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Record - 1

DIALOG(R)

In Lynn, teacher hopes for a comeback
Kathy McCabe
Boston Globe (MA), p1
Sunday, August 16, 2009

TEXT:
LYNN - With the Smithsonian, Harvard, and NASA on his resume, Sean McKenzie hoped he would land a teaching job soon after he was laid off in June from the Robert L. Ford School in Lynn.

But the middle school science teacher, on the job only three years, now is riding the budget roller coaster. "It's stressful," said McKenzie, 37. "You always hear that schools need male, math, and science teachers. Well, I'm a male. I'm a science teacher. I just lost my job."

Although federal stimulus funds were used to balance many local school budgets, not every school district was able to avoid job cuts. Lynn, one of

the region's largest school districts, laid off 118 teachers in June.
It is unclear how many may be recalled by the time school opens next month. Neither Lynn School Superintendent Catherine Latham nor Lynn Teachers Union President Alice Gunning could be reached for comment.

School districts often recall laid-off teachers, usually due to a mix of late retirements and enrollment projections. In Malden, for example, 53 positions were eliminated, most of them teachers. But rehiring started after 24 teachers retired, said Nancy Kassabian, assistant superintendent

"We're rebounding well," she said. "We've signed a number of contracts with new teachers over the past few weeks. All of them are just bright lights, eager to teach."
In Andover, where 18 teachers were laid off, Superintendent Claudia L. Bach said there is always the chance of a recall. "Maybe tomorrow somebody else will resign," she said.

In Lynn, McKenzie is hoping his cellphone rings soon. He and his wife are expecting their first child. His health insurance is due to run out in October. "There are not that many jobs out there now," he said. "What I really hope is that I get to stay in Lynn."
McKenzie's job was cut after Ford's middle school program was eliminated. The school used to be grades K-8, but will open in September as a grade K-4 elementary school. In all, 16 teachers lost their jobs, principal Claire Crane said
"A lot of young talent was lost," Crane said. "It's really too bad. Some of them still have no jobs."
McKenzie is a former wildlife biologist for the State of Florida. He worked at state parks, studying shore birds, sea turtles, and alligators, among other species. He opted to change careers when he moved to Lynn in 2004.

"The ecosystems up here are different, so I didn't think I could get a biology job right away," said McKenzie, a former swimmer at Florida State University. "I had run educational programs in the parks, and I like kids, so I decided to try teaching."
McKenzie dove into the Ford universe. In 2006, the school was chosen as a NASA Explorer School, with the national space agency providing science and technology curriculum, along with teacher training. He attended free NASA training on climate and ice one winter at Yellowstone National Park in Wyoming

"NASA wanted to look at the harshest environment on Earth to better understand where there could possibly be life in space," said McKenzie, who attended with another Ford teacher. "It was the best professional development one could receive. We studied with some of the best scientists on the planet."
He loved to share his new knowledge with his seventh-graders. "People tell me, 'Middle school is a very tough age. The kids are all over the board.' I loved it. I saw a lot of kids mature and become really good students."
McKenzie last year supervised a three-year pilot program with the Harvard-Smithsonian Center for Astrophysics in Cambridge. They studied physical and planetary science two days after school, using Web-based technology to tap into a center telescope.

After school got out in June, the kids spent two days working in laboratories, and visiting museums at Harvard. "The kids were out of

school, but they came back to go," McKenzie said. "I had the most amazing job."

Globe editorial assistant Brian Benson contributed to this story. Kathy McCabe can be reached at kmccabe@globe.com.

Record - 2

DIALOG(R)
Large galaxy hides behind the Milky Way
Ken Croswell
New Scientist, v203, n2721, p10
Saturday, August 15, 2009

TEXT:
A LARGE satellite galaxy may be lurking, hidden from view, next door to our own.

Sukanya Chakrabarti and Leo Blitz of the University of California, Berkeley, suspected that the gravity of a nearby galaxy was causing perturbations that have been observed in gas on the fringes of the Milky Way. "We did a large range of simulations where we varied the mass of the perturber and the distance of closest approach," says Chakrabarti. In the best-fitting simulation, the unseen galaxy has about 1 per cent of the Milky Way's mass, or 10 billion times the mass of the sun.

