quoted the philosopher of science, Paul Feyerabend, who maintained that the Inquisition's treatment of Galileo was "reasonable and just." In fact, BBC, in the same vein as *The New*

York Times in 1992, observed that Pope John Paul had formally and officially acknowledged that the Earth moved!

Cardinal Ratzinger, however, did not endorse Feyerabend's historical judgment so much as reflect on the fact that some scholars had come to see dangers in modern science and technology. As he has done since becoming Pope, he warned against identifying reason with only what science affirms. In 1990 he was addressing what he described as increasing attention in scholarly circles to the limits of science and the criteria which it must observe. He noted that emblematic of this new intellectual climate were the questions that were being asked about the Galileo Affair. Rather than see Galileo as a victim of "mediaeval obscurantism" and an attempt to stifle science, some scholars were now maintaining that the Church at the time of Galileo, in Feyerabend's words, "was much more faithful to reason than Galileo himself, and also took into consideration the ethical and social consequences of Galileo's doctrine." The Cardinal was interested in examining what he called "modernity's doubts" about some of its cherished notions of science. But he was quick to add that "it would be absurd on the basis of these [Feyerabend's and others'] assertions to construct a hurried apologetics. The faith does not grow from resentment and the rejection of rationality, but from its fundamental affirmation and from [faith's] being inscribed in a still greater form of reason." But, as the reaction to his scheduled appearance at La Sapienza reveals, the Pope's 1990 analysis that the old myth of the Galileo Affair had lost some of its appeal was not entirely accurate.

The signatories of the 2008 letter of protest noted that they were "humiliated and offended" by what the Pope had said more than seventeen years before. In the signatories' commitment to what they called "lay science" [*laicità della scienza*], as distinct, no doubt, from science seemingly contaminated by religion, we see the old battle between lay and clerical cultures. If we needed any further evidence, the events in Rome in January 2008 show us that the legend of the encounter between Galileo and the Inquisition continues to resonate in our day. These events also reveal the wider context in which the legend survives.

We can see that wider context in the first salvo against Pope Benedict's appearance at La Sapienza in November 2007, when Professor emeritus Marcello Cini complained, in a letter to the Rector of the University, that it was dangerous to have the Pope at the university. Theology, he argued, has no place in a modern, public university. The Pope's strategy has been cunning; ever since he was the "head of the Holy Office," he has tried to use the rationality of the Enlightenment *philosophes* as a "Trojan horse" to enter the citadel of science and to keep it under control of "the pseudo-rationality of the dogmas of religion." An example Cini cited in this regard is what he called the Pope's support for "Intelligent Design," which, as he said, rejects Darwinian science. For Cini, nothing less than the cultural advances of the last several hundred years were at risk if the Pope were to speak at La Sapienza.

Galileo and Modernity

Michael Segre, writing in *The Cambridge Companion to Galileo*, refers to the "never-ending Galileo story." In some respects, Galileo himself contributed to the beginning of a hagiographical tradition when he wrote, in various places, of the importance of his astronomical discoveries and ridiculed his opponents. By the nineteenth century he had become an icon of modernity, a view which continues to the present. We can see this clearly in a passage from José Ortega y Gasset's book, *En Torno a Galileo* (1933):

> [Galileo exists]. . . in a great sector of the past which has a very precise form: the beginning of the modern age, of the system of ideas, values, and forces which fed and dominated the history-laden soil that stretches straight from Galileo to our own feet... There in the deep background of our contemporary civilization, marked as it is among all the civilizations by the exact natural sciences and the scientific techniques, pulses the man's great figure. He is thus an ingredient in our own lives, and not a casual one, but one whose task it was to play the mysterious role of initiator... The figure of Galileo appears ... like a divide that parts the waters. With him modern man enters into the modern age.

