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THE LEGACY OF GALILEO GALILEI

Conference Discusses Scientist's Continuing Influence

By Edward Pentin

ROME, DEC. 3, 2009 (Zenit.org).- Four hundred years after he invented the first telescope, Galileo Galilei's legacy lives on, continuing to influence how the world views science and how science views the world and, of course, the universe.

The extent of his impact on the scientific world and the Church was examined in great detail at a fascinating Rome conference this week, held by the Pontifical Lateran University.

Entitled "1609-2009: From Galilei's Telescope to Evolutionary Cosmology -- Science, Philosophy and Theology in Dialogue," the three-day meeting brought together a star line-up of speakers including two Nobel Laureates for Physics, cosmologists, theologians and philosophers. It comes at the end of an International Year of Astronomy, held to celebrate Galileo's 1609 invention.

The conference logically began by clearing up the myths that still surround Galileo and his relationship with the Church. Dr. Owen J. Gingerich, a former research professor of astronomy and of the history of science at Harvard University, laid out the history of the

controversy.

He swiftly ruled out the most famous and seemingly irrefutable accusation: that Galileo was tortured by the Church. The Italian astronomer was sent a letter, Gingerich said, which stated he was to be "interrogated for vehement expression of heresy" and that included "legally being shown the instruments of torture."

But Gingerich said Galileo "was certainly not tortured and I suspect also not shown the instruments of torture, but he was on his third interrogation when he realised there was to be no discussion, that he wasn't going to be able to argue that the Copernican system should be taken seriously." He therefore was willing to "confess in any way that was required, put under house arrest and sent back to Florence."

Professor Gingerich said it was particularly important to view the Galileo case in context. "You must understand that the great majority of people thought the Copernican system was completely ridiculous," he explained. "It was not a matter of only the Catholic hierarchy thinking it was ridiculous; nobody else wanted to adopt the Copernican system."

The American astronomer then made a particularly pertinent observation: that the Galileo controversy "essentially changed the way we do science because today science works primarily by persuasion and not by proof, and Galileo greatly influenced in making that happen."

After Galileo published his Dialogue Concerning the Two Chief World Systems which compared the Copernican and Ptolemaic systems (that the earth went round the sun and that the sun went round the earth), Gingerich said there was a steady "erosion of this distinction between the earth and the heavens." But it took centuries for the world to fully come around.

Era of discovery

Yet the advances in astronomy since then have been breathtaking, and many of them have taken place over the last 15-20 years. "We're in an era of great discovery and making great progress," said Professor George F. Smoot, who won the Nobel Prize for Physics in 2006 for

his work in helping to understand the Big Bang Theory.

Thanks to the Hubble space telescope and the more recent Planck space observatory launched by the European Space Agency, astronomers can now see the universe in much greater detail. Smoot, whose task is to map the surface of the beginning of the universe, compared two maps of the globe to illustrate how much progress has been made. One showed all the continents roughly mapped out much like a medieval atlas; the second displayed the earth in great topographical detail. The former represented what we knew of the universe in 1992; the latter, what we know today.

Today's telescopes have led to the discovery of at least 100 billion galaxies in the universe, Smoot noted, leading him to pose a provocative cosmological question: "If the purpose of the universe is that human beings could live there, why would you make so many galaxies? Clearly one would be more than enough to create the solar system [yet] there are many, many galaxies distributed in strange ways and evolving all the time. So the question you have in cosmology is to explain all these series of factors." He added that astronomers hope Planck will help them better understand the fundamental nature of creating space and time which, he said, "is very critical."

Beyond observation

In his address to the conference participants on Tuesday, Benedict XVI said Galileo's lesson is also a call to go beyond what can be observed. The questions about the immensity of the universe, its origin and its end, "do not admit only one answer of a scientific character," he said. "Whoever looks at the cosmos following Galileo's lesson will not be able to stop only with that which he observes with a telescope; he will have to further proceed to ask himself about the meaning and end to which the whole of creation is oriented."

In this context, the Pope observed, philosophy and theology have an important role "to prepare the way for further knowledge."

Several speakers stressed that Galileo valued Scripture, noting that he liked to quote Cardinal Ceasar Baronius who said: "The Bible was written to show us how to go to heaven, not how the heavens go." But Galileo stressed that the Bible should not be taken literally or

as an instrument for proving science. By doing so, hoped this view might foster a reconciliation between faith and science (his detractors, however, took the opposite view and saw it as an attempt by him to interfere in theology).

However, according to Archbishop Gianfranco Ravasi, president of the Pontifical Council for Culture, Galileo's point on literalism taught something very relevant to the world today: that such interpretations of the Bible lead to fundamentalism. The Italian archbishop, who is also a renowned biblical scholar, said that biblical texts are "a living reality" and therefore involve the risk of fundamentalism. But he also stressed that through the Bible one can come to appreciate the "aesthetics of creation." "Man can never present himself in creation just by studying it from a physical standpoint," he explained. "As the scientist studies the universe from scientific standpoint, he lets himself be overwhelmed by symbolic language and resorts to aesthetic, poetic emotions."

"This is what believers do, and great thinkers such as [Blaise] Pascal when he talks of the awe and almost dizziness when he is faced with these immense spaces and recognizes that he is a very fragile creature," the archbishop continued. He referred to Psalm 8 in which a man contemplates the galaxies and thinks to himself: what is man? "Great existential questions stem from the aesthetic contemplation of creation," said Archbishop Ravasi, "and this is one of our great impoverishments." It's not that mankind hasn't progressed in science, he said, "but that man hasn't progressed in contemplation of the beauty of creation."

Quoting G.K. Chesterton, he said "we are perishing for lack of wonder, not for lack of wonders." The archbishop then implored believers and non-believers "to discover the secret, poetic value" of creation.

Order or disorder?

As an interesting aside, Professor Smoot had said in his talk that the universe is "extremely ordered" and appears to be becoming even more ordered.

This prompted a member of the audience to question the professor's observation, asking whether, as is commonly thought, the universe is expanding and cooling to a uniform

temperature and therefore becoming more disordered, a process known in thermodynamics as increasing entropy.

The logical conclusion is that, if this is so, then the universe is heading toward eventual death, or what astrophysicists call "heat death" whereby all the energy of the cosmos ends up as a homogeneous distribution of thermal energy, so that no more work can be extracted from any source.

Professor Smoot replied first of all by saying that the very early part of the universe had low entropy. He then continued: "Entropy is greatest where there are black holes, and our present understanding is that most of the entropy of the universe is in large black holes.

"Specific entropy is still quite low, and although the universe started extremely ordered, it has gotten less ordered. Even though it looks more ordered, if you look at how galaxies and dark matter is distributed, it is actually more disordered than the almost uniform distribution it had to start with.

"This disorder is increasing, and one of the major arguments today is whether this entropy will keep increasing forever, or whether at some time that information is lost and erased and you get a new Big Bang.

"That's one of the interesting questions in cosmology now: that even though it appears we're getting more ordered, we're not."

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