That's a lot. It means the object has roughly the same mass as the Milky Way's brightest satellite galaxy, the Large Magellanic Cloud (LMC). Right now, says Chakrabarti, the galaxy is roughly 300,000 light years away from us - about twice as far away as the LMC. But the simulations suggest it follows a highly elongated elliptical path, and about 300 million years ago it swept through our own galaxy just 16,000 light years from the galactic centre - closer in than Earth - disturbing the Milky Way's outskirts as it went.

"Overall, it is a very plausible scenario," says Abraham Loeb at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, who was not part of the study. "Of course, the fact that we don't see such a massive satellite is an issue."

Chakrabarti suggests that the galaxy has remained hidden because it is not a brilliant spectacle. Whereas the LMC glistens with bright young stars and the gas that spawned them, the unseen galaxy may be dead, containing old stars and little gas.

To make matters worse, the simulations suggest that the galaxy orbits ours in the same plane as our galaxy's disc. If it is now on the opposite side of the galaxy from us, it could be hiding behind the thick gas and dust in the galactic plane. "It's very likely to be in a region of very high obscuration," says Chakrabarti. The work will appear in Monthly Notices of the Royal Astronomical Society .
By further studying the distribution of gas, Chakrabarti hopes to pinpoint

the galaxy's location so that astronomers will know where to look for it. This parallels the way astronomers in the 1840s discovered Neptune from irregularities in the motion of Uranus caused by gravitational tugs from the more distant planet. If the unseen galaxy exists, it will be the first nearby galaxy detected through its gravity rather than its starlight.

Record - 3

DIALOG(R)
Did self-assembling asteroids gave rise to planets?
David Shiga
New Scientist, v203, n2721, p9
Saturday, August 15, 2009

TEXT:
PERHAPS we should thank rapid-assembly asteroids for spawning the planets. New simulations suggest that dense swarms of boulders collapsed under their own gravity to make the building blocks of our solar system.

The planets are thought to have formed from a disc of dust and gas around the infant sun. The initial process is well known: dust grains clumped together, forming objects in the millimetre-to-metre range. However, it is not known how the growth process continued. The gas in the disc should have put a drag on the new boulders, causing them to spiral into the sun before they could grow further.

Evidence is now mounting that the next step was a sudden leap forward, skipping intermediate sizes to make asteroids hundreds of kilometres across - massive enough to resist gas drag.

This basic idea is decades old, but it attracted renewed attention in 2007 and 2008 following simulations by a team led by Anders Johansen of the Max Planck Institute for Astronomy in Heidelberg, Germany, and by another team led by Jeffrey Cuzzi of NASA's Ames Research Center in Moffett Field, California. These showed that turbulence in the nebula could have concentrated objects less than a metre across in dense enough swarms to collapse under their mutual gravity and form large asteroids tens to hundreds of kilometres across.

"If either one of these models turns out to be right... this will be a big step forward," says John Chambers of the Carnegie Institution in Washington DC.

Now a new study has found evidence that such a process did occur in our solar system. It is based on the size of objects in the asteroid belt. Estimates from telescopic surveys suggest there are millions of the smallest asteroids, which are less than a kilometre across, with the numbers of larger ones dropping off sharply. Yet this size distribution and number would once have been different: asteroids can grow by sweeping up smaller objects, and shatter if they collide with an object of similar size.
Alessandro Morbidelli of the Cote D'Azur Observatory in Nice, France, led a team that simulated the evolution of the asteroid belt, modelling a variety

of starting populations (Icarus , DOI: 10.1016/j.icarus.2009.07.011).

When the team started with small asteroids a few hundred metres to a few kilometres across - a scenario that might have occurred in the absence of a "sudden leap" - they ended up with far more small asteroids than are seen today. Another scenario started solely with 100-kilometre objects, but ended up with too few asteroids at the high end of the size range. But they did find a good fit with today when they started with a mixture of sizes between 100 and 1000 kilometres across, suggesting that large asteroids did form spontaneously during the solar system's development.