The text is from a chapter entitled "Galileísmo de la historia," and Ortega draws a sharp distinction between the new science of Galileo and what came before. Galileo did reject several conclusions which Aristotle and his followers had accepted as true, especially cosmological claims about the incorruptibility of the heavens, geocentricity, the immobility of the Earth, and the like. But this cosmology is not really an essential feature of Aristotelian natural philosophy; that is, its rejection does not necessarily entail a rejection of the fundamental *principles* of Aristotelian physics (e.g., distinctions of form and matter, act and potency, the definition of motion, time, and the like). Galileo was eager to point out that were Aristotle to have the evidence of the new telescopic discoveries he would have accepted the conclusions Galileo drew from them. Galileo's commitment to the importance of mathematics in studying nature does represent an *emphasis* not found in the Aristotelian traditions; nevertheless, it is, I think, consistent with the Aristotelian notion of an intermediate science —intermediate, that is, between the natural sciences and mathematics— in which the principles of mathematics are applied to the study of natural phenomena. The new mathematical physics of the seventeenth century does not represent such a rupture with the past as many argue. Furthermore, as I have already noted, Galileo accepted the prevailing Aristotelian notion of what constituted a true scientific demonstration.

In 1929, four years before Ortega penned the words I cited above, Vittorio Emmanuele III, King of Italy, inaugurated the Institute and Museum of the History of Science in Florence. The ceremonies coincided with the first national exposition of the history of science, which had been sponsored by the Fascist regime to celebrate the tradition of Italian science. The museum houses an impressive collection of artifacts belonging to or connected with

Galileo. When Mussolini visited the exposition in 1930, he underlined the importance of Galileo as he stood in admiration before the text of Galileo's first astronomical treatise, *The Starry Messenger*. A contemporary chronicler of this encounter between Mussolini and the textual remains of Galileo observed that this was the first time that the manuscript had for a reader a man of the stature of the one who wrote the text!

The legend of Galileo was well established by the time Mussolini viewed *The Starry Messenger*. The Grand Dukes of Tuscany had begun to cultivate such a legend soon after Galileo's death in 1642. When Grand Duke Pietro Leopoldo opened the Museum of Physics and Natural Sciences in 1774 he dedicated a special exhibition which commemorated the principal discoveries of Galilean physics. In 1841 Galileo's scientific memorabilia were moved to a special "Tribuna di Galileo," established in another Florentine palace which was a meeting place for the congress of Italian scientists. Galileo, by now an "Italian" scientist (as distinct from a Florentine or a Tuscan scientist), served an important political role, helping to legitimate the aspirations of those Italian nationalists who longed for the establishment of a single Italian nation.

Today, a walk through the second floor of the Institute and Museum of the History of Science reveals the continuing importance of Galileo. Museum attendants stand ready to demonstrate a reproduction of Galileo's device for measuring motion down an inclined plane. The same text which attracted Mussolini's interest more than seventy-five years ago shares a glass case with first editions of the *Dialogue Concerning the Two Chief World Systems* and the *Discourses and Demonstrations on Two New Sciences*. There is a famous military compass and designs of fortifications Galileo produced for his Venetian patrons, before he became chief mathematician and philosopher at the Medici court in Florence in 1610. And, of course, there are the telescopes which Galileo used to discover new astronomical wonders.

Among the display of telescopes there is a handsomely decorated, oval ivory frame, with a round glass at its center. It looks much like a monstrance used to hold the consecrated host in religious ceremonies such as benediction of the blessed sacrament. The central glass is surrounded by drafting tools and scientific instruments, all etched in ivory. At the top of the inner frame there is a depiction of four moons revolving about Jupiter. The cracked lens at the center of this scientific icon came from the telescope which Galileo used when he first observed these moons. The lens cracked when Galileo dropped it as he prepared to send it to Cosimo de' Medici, after whom he had named the moons the "Medicean stars."

The image of Galileo as patron saint of modern science is further reinforced by an odd reliquary. On a small marble pillar there is a glass sphere which contains the skeleton of the middle finger from Galileo's right hand. In 1737 when Galileo's body was being transported from a small chapel in the bell tower of the Church of Santa Croce to a great monumental tomb in the Church itself, this finger was cut from the corpse; it has been preserved ever since.

