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A Look at Astronomy's Present and Its Exciting Future

By Terrell Kent Holmes

Dr. Richard Tresch Fienberg, former editor-in-chief at *Sky & Telescope*, came of age at a time when mankind took its first steps on the Moon, Mount Palomar was the world's dominant telescope and quasar was more popular as a brand of television than an astronomical object. During his April 3 AAA lecture at the AMNH, "The More Things Change," he enthusiastically discussed the many changes that have transpired during his life in astronomy, and provided informed speculation about what might happen in the future.

2009 is the International Year of Astronomy (IYA), and the lecture coincided with "100 Hours of Astronomy," a weekend where astronomers in 100 countries trained their scopes on the skies and shared their views on a website devoted to the event. The highlight was a 24-hour online tour where 80 professional observatories worldwide provided close-up views to the public of objects like Saturn, the Sun and the Moon. As the Earth rotated, Fienberg noted, the observational reins were passed to another dark-sky site in another time zone. This kind of shared global experience exemplified one of the important ways in which astronomy has evolved in the past generation.

At the Franklin Institute in Philadelphia, there's currently an exhibit devoted to Galileo, the centerpiece of which is the small refractor he used 400 years ago to make the observations that changed scientific, religious and world history forever. After proudly showing a photo of himself holding Galileo's actual telescope, Fienberg displayed the Galileoscope, an inexpensive, easy-to-assemble telescope similar to Galileo's, developed in conjunction with the IYA. Fienberg is one of the people behind the scope which, at 25 to 50 power, can capture what Galileo saw, such as Jovian moons, lunar craters and Saturnian rings. So what the great Galileo used to change the world is now mass produced to pass the time.

Fienberg illustrated the new astronomical landscape with a simple question: How many planets are there in the solar system? The answer speaks to phenomena such as Kuiper Belt Objects, leading us to re-examine parameters such as planetary definition, which subsequently led to Pluto's reassignment. The recent discovery and direct observation of extrasolar planets has expanded the boundaries of our knowledge to frontiers even beyond H.G. Wells' imagination. Fienberg also expects astronomers to find exoplanets orbiting stars within a habitable zone that will eventually lead to discovery of life forms. He even suggested (jokingly) that the Search for Extraterrestrial Intelligence (SETI) would receive a signal from alien intelligence.

Computers have changed everything forever. From providing and storing data, to online observing to the application of technology in telescopes, computers have improved observing techniques and the speed of data processing. Observing techniques are far smoother now that scopes with go-to capability eliminate much time-consuming guesswork. in finding objects. Some large telescopes, according to Fienberg, can change the shape of their mirrors to conform to weather patterns.

Fienberg discussed how the advent of adaptive optics has provided better observing and photographic experiences for all astronomers. Indeed, the gap between the quality of amateur and professional photography has narrowed considerably. Fienberg noted that many photos he chose for the cover during his tenure at *Sky & Telescope* wouldn't even be considered today because of their comparatively mediocre quality.

We're in a kind of golden age, where excellent equipment is affordable, there's a plethora of info available online and there's a new era of collaboration between amateur and professional astronomers. But Fienberg warned of a downside to all of this. With all this progress, something will always be lost in translation, and he fears that with all of the changing nature of the media and how information is disseminated, some seemingly stalwart publications will fold. He also predicts that solid astronomy journalism will be replaced by blogs. Evidence of this shift is already occur-

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What's Up

By Tony Hoffman

The Sky for May 2009

May's Constellations. Winter's bright stars linger in the early evening sky, though they're gradually sliding into the solar glare. Sirius and Orion set early, along with Taurus. As the month opens, Mercury can be seen as a first-magnitude "star" next to the Pleiades. By month's end, Castor and Pollux will stand side by side above the twilight in the west, with Procyon and Capella near the horizon to their lower right and left, respectively. Virgo and Ursa Major will be on the meridian as the sky darkens, with Leo starting its westward swing. Saturn will lie in eastern Leo, below Denebola, and will shine slightly brighter than Regulus. A telescope will show its rings nearly edge-on, but more open than a few months ago. Jupiter, in Capricornus, won't rise until well after midnight. Venus will blaze in the predawn sky, lying not far from Mars around midmonth.

Between the Big Dipper's bowl and Virgo's Y lies Coma Berenices, a constellation that's mostly made up of an open cluster. Although washed out from the city, it is still a fine sight in binoculars. For those with telescopes, the Coma Berenices/Virgo/Leo/Ursa Major region will abound with galaxies. Arcturus will cross the meridian a couple hours after dark, as Scorpius--with its brilliant heart, Antares--swings up out of the southeast. Trailing Arcturus will be Corona Borealis, Hercules, and the Summer Triangle of Vega, Deneb and Altair.