"It's a nice story and they have a lot of evidence supporting their point of view," says Scott Kenyon of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts. But he cautions that it may have been difficult to complete planet formation in a reasonable time if there were no small asteroids at the outset. Small asteroids boost the rate of collisions needed for growth through their gravitational interactions with larger ones, he says.

Record - 4

DIALOG(R)
EVA PELL NAMED SMITHSONIAN UNDER SECRETARY FOR SCIENCE
US Federal News
Friday, August 14, 2009

TEXT:
WASHINGTON, Aug. 13 -- The Smithsonian Institution issued the following press release:

Eva J. Pell, Senior Vice President for Research and Dean of the Graduate School at Pennsylvania State University, has been named Under Secretary for Science at the Smithsonian Institution. Pell has been Vice President and Dean since 2000 and was promoted to Senior Vice President for Research and Dean of the Graduate School at the university in 2006. She will begin at the Smithsonian Jan. 4, 2010, and report directly to Smithsonian Secretary Wayne Clough.

As Under Secretary for Science, Pell will directly oversee the operations of the National Museum of Natural History; the National Air and Space Museum; the National Zoo and its Conservation and Research Center in Front Royal, Va.; the Smithsonian Astrophysical Observatory in Cambridge, Mass.; the Smithsonian Environmental Research Center in Edgewater, Md.; the Smithsonian's Museum Conservation Institute in Suitland, Md.; and the Smithsonian Tropical Research Institute in Panama.

Pell, 61, brings an environmental science background to this position and a strong track record of leadership. She was a professor in the department of plant pathology at Penn State for more than 35 years. In her role as Senior Vice President for Research at the university, Pell spearheads the development of cross-disciplinary institutes for life sciences, materials, energy and environment, social sciences, cyber science, and arts and humanities; all six institutes report directly to her. She is also

responsible for sponsored research, compliance and the university's animal research center. In addition, Pell is responsible for the Penn State Research and Technology Transfer Organization, which connects Penn State researchers with industries in order to stimulate economic development.

As Dean of the Graduate School, she oversees graduate admissions, fellowships, awards and curriculum. Pell has developed several programs at Penn State to increase the number of minority applicants for graduate programs.

Pell holds a bachelor's degree in science from the City College of New York and a doctorate degree in plant biology from Rutgers University. Her research focuses on the effects of air pollution on plants.

Pell has served on panels and advisory boards for the Environmental Protection Agency, the Department of Agriculture and the Department of Commerce. She currently serves on the National Science Foundation's Biological Sciences Advisory Committee. In addition, Pell is active in economic development and serves on a number of Pennsylvania state boards, including the Ben Franklin Center of Central and Northern Pennsylvania and the Life Sciences Greenhouse of Central Pennsylvania. She is also the president of the Penn State Research Foundation and the Research Park Management Corporation.

"We are proud to welcome Dr. Pell to the Smithsonian as our new Under Secretary for Science," said Secretary Clough. "She is an accomplished scientist, experienced leader and inspired educator who will help us raise the global profile of Smithsonian science. We will benefit greatly from her many talents."

"Anyone who comes to Washington, D.C., finds him or herself touched by Smithsonian activities, as the Institution is at the nexus between discovery and education," said Pell. "I am excited and humbled by the opportunity presented to me by Secretary Clough and am looking forward to the possibilities to expand the reach and dimensions of Smithsonian science."
Pell succeeds David L. Evans who left the position in April 2007. For the past two years, the position of acting Under Secretary for Science has been held by Ira Rubinoff, former director and current senior scientist at the Smithsonian Tropical Research Institute, and currently by Charles Alcock, director of the Smithsonian Astrophysical Observatory.For more information please contact: Sarabjit Jagirdar, Email:-
htsyndication@hindustantimes.com.

Record - 5
DIALOG(R)
Penn State scientist tapped for Smithsonian post
AP Alert - Virginia
Thursday, August 13, 2009

TEXT:
WASHINGTON_Eva Pell, the senior vice president for research and dean of Pennsylvania State University's graduate school, has been appointed

undersecretary for science at the Smithsonian Institution.

Pell, 61, is an environmental scientist and was a professor for 35 years in Penn State's plant pathology department. The appointment announced Thursday by Smithsonian Secretary Wayne Clough takes effect in January 2010.