The story of Galileo's encounter with the Inquisition is as fascinating to many in our own day as it has been for almost four centuries. The famous

Galileo codex, which contains most of the documents concerning the Inquisition's treatment of Galileo, was preserved as a result of Napoleon's interest in Galileo. When Napoleon seized the Vatican archives in 1810 —and ordered them to be shipped to Paris to be part of a new center of European culture— he made a point of having the material on Galileo sent by imperial courier, lest it be lost. Napoleon saw himself as a kind of political Galileo who was ushering in a new order in the political cosmos of Europe, and who, like Galileo, was opposed by the Church.

Galileo and the Age of Positivism

Already by the eighteenth century, the legend of Galileo's defense of reason and science in the face of Catholic (if not Christian) obscurantism was already well established. The European Enlightenment, reacting to the horrors of the wars of religion of the previous century, saw dogmatic religion as a disease in the body politic. For the Enlightenment, Galileo's travails at the hands of the Inquisition offered unequivocal evidence of the conflict between truth and superstition. The program of reform advocated by Enlightenment *philosophes* involved the evaluation of all human institutions according to the criteria of reason and science. Those institutions and modes of thought which failed the test of reason were to be discarded.

In the early nineteenth century, Auguste Comte, one of the founding fathers of the modern social sciences, argued that humanity was laboriously struggling upward toward the reign of science, and the principal opponent in this struggle was a reactionary theological and metaphysical view of the world. For Comte, Galileo represents the modern spirit's freeing itself from the stultifying grasp of theology and metaphysics. Galileo's "odious persecution" will remain forever, according to Comte, an exemplar of the "first direct collision" between modern science and the old view of the world.

The nineteenth century was the great age of positivism, which saw modern science as the pinnacle of human thought. For the positivists, science was objective, inductive, and experimental —and it was born in the great revolution of the seventeenth century when geniuses such as Galileo and Newton succeeded in overthrowing the heritage of Aristotle. Thus, the Inquisition's treatment of Galileo was but one of the attempts to impede the inevitable progress of the human mind. The legend of Galileo's persecution by the Inquisition had become part of the larger story— also widely accepted – of the Scientific Revolution. The more one saw that Revolution in terms of the victory of the modern scientific method, a method, so it was claimed, which Galileo pioneered, the more it was easy to accept what had become the common wisdom of the Inquisition's attempting to thwart scientific progress to protect the literal truth of the Bible.

By the second half of the nineteenth century the condemnation of Galileo had come to be seen in messianic terms. The figure of Galileo took on a prophetic role in the redemption of mankind from the dogmatism of the past. The great conflict between truth and falsehood had several heroes, and Galileo was among such a pantheon. The legend of Galileo came to be considered a

central chapter in a long history of warfare between science and religion. Increasingly, this metaphor of warfare served as an important tool for the modern world's understanding of its own history. The legend of Galileo was important evidence for the purported truth of this interpretation. At the same time the legend was held captive by this interpretation: so much so that, even today when we know how false the legend is, it remains difficult to reject it.

The great scientific debate in this period concerned evolution. Darwin's *On the Origin of Species* first appeared in 1859, and one of Darwin's ardent supporters, Thomas Huxley, characterized religious opposition to evolution in the following way:

> Who shall number the patient and earnest seekers after truth, from the days of Galileo until now, whose lives have been embittered and their good name blasted by the mistaken zeal of Bibliolaters? Who shall count the host of weaker men whose sense of truth has been destroyed in the effort to harmonize impossibilities – whose life has been wasted in the attempt to force the generous wine of Science into the old bottles of Judaism...?
>
> Extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed, if not annihilated; scotched, if not slain. . . . Orthodoxy . . . is willing as ever to insist that the first chapter of Genesis contains the beginning and the end of sound science; and to visit, with such petty thunderbolts as its half-paralysed hands can hurl, those who refuse to degrade Nature to the level of primitive Judaism.

In the United States, John William Draper, professor of chemistry and biology and head of the medical school at New York University, published *The History of the Conflict Between Religion and Science* in 1874. Draper thought that religion enlightened by science could come to affirm progressive principles of intellectual freedom and tolerance, so essential for the moral improvement of man. Draper was particularly concerned about what he thought was the evil influence of Catholicism. He could point with horror to Pope Pius IX's famous *Syllabus of Errors*, which condemned "modernism" and announced, so it seemed, an irreconcilability between Catholicism and progressive liberal thought.

Draper wrote that the Catholic Church and science were "absolutely incompatible; they cannot exist together; one must yield to the other; mankind must make its choice – it cannot have both." He was certain that he had discovered the source of the fundamental problem for Western Civilization:

> The antagonism we thus witness between Religion and Science is the continuation of the struggle that commenced when Christianity began to attain political power. A divine revelation must necessarily be intolerant of contradiction; it must repudiate all improvement in

> itself, and view with disdain that arising from the progressive intellectual development of man . . . . The history of Science is not a mere record of isolated discoveries; it is a narrative of the conflict of two contending powers, the expansive force of the human intellect on one side, and the compression arising from traditionary [*sic*] faith and human interests on the other . . . . Faith is in its nature unchangeable, stationary; Science is in its nature progressive; and eventually a divergence between them, impossible to conceal, must take place.

The cause of science in the purported battle with religion was taken up by others less virulently anti-Catholic than Draper. Chief among them was Andrew Dickson White, the first president of Cornell University. He planned for a new university in which the undergraduate curriculum would no longer be tied to any religious doctrine. To White, more than to any other, we owe the foundation of the metaphor of warfare between science and religion.

In the debate over the granting of a state charter to Cornell University, the religious press excoriated the proposal since the new university did not have among its goals the protection and propagation of Christianity. Indeed, much of the same rhetoric which many used against evolution was also used against the new university. Cornell, so it was claimed, would be a "Godless institution," established for the dissemination of "atheism and infidelity." White responded with an impassioned defense of science against the attacks of the anti-Darwinists and the opponents of Cornell University. In 1876 he published a pamphlet, *The Warfare of Science*, which in 1896 appeared in a greatly expanded two-volume work, *History of the Warfare of Science with Theology in Christendom*. Unlike Draper, White sought to distinguish more carefully between religion and theology. According to White, the "theological spirit [was] that tendency to dogmatism which has shown itself in all ages [to be] the deadly foe not only of scientific inquiry but of the higher religious spirit itself." Such a distinction between theology and religion seems specious at best; at worst it reduces religion to a system of ethics.

In the preface to the *History*, White tells the story of the founding of Cornell University and he locates that struggle in a broader historical framework:

> I propose to present an outline of the great, sacred struggle for the liberty of science – a struggle which has lasted for so many centuries, and which yet continues. A hard contest it has been; a war waged longer, with battles fiercer, with sieges more persistent, with strategy more shrewd than in any of the comparatively transient warfare of Caesar or Napoleon or Moltke . . .
>
> My thesis, which, by an historical study of this warfare, I expect to develop, is the following: In all modern history, interference with science in the supposed interest of religion, no matter how conscientious such interference may have been, has resulted in the direst evils both to religion and to science – and invariably. And, on the

> other hand, all untrammeled scientific investigation, no matter how dangerous to religion some of its stages may have seemed, for the time, to be, has invariably resulted in the highest good of religion and science. I say 'invariably.' I mean exactly that. It is a rule to which history shows not one exception.

The titles of the various sections of White's book reveal the approach he takes: "From Creation to Evolution;" "From 'Signs and Wonders' to Law in the Heavens;" "From Genesis to Geology;" "The 'Fall of Man' and Anthropology;" "From 'the Prince of the Power of the Air' to Meteorology;" "From Magic to Chemistry and Physics;" "From Miracles to Medicine;" "From Fetich to Hygiene;" "From Demoniacal Possession to Insanity;" "From Babel to Comparative Philology;" "From Leviticus to Political Economy;" and "From Divine Oracles to the Higher Criticism."