Clough said Pell will help raise the global profile of Smithsonian science and research. He has said he wants the world's largest museum and research complex to be a major player on current science issues, such as climate change and sustainability.

"Anyone who comes to Washington, D.C., finds him or herself touched by Smithsonian activities, as the institution is at the nexus between discovery and education," Pell said in a statement.

She will oversee the National Museum of Natural History, the National Air and Space Museum, the National Zoo and research centers in Maryland, Massachusetts, Virginia and Panama. Pell currently serves on a biological sciences advisory committee for the National Science Foundation.

Pell succeeds David Evans who left the Smithsonian in 2007 _ one day after embattled Smithsonian Secretary Lawrence Small stepped down amid criticism of his spending and compensation. For the past two years, the position has held by directors from the Smithsonian Tropical Research Institute in Panama and the Smithsonian Astrophysical Observatory in Cambridge, Mass.

Record - 6

DIALOG(R)
Panel: NASA needs to do more to spot killer asteroids
Dan Vergano
USA Today (USA), p10D
Thursday, August 13, 2009

TEXT:
NASA is falling well short in its goal to spot huge asteroids that could threaten Earth, and it needs more money and skywatchers to do the job, a science panel said Wednesday.

In 2005, Congress asked the space agency to find 90% of all "potentially hazardous" near-Earth asteroids and comets, ones more than 460 feet wide (farther than home plate to deep centerfield in Yankee Stadium), by 2020. Instead, the three current survey efforts dedicated to the problem, supported at current levels, will likely find only about 15%, suggests the National Research Council panel.

"For the first time, humanity has the capacity and the audacity to avoid a natural disaster," says Irwin Shapiro of the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Mass., who headed the panel. "It really is a question of how much to invest in an insurance policy for the planet."

Astronomers rate the odds of a civilization-threatening space impact at once every 2 million years. The chances of a smaller impact, such as the 1909 Siberian event that leveled nearly 800 square miles of forest, are rated at once every two centuries, according to a 2008 estimate by space scientist David Morrison of NASA's Ames Research Center in Moffett Field, Calif.

The CfA lists 1,060 "potentially hazardous" asteroids or comets on its registry, those that pass within about 4.5 million miles of Earth as they orbit the sun and measure at least 245 feet across. That's big enough to cause a 3-megaton explosion, more than 100 times more powerful than the Hiroshima bomb .

Despite the 90% detection mandate, "the administration has not requested and Congress has not appropriated new funds to meet this objective," the report notes. Says Laurence Young of MIT, who reviewed a draft of the report: "The sky is falling, but we don't know how fast, and we don't know where and when. We should be improving our abilities to detect these objects."

The NRC report is an interim one, ahead of a final report later this year recommending further options for more asteroid observatories, including spacecraft. At least five new observatories, as well as German and Canadian spacecraft, are under consideration for Earth's asteroid-detecting capabilities. In July, NASA's Jet Propulsion Laboratory started an "Asteroid Watch" website to update the public on near-Earth asteroids and comets.

Despite the report, Alan Harris of the Space Science Institute in La Canada, Calif., suggests that new telescopes planned for Hawaii will improve searches and lead to the detection of about 80% of the most threatening asteroids by 2020.

"My personal opinion is that the risk reduction to be had by enhancing the discovery rate to literally meet the congressional goal is not worth the costs," Harris says.

The panel's final report will examine the 90% goal, warning-time improvement and international collaboration.

"I wouldn't get too frightened," Shapiro says. But he adds that all the proposed future observatories for finding more asteroids aren't funded yet. "Without the cameras in place, they aren't going to see anything."

Record - 7

DIALOG(R)
Space Telescopes Find Trigger-Happy Star Formation
National Aeronautics and Space Administration Documents
Wednesday, August 12, 2009

TEXT:
MEDIA RELATIONS OFFICE

JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PASADENA, CALIFORNIA 91109. TELEPHONE 818-354-5011

http://www.jpl.nasa.gov

Whitney Clavin 818-354-4673
Jet Propulsion Laboratory, Pasadena, Calif.

whitney.clavin@jpl.nasa.gov

Megan Watzke 617-496-7998

Chandra X-ray Center, Cambridge, Mass.

mwatzke@cfa.harvard.edu

Janet Anderson 256-544-6162

NASA Marshall Space Flight Center, Ala.

janet.l.anderson@nasa.gov

NEWS RELEASE: 2009-123 - - - - -

August 12, 2009

Space Telescopes Find Trigger-Happy Star Formation

PASADENA, Calif. -- A new study from two of NASA's Great Observatories provides fresh insight into how some stars are born, along with a beautiful new image of a stellar nursery in our Milky Way galaxy. The research shows that radiation from massive stars may trigger the formation of many more stars than previously thought.

While astronomers have long understood that stars and planets form from the collapse of a cloud of gas, the question of the main causes of this process has remained open.

One option is that the cloud cools, gravity gets the upper hand, and the cloud falls in on itself. The other possibility is that a "trigger" from some external source -- like radiation from a massive star or a shock from a supernova -- initiates the collapse. Some previous studies have noted a combination of triggering mechanisms in effect.

By combining observations of the star-forming cloud Cepheus B from the Chandra X-ray Observatory and the Spitzer Space Telescope, researchers have taken an important step in addressing this question. Cepheus B is a cloud of mainly cool molecular hydrogen located about 2,400 light years from Earth. There are hundreds of very young stars inside and around the cloud -- ranging from a few million years old outside the cloud to less than a

million in the interior -- making it an important testing ground for star formation.

"Astronomers have generally believed that it's somewhat rare for stars and planets to be triggered into formation by radiation from massive stars," said Konstantin Getman of Penn State University, University Park, Pa., lead author of the study. "Our new result shows this belief is likely to be wrong."

This particular type of triggered star formation had previously been seen in small populations of a few dozen stars, but the latest result is the first time it has been clearly observed in a rich population of several hundred stars.

While slightly farther away than the famous Orion star-forming region, Cepheus B is at a better orientation for astronomers to observe the triggering process. The Chandra observations allowed the astronomers to pick out young stars within and around Cepheus B. Young stars have turbulent interiors that generate highly active magnetic fields, which, in turn, produce strong and identifiable X-ray signatures.

The Spitzer data revealed whether the young stars have a disk of material (known as "protoplanetary" disks) around them. Since they only exist in very young systems where planets are still forming, the presence of protoplanetary disks -- or lack thereof -- is an indication of the age of a star system.

The new study suggests that star formation in Cepheus B is mainly triggered by radiation from one bright, massive star outside the molecular cloud. According to theoretical models, radiation from this star would drive a compression wave into the cloud-triggering star formation in the interior, while evaporating the cloud's outer layers. The Chandra-Spitzer analysis revealed slightly older stars outside the cloud, and the youngest stars with the most protoplanetary disks in the cloud interior -- exactly what is predicted from the triggered star formation scenario.

"We essentially see a wave of star and planet formation that is rippling through this cloud," said co-author Eric Feigelson, also of Penn State. "It's clear that we can learn a lot about stellar nurseries by combining data from these two Great Observatories."

A paper describing these results was published in the July 10 issue of the Astrophysical Journal. The team of astronomers that worked with Getman and Feigelson also included Kevin Luhman and Gordon Garmire from Penn State; Aurora Sicilia-Aguilar from Max-Planck-Institut fur Astronomie in Germany; and Junfeng Wang from Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.

NASA's Marshall Space Flight Center in Huntsville, Ala., manages the Chandra program for NASA's Science Mission Directorate in Washington. The Smithsonian Astrophysical Observatory controls Chandra's science and flight operations from Cambridge, Mass. NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA. The Spitzer observations were taken

during the observatory's "cold" mission, before its coolant ran out and it began operating at a warmer temperature.

The new image and information about Spitzer are online at http://www.spitzer.caltech.edu/spitzer and http://www.nasa.gov/spitzer. The image and information about Chandra are online at http://chandra.harvard.edu and http://chandra.nasa.gov.