The story of Galileo's encounter with the Inquisition occupies a prominent place in the first section ["From Creation to Evolution"] of White's book. He casts the entire story in terms of the metaphor of warfare: with attacks and battles, victories and retreats. Although White's description of the events may sound a bit extreme to us today, we ought to recognize an affinity between it and the persisting legend of the Galileo affair:

> [Galileo's] discoveries had clearly taken the Copernican theory out of the list of hypotheses, and had placed it before the world as a truth. Against him, then, the war was long and bitter. The supporters of what was called 'sound learning' declared his discoveries deceptions and his announcements blasphemy. Semi-scientific professors, endeavoring to curry favor with the church, attacked him with sham science; earnest preachers attacked him with perverted scripture; theologians, inquisitors, congregations of cardinals, and at least two popes dealt with him, and, as was supposed, silenced his impious doctrine forever. . . .
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> The whole struggle to crush Galileo and to save him would be amusing were it not fraught with evil. There were intrigues and counter-intrigues, plots and counter-plots, lying and spying; and in the thickest of this seething, squabbling, screaming mass of priests, bishops, archbishops, and cardinals, appear two popes, Paul V and Urban VIII. It is most suggestive to see in the crisis of the church, at the tomb of the prince of the apostles, on the eve of the greatest errors in church policy the world has known, in all the intrigues and deliberations of these consecrated leaders of the church, no more evidence of the presence of the Holy Spirit than in the caucus of New York politicians at Tammany Hall.

The debate over papal infallibility, formally defined at the First Vatican Council in 1870, as well as liberal reaction to the Catholic Church's condemnation of "modernism," and the politics of the Italian Risorgimento only reinforced the skewed interpretation of the Galileo affair as a prime example of

the hostility of the Catholic Church to reason and science. How, it was alleged, could the Church proclaim its pontiff to be infallible when at least two popes affirmed as a matter of faith the false proposition that the Earth does not move? Proponents of Italian unification saw the Church as a principal barrier to their goal and they invoked the image of a Galileo persecuted by the Church for his advocacy of the liberation of science from religion as a model for those who sought the political liberation of Italy from clerical domination.

In 1887 the government of a united Italy erected a marble pillar outside the Villa Medici near the top of the Spanish Steps in Rome. The pillar has the following inscription: "The next palace is the Trinità dei Monti, once belonging to the Medici; it was here that Galileo was kept prisoner of the Inquisition when he was on trial for seeing that the earth moves and the sun stands still." Galileo was indeed lodged in this villa, then the residence of the Tuscan ambassador to Rome, when he was on trial before the Inquisition in 1633. The second part of the inscription, that the reason for Galileo's trial was that he saw that the earth moves and the sun stands still, captures the prevailing myth that it was Galileo's clear evidence for the new astronomy which was being rejected. It was no coincidence that in 1889 the government of Rome dedicated a statue to Giordano Bruno in the Campo de' Fiori, on the very spot at which he was burned at the stake in 1600. It continues to be easy to associate the treatment of Galileo with that of Bruno, seeing both as champions of science and freedom of thought versus the brutal authoritarianism of the Inquisition.

In the same year that the marble pillar was erected, Umberto I, the second king of a united Italy, issued a royal decree for the collection of Galileo's writings in what would become the famous National Edition edited by Antonio Favaro. The decree announced that it was "a consideration of supreme national pride to satisfy in this manner the long-lasting desire of the scholars, the raising of a new and permanent monument of glory to the marvelous Genius who created experimental philosophy." The National Edition of the works of Galileo, published between 1890 and 1909, is a great scholarly work which came to allow historians of science to challenge essential features of that myth of Galileo which was so evident in the call for the publication of Galileo's works. The very title of the collected works, *Edizione Nazionale*, reveals its political association with the new Italian nation.

In so many ways events in the nineteenth century helped to solidify the legend of Galileo as icon of modernity. As Pietro Redondi has aptly put it, in the mentality of positivism, Galileo represents a "titanic force of reason" breaking into decadent metaphysics and theology and ushering in a "total regeneration of humanity." The condemnation of Galileo was the *scena primaria della modernità*: an unequivocal lesson of the conflict between truth and superstition, freedom of thought and despotism of power, emancipation and servitude. That such a view of the Galileo Affair remains both persuasive and widespread can be seen in a distinguished contemporary Spanish historian of science, Antonio Beltrán, whose most recent work (2006) is *Talento y Poder: Historia de las relaciones entre Galileo y la Iglesia Católica*. Beltrán leaves little doubt as to who represents "talent" and who "power."