-end-

Record - 8

DIALOG(R)
Galileo's vision: four hundred years ago, the Italian scientist looked into space and changed our view of the universe. A new exhibit brings one of...
Zax, David
Smithsonian, v40, n5, p58(6)
Saturday, August 1, 2009

TEXT:
Galileo's vision: four hundred years ago, the Italian scientist looked into space and changed our view of the universe. A new exhibit brings one of his telescopes to the U.S. for the first time.

INSIDE A GLASS CASE SITS A PLAIN-LOOKING TUBE, worn and scuffed. Lying in the street, it would look like a length of old pipe. But as I approach it, Derrick Pitts--only half in jest--commands: "Bow down!"

The unremarkable-looking object is in fact one of the most important artifacts in the history of science: it's one of only two surviving telescopes known to have been made by Galileo Galilei, the man who helped revolutionize our conception of the universe. The telescope is the centerpiece of "Galileo, the Medici and the Age of Astronomy," an exhibition at the Franklin Institute in Philadelphia (until September 7).

Pitts, who runs the institute's planetarium and other astronomy programs, says that receiving the telescope from Florence's Institute and Museum of the History of Science--the first time the Instrument has ever left Florence--was "something of a religious experience." Understandably so: If Galileo is considered a patron saint of astronomy, then his telescope is one of its holiest relics. "Galileo's work with the telescope unleashed the notion that ours is a sun-centered solar system and not an Earth-centered solar system," says Pitts. in other words, from that ugly old cylinder came the profound Idea that we are not the center of the universe.

It was a dangerous idea, and one that cost Galileo his freedom.

ON A STARRY NIGHT in Padua 400 years ago, Galileo first turned a telescope toward the sky. It might seem the most natural of actions--what else does one do with a telescope, after all? But in 1609, the instrument, which had been invented only the year before by Dutch opticians, was known as a "spyglass," in anticipation of its military uses. The device was also sold as a toy. When Galileo read of it, he quickly set about making a much more

powerful version. The Dutch telescopes magnified images by 3 times; Galileo's telescopes magnified them by 8 to 30 times.
At the time, astronomy, like much of science, remained under the spell of Aristotle. Almost 2,000 years after his death, the giant of Greek philosophy was held in such high regard that even his most suspect pronouncements were considered unimpeachable. Aristotle had maintained that all celestial objects were perfect and Immutable spheres, and that the stars made a dizzying daily journey around the center of the universe, our stationary Earth. Why scrutinize the sky? The system had already been neatly laid out in books. Astronomers "wish never to raise their eyes from those pages," Galileo wrote in frustration, "as if this great book of the universe had been written to be read by nobody but Aristotle, and his eyes had been destined to see for all posterity."

In Galileo's day, the study of astronomy was used to maintain and reform the calendar. Sufficiently advanced students of astronomy made horoscopes; the alignment of the stars was believed to influence everything from politics to health.

Certain pursuits were not in an astronomer's job description, says Dava Sobel, author of the bestselling historical memoir Galileo's Daughter (1999). "You didn't talk about what the planets were made of," she says. "It was a foregone conclusion that they were made of the fifth essence, celestial material that never changed." Astronomers might make astrological predictions, but they weren't expected to discover anything new.
So when Galileo, then 45 years old, turned his telescope to the heavens in the fall of 1609, it was a small act of dissent. He saw that the Milky Way was in fact "a congeries of innumberable stars," more even than his tired hand could draw. He saw the pockmarked surface of the moon, which, far from being perfectly spherical, was in fact "full of cavities and prominences, being not unlike the face of the Earth." Soon he would note that Jupiter had four moons of its own and that Venus had moonlike phases, sometimes waxing to a disk, sometimes waning to a crescent. He later saw imperfections in the sun. Each discovery drew Aristotle's system further into question and lent ever more support to the dangerously revolutionary view that Galileo had privately come to hold--set out just a half-century earlier by a Polish astronomer named Nicolaus Copernicus--that the Earth traveled around the sun.

"I give infinite thanks to God," Galileo wrote to powerful Florentine statesman Belisario Vinta in January of 1610, "who has been pleased to make me the first observer of marvelous things."

LIKE MANY FIGURES whose names have endured, Galileo wasn't shy about seeking fame. His genius for astronomy was matched by a genius for self-promotion, and soon, by virtue of several canny decisions, Galileo's own star was rising.