The Legend Persists

We might recall the popularity, a few decades ago, of Carl Sagan's television series "Cosmos," or Jacob Bronowski's "Ascent of Man." Each celebrated the victories of science over the forces of religion and superstition. Sagan spoke of the "long mystical sleep," "the thousand years of darkness," when Christianity's dominance thwarted the development of science. Bronowski, in his episode on Galileo and the Church, told us that Galileo thought that "reason should persuade," whereas the Catholic Church claimed that "faith must dominate."

Even so distinguished a historian as Daniel Boorstein, former Librarian of Congress, saw the emancipation of science and reason from domination by religion as a crucial feature of modern Western history. In his best-seller, *The Discoverers*, Boorstein referred to a great hiatus in the history of the West, between the advances in science effected by the ancient Greeks and Romans and the achievements of Galileo and Newton in the seventeenth century. Between these two periods Boorstein claims that there was "a great interruption . . . [a] European-wide phenomenon of scholarly amnesia." He had little difficulty in titling one of his chapters, "The Prison of Christian Dogma." Here we see the legend of Galileo as part of a broader myth of the origins of modern science, according to which the Middle Ages were an unenlightened period, hostile to the development of science. Scholars of mediaeval science, such as Edward Grant, have shown the richness and variety of scientific developments in mediaeval Europe (not to mention the mediaeval Islamic world) which contributed significantly to our understanding of nature. We do not have to go so far as some, who think that without Christianity there would be no science, to recognize that in important ways Galileo's own scientific achievements depended upon the work of his mediaeval predecessors.

It is interesting that in current debates about whether human cloning should be prohibited the spectre of Galileo is invoked by those who argue for freedom of scientific research and cast those who wish to prohibit such research as modern-day inquisitors. In April 2002, speaking in opposition to proposed legislation which would prohibit various forms of research on human stem cells, Senator Arlen Specter stated: "Ideology has no place when it comes to medical science. There have been attempts by government to stifle science. Galileo was imprisoned because he followed Copernicus who said the Earth was not flat." Senator Orrin Hatch, commenting on President Bush's veto in July 2006 of a bill supporting funding for stem cell research, made the same comparison: those who oppose such research, like the inquisitors who opposed Galileo, are on "the wrong side of history:"

> Stem cell research promises to expand human knowledge of the body the way Galileo's vision expanded human knowledge of the universe. By vetoing H.R. 810 this week, the President tried to build a roadblock to the future of stem cell research. . . . Opponents of stem cell research are on the wrong side of history. In 1992, Pope John Paul II officially apologized for the Inquisition's treatment of Galileo. At some point in the future, when the fruits of stem cell

> research bless millions, I imagine critics of this breathtaking technology will offer a similar apology. But victims of afflictions like spinal cord injuries and their families cannot wait 360 years for the country to move ahead with this. We need to get these tools into scientists' hands as quickly as possible. Even if opponents block access to stem cells for a while, this week's vote is an important way of telling them, 'And yet she moves.'

Bioethics continues to be an arena for lively debates which reflect broader cultural issues, and, as we have seen, the story of Galileo and the Inquisition can be used as a powerful rhetorical tool in this discourse. Indeed, in March 1987, on the occasion of the publication of the Catholic Church's condemnation of *in vitro* fertilization, surrogate motherhood, and fetal experimentation, there appeared a page of cartoons in one of Rome's major newspapers, *La Repubblica*, with the headline: "*In Vitro Veritas*." In one of the cartoons, two bishops are standing next to a telescope, and in the distant night sky, in addition to Saturn and the Moon, there are dozens of test-tubes. One bishop turns to the other, who is in front of the telescope, and asks: "*This* time what should we do? Should we look or not?" The historical reference to Galileo was clear. In fact, at a press conference at the Vatican, then Cardinal Josef Ratzinger was asked whether he thought the Church's response to the new biology would not result in another "Galileo affair." The Cardinal smiled, perhaps realizing the persistent power —at least in the popular imagination— of the story of Galileo's encounter with the Inquisition more than three hundred and fifty years before. The Vatican office which Cardinal Ratzinger was then the head, the Congregation for the Doctrine of the Faith, is the direct successor to the Holy Roman and Universal Inquisition into Heretical Depravity.

In 2002, PBS aired a documentary, "Galileo's Battle for the Heavens," which included insightful comments by Dava Sobel, author of *Galileo's Daughter*, and by outstanding scholars like Albert Van Helden and Ernan McMullin. Nevertheless, the narrator observed more than once that geocentric astronomy was a matter of Church doctrine at the time of Galileo. We need to remember, however, that Cardinal Bellarmino had told Galileo in 1615 that "if there were a true demonstration" for the motion of the Earth, then Scripture could not be read as affirming the contrary, since truth cannot contradict truth. Were the cardinal to have thought that the immobility of the Earth was a matter of Church doctrine, he could not, as a Catholic, admit the possibility of a scientific demonstration of the contrary. Although some theologians (and perhaps some popes) may have thought that it was heretical to embrace heliocentric astronomy, the *official* acts of the Church in 1616 and in the trial of Galileo in 1633 were disciplinary not doctrinal. The 1616 prohibition of books which espoused the new astronomy issued by the Index of Forbidden Books was gradually relaxed. The 1757 edition of the Catalogue of Forbidden Books did not include books that favored heliocentric astronomy. In 1820, Pope Pius VII sanctioned the granting of the imprimatur to works presenting Copernican astronomy as true and not merely as hypothetical. The failure to change Church discipline more expeditiously did contribute, however, to the myth that there was a fundamental conflict between faith and science.

Current controversy within the Catholic Church concerning what kind of authority Rome has —or should exercise— on a range of topics also provides evidence for the enduring influence of the legend of Galileo. Hans Küng, whom I have already cited, argued that Pope John Paul II's "judgments on birth control and the ordination of women were as infallibly wrong as were those of his predecessors on astronomy and heliocentricity." Writing in the British Catholic weekly, *The Tablet*, in March 2004, Michael Hoskin of Cambridge University reflected on what he called "The Real Lesson of Galileo." He claimed that "the much heralded 'rehabilitation' of Galileo in 1992 was in part an attempt to gloss over the falsity of the doctrinal decrees issued —with papal endorsement— by the church organisations of Galileo's day. If the Holy Office was mistaken in its doctrinal decree then its successor, the Congregation for the Doctrine of the Faith, may sometimes be mistaken now. But this is not a conclusion the Church has allowed." Note how important it is for Hoskin that what happened in the seventeenth century be recognized as an error in doctrine – versus what I called an error in discipline. According to Hoskin: "The real issue of the Galileo affair for the Church today —an acceptance of the possible reformability of doctrinal pronouncements promulgated by the Congregation for the Doctrine of the Faith even with the approval of the Pope— has yet to be learned."

Hoskin's interpretation is informed, in part, by the work of a Swiss-Italian historian, Francesco Beretta, who has done ground-breaking work in the recently opened archives of the Inquisition. Beretta claims that a censure of heresy was *formally* applied to heliocentric astronomy and since such a censure was pronounced by the pope, as supreme judge of the faith, it acquired the value of an act of the magisterium of the Church. He thinks that in 1633 Pope Urban VIII acted in his role as "supreme judge in matters of faith" and that already in 1616 Pope Paul V, in his formal capacity as head of the Inquisition, declared Copernican astronomy to be "contrary [*omnino adversantem*] to Holy Scripture" and therefore cannot be defended or held. This latter decision was the basis of the order given to Galileo not to hold or defend the new astronomy. Any evaluation of Beretta's thesis requires careful distinctions both of different senses of heresy and of the judicial and magisterial authority exercised by popes.