In Tuscany the name Medici had been synonymous with power for centuries. The Medici family acquired and wielded it through various means-public office, predatory banking and alliances with the powerful Catholic Church. Conquest was a method favored in the late 16th century, when the head of the family, Cosimo I, seized many regions neighboring Florence. The family took a keen interest in science and its potential military applications.

The Medicis may have needed scientists, but scientists--and especially

Galileo--needed the Medicis even more. With a mistress, three children and an extended family to support, and knowing that his questioning of Aristotelian science was controversial, Galileo shrewdly decided to court the family's favor. In 1606, he dedicated a book about a geometric and military compass to his student Cosimo II, the family's 16-year-old heir apparent.

Then, in 1610, on the occasion of his publication of The Starry Messenger, which detailed his telescopic findings, Galileo dedicated to Cosimo II something far greater than a book: the very moons of Jupiter. "Behold, therefore, four stars reserved for your illustrious name," wrote Galileo." ... Indeed it appears that the Maker of the Stars himself, by clear arguments, admonished me to call these new planets by the illustrious name of Your Highness before all others." (Galileo chose the name "Cosmian stars," but Cosimo requested "Medicean stars" instead, and the alteration was duly made.) "The Starry Messenger was a job application," says Owen Gingerich, an astronomer and science historian at the Harvard-Smithsonian Center for Astrophysics--and, sure enough, Galileo got what he was seeking: the Medicis' patronage.

He could hardly have hoped for better patrons, as the Franklin exhibit makes clear. It includes scores of intricately wrought instruments from the family's collection. The names of the ingenious contraptions hint at their function and describe their form--nautical planispheres, gimbaled compasses, horary quadrants, armillary spheres. One of the oldest surviving astrolabes, an instrument for calculating the position of the sun and stars, is on exhibit, as is a set of brass and steel compasses believed to have belonged to Michelangelo, another Medici beneficiary.

Though capable of measuring the world in various ways and to various ends--determining the caliber of projectiles, surveying land, aiding navigation--some of the instruments were never used, having been collected for the very purpose to which the Franklin puts them today: display. A few, such as a compass that collapses into the shape of a dagger, demonstrate the era's alliance of science and power. But they also illustrate its blending of science and art--the gleaming artifacts rival works of sculpture. They tell, too, of a growing awareness that, as Galileo said, nature was a grand book ("questo grandissimo libro") written in the language of mathematics.

NOT EVERYONE TOOK PLEASURE IN--or even believed--what Galileo claimed to have seen in the sky.

Some of his contemporaries refused to even look through the telescope at all, so certain were they of Aristotle's wisdom. "These satellites of Jupiter are invisible to the naked eye and therefore can exercise no influence on the Earth, and therefore would be useless, and therefore do not exist," proclaimed nobleman Francesco Sizzi. Besides, said Sizzi, the appearance of new planets was impossible--since seven was a sacred number: "There are seven windows given to animals in the domicile of the head: two nostrils, two eyes, two ears, and a mouth. From this and many other similarities in Nature, which it were tedious to enumerate, we gather that the number of planets must necessarily be seven."

Some who did deign to use the telescope still disbelieved their own eyes. A Bohemian scholar named Martin Horky wrote that "below, it works

wonderfully; in the sky it deceives one." Others nominally honored the evidence of the telescope but scrambled to make it conform to their preconceptions. A Jesuit scholar and correspondent of Galileo named Father Clavius attempted to rescue the idea that the moon was a sphere by postulating a perfectly smooth and invisible surface stretching above its scarred hills and valleys.

The Starry Messenger was a success, however: the first 500 copies sold out within months. There was a great demand for Galileo's telescopes, and he was named head mathematician at the University of Pisa.