The ways in which the legend of Galileo have been used for various ideological purposes seem to defy the imagination. But I would like to cite one final and especially bizarre example from the twentieth century. In May 1938 Adolf Hitler paid a state visit to Italy to strengthen the Rome-Berlin Axis. At an official ceremony in the Palazzo Venezia, Hitler handed Mussolini a document expressing "the gratitude of the German people towards one of the most famous scientists in world history." He continued: "As Führer and Chancellor of the Deutsches Reich, I request Benito Mussolini, the Duce of the people, that has given the great inventor and scientist Galileo Galilei to the world, to accept as a token of our reverence and friendship a Zeiss telescope and the complete equipment of an observatory." The gift of the telescope honors Galileo and his fight for the "theory of the great German Nicholas Copernicus." For some time, even before Hitler's ascent to power, many

Germans considered Copernicus to be German, not Polish, since he was born in Torùn (in German, Thorn), which had been founded by the Teutonic Order of Knights in 1231, ceded to Poland in 1466, to Prussia in 1815, and back to Poland in 1919. Kepler, like Copernicus, is also German, and thus the origins of modern science are German and Italian. These three scientists, collectively, serve as a symbol for the German-Italian block, which Goebbels conceived as "the centerpiece of Occidental culture." As Galileo and Kepler were intellectual brothers in arms, so too are Mussolini and Hitler, united "for a better and more unified Europe." There is yet a further twist to the story. In March 1937 Pope Pius XI issued *Mit brennender Sorge* (With Deep Anxiety) which, among other things, condemned Nazi racial theory. A German mathematician, Ludwig Bieberbach (1886-1982), known for his commitment to "Deutsche Mathematik," a racial theory of mathematics, published a book in 1938 on Galileo and the Inquisition. He compared the trial of Galileo with the show trials in Moscow ordered by Stalin. At the heart of his book, however, was a rejection of the Pope's condemnation of Nazi racial laws. Just as the reactionary Catholic Church at the time of Galileo wrongly sought to suppress the advance of science, so too, in the twentieth century, the same Church wrongly condemns the new science espoused by Nazi Germany. The Galileo Affair became an ideological tool to support Nazi policy; the lesson Bieberbach drew was clear: to oppose Nazi racial laws was like opposing Galileo's claim that the Earth moves.[2] Here we come full circle from Serge Galam's comparison, in *Le Monde*, of the Church's treatment of Galileo with the Nazis' treatment of Einsteinian science.

Conclusion

The rhetoric of the hostility between science and religion continues to exercise a powerful hold on contemporary interpretations of the history of the modern world. Since Galileo was correct in his conclusion that the Earth moves, it became and remains useful to portray defenders of other scientific claims as modern-day Galileos and to see their opponents as successors of the Inquisition. And, with respect to topics like bioethics and global warming, too often there has been a confusing or conflating of ethical and scientific theses. The condemnation of research on human embryonic stem cells, for example, is not a rejection of scientific knowledge; it concerns what actions are ethically legitimate, not what knowledge is somehow unacceptable.

There is no evidence that Galileo, when he acceded to the Inquisition's demand in 1633 that he formally renounce the view that the Earth moves, muttered under his breath, *eppur si muove*, but still it moves. What continues to move, despite evidence to the contrary, is the legend that Galileo represents science's fighting to free itself from the clutches of blind faith, biblical literalism, and superstition. But Galileo and the Inquisition shared common first

[2] Information concerning this analysis can be found in VOLKER REMMERT, "In the Service of the Reich: Aspects of Copernicus and Galileo in Nazi Germany's Historiographical and Political Discourse" in Science in Context 14:3 (2001), 333-359.

principles about the nature of scientific truth and the complementarity between science and religion. In the absence of scientific knowledge that the Earth moves, Galileo was required to deny that it did. However unwise it was to insist on such a requirement, the Inquisition did not ask Galileo to choose between science and faith. Nevertheless, for many it remains ideologically useful to think of Galileo as a martyr who was persecuted because his science challenged the authority of the Catholic Church.