In time Galileo's findings began to trouble a powerful authority--the Catholic Church. The Aristotelian worldview had been integrated with Catholic teachings, so any challenges to Aristotle had the potential to run afoul of the church. That Galileo had revealed flaws in celestial objects was bothersome enough. But some of his observations, especially the changing phases of Venus and the presence of moons around other planets, lent support to Copernicus' heliocentric theory, and that made Galileo's work potentially heretical. Biblical literalists pointed to the book of Joshua, in which the sun is described as stopping, miraculously, "in the midst of heaven, and hasted not to go down about a whole day." How could the sun stop if, as Copernicus and now Galileo claimed, it was already stationary? By 1614, a Dominican friar named Tommaso Caccini preached openly against Galileo, calling the Copernican worldview heretical. In 1615 another Dominican friar, Niccolo Lorini, filed a complaint against Galileo with the Roman Inquisition, a tribunal Instituted the previous century to eliminate heresy

These church challenges greatly troubled Galileo, a deeply pious man. It is a common misconception that Galileo was irreligious, but as Dava Sobel says, "everything he did, he did as a believing Catholic." Galileo simply believed that Scripture was not intended to teach astronomy, but rather, as he wrote in a 1613 letter to his disciple Benedetto Castelli, to "persuade men of the truths necessary for salvation." Some members of the church held the same opinion: Cardinal Baronius In 1598 said that the Bible was meant "to teach us how to go to heaven, not how the heavens go."

Late in 1615, Galileo traveled to Rome to meet with church leaders personally, eager to present his discoveries and make the case for heliocentrism. But Baronius' view turned out to be the minority one in Rome. Galileo was cautioned against defending Copernicanism.

Eight years later, a new pope--Urban VIII--ascended and Galileo again requested permission to publish. Pope Urban granted permission--with the caveat that Galileo should present the theory hypothetically. The book Galileo finally published in 1632, Dialogue Concerning the Two Chief World Systems, however, came off clearly in favor of the Copernican view, infuriating the pope.

And so, In what Pope John Paul II would deem, more than three centuries later, a case of "tragic mutual incomprehension," Galileo was condemned by the Holy Office of the Inquisition for being "vehemently suspected of heresy, namely of having held and believed the doctrine which is false and contrary to the Sacred and Divine Scriptures, that the Sun is the center of the world." He was sentenced to imprisonment, which was commuted to house arrest for the by then ailing 69-year-old man.

Despite repeated requests for clemency, the astronomer spent his last eight years confined to his home, forbidden to speak or write of the topics that had so captivated him. (Meanwhile, forbidden copies of his Dialogue were widely sold on the black market.) Blindness overcame him, and as he wrote to a friend in 1638, "The universe which I with my astonishing observations and clear demonstrations had enlarged a hundred, nay, a thousandfold beyond the limits commonly seen by wise men of all centuries past, is now for me so diminished and reduced, it has shrunk to the meager confines of my body."

AT THE FRANKLIN, just beyond the telescope that Galileo held to his eye sometime in the early 17th century, is a room devoted to the history of the device that allowed him to see so far. Through the eyepieces of reproductions, visitors can see what Galileo would have seen on those starry nights in Italy.

The exact composition of some of Galileo's telescopes remains a mystery. A written fragment--a shopping list jotted on a letter--allows historians to surmise the materials Galileo used for his lenses. And so the ingredients for one of the most famous telescopes in history--an organ pipe, molds for shaping lenses, abrasives for polishing glass--are thrown in with reminders to buy soap, combs and sugar.

It's a humdrum list--as plain as the lusterless tube sitting in the Franklin. Yet what came from that tube, like the man who made it, was anything but ordinary. Galileo "was one of those who was present at the birth of modern astronomy," says Harvard-Smithsonian's Gingerich.

In the dedication of The Starry Messenger, addressed to Cosimo II, Galileo hailed the effort to "preserve from oblivion and ruin names deserving of immortality." But the moons of Jupiter he named the Medicean have come to be more commonly known as the Galilean moons, and in 1989, the spacecraft NASA launched to study them was named Galileo. And 2009 has been named the International Year of Astronomy by the United Nations in honor of the 400th anniversary of Galileo's first telescopic observations.

The fame Galileo sought and obtained, he earned. "Galileo understood what was fundamentally important" about his telescopic observations, says Gingerich. "Namely, that they were showing us a whole new universe."

Learn more about the scientific instruments on display at the Franklin Institute at Smithsonia.com/Galileo

DAVID ZAX has written for SMITHSONIAN about Elvis in the Army, a party of Santas and George Washington's boyhood home.