May 1 First-quarter Moon at 4:44 p.m.
May 2 Venus is at its brightest in the morning sky.
May 4 Moon lies near Saturn.
May 5 Eta Aquarid meteor shower peaks.
May 9 Full Moon at 12:01 a.m.
May 10 Moon lies near Antares.
May 17 Last-quarter Moon at 3:26 a.m.; Moon lies near Jupiter.
May 21 Moon lies near Venus and Mars.
May 24 New Moon at 8:11 a.m.
May 25 Moon at perigee.
May 30 First-quarter Moon at 11:22 p.m.; Moon lies near Saturn. ■

Venus Could be Seen in Bright, Blue Sky

By Joseph A. Fedrick

Venus disappeared from the evening sky during late March, but was still visible in my 10x50 binoculars as an easily discernable thin white crescent on March 21 and 22 at around 1 p. m, and March 24 and 25 at around 5:30 p. m. in a bright blue sky. The crescent of light faced southwest toward the Sun. Locating Venus in bright daylight was quite challenging. However, the fact that Venus was passing well north of the Sun made it possible to see it up to two days prior to its inferior conjunction with the Sun. Venus passed 8.2 degrees north of the Sun on March 27, but cloudy, hazy skies prevented my observing it that day. The orbit of Venus is at a 3-degree angle to the ecliptic. However, because Venus is relatively close to the Earth, the view from Earth of Venus was at a steeper 8.2-degree angle. This geometry was discussed by AAA president Rich Rosenberg at a meeting of the Observers' Group at the club's new headquarters.

Jupiter climbed out of the horizon haze into dark nighttime skies by late March so that by March 25, I could see its four Galilean moons with my 60 mm refractor at 50x and the two brown-gray equatorial cloud belts with my 60 mm refractor at 50x and 100x.

Saturn presented a spectacular view of its rings in Michael O'Gara's 76 mm apochromatic Pronto refractor at approximately 120x with use of a Barlow lens. The rings weren't quite edge-on, but still tilted slightly so I could see the outer dimmers of the A ring; the inner, brighter B ring, and could barely discern the Cassini division between the A and B rings. Faint cloud belts were barely discernable on Saturn's pale tan-yellow disk. ■

Explorers Club Program

"From Galileo to Hubble and Beyond: The Exploration Challenge" is a day-long program at the Explorers Club, 46 East 70 St., Saturday, May 2. Astronomers, astronauts and journalists will be featured at the public event, which runs from 9 a. m. to 7 p. m. and includes lunch and a reception

The event will feature presentations from traditional space and aeronautical disciplines to emerging fields in space exploration. Speakers include NASA's Jerry Bonnell, co-creator of the astronomy picture of the day; Dr. Steve Squyres, principal investigator responsible for the scientific activities of the Mars robots Opportunity and Spirit; and astronaut Dr. Leroy Chiao, a veteran of four space flights and six space walks.

Tickets will not be sold at the door. Call 212-628-8383 or e-mail reservations@explorers.org. Member and guest tickets are $55, students $25. ■

A Message from AAA President Richard Rosenberg

Hello members:

The annual meeting of the Amateur Astronomers Association will be held on Wednesday, May 20 at our headquarters, 120 Warren Street in lower Manhattan. We'll be in the large room on the ground floor. The meeting will get underway with a buffet dinner at 6 , a half hour earlier than in past years. The business meeting will begin at 7:15. Officers and committee chairs will speak, letting you know how we're doing and what issues we're currently dealing with. Members will then vote to fill six of the 18 seats on our board of directors.

If you haven't been to an annual meeting, or even if you have, officers and committee chairs would very much like to meet you and hear your opinions: what we're doing well, what not so well and changes you'd like to see. After the annual meeting, the board will meet to elect officers for the coming year.

On Friday, May 1, AAA member Denton Ebel of the American Museum of Natural History will conclude our 2008-09 annual lecture series at the museum. Dr. Ebel will speak on "Stardust Findings and Meteorites: New Constraints on Solar System Formation Models." The lecture runs from 6:15 to 8 p. m.

The following Tuesday, May 5, at 7 p. m., I will speak on the spring sky at the Avenue U Salt Marsh Nature Center in Brooklyn. Weather permitting, this will be followed by observing (the location is quite dark by NYC standards). For directions, check our website at www.aaa.org or call me.

Spring is finally here. We have observing sessions at no fewer than eight locations in May, plus the Observers' Group meeting

AMNH Geologist Ebel to Address the AAA May 1

Denton Ebel, curator-in-charge of the Department of Earth and Planetary Sciences at the American Museum of Natural History, will deliver the final lecture of the AAA's 2008-09 lecture series when he discusses "Stardust Findings and Meteorites: New Constraints on Solar System Formation Models" Friday, May 1. The free public lecture begins at 6:15 p. m. in the Kaufmann Theater of the museum.

The Stardust mission returned to Earth the first solid extraterrestrial samples since the Apollo era, Ebel notes. "Combined with meteorites and interstellar dust particles (IDPs), this sample suite provides fundamental facts that must be explained by all theories that are proposed to explain dynamic phenomena in our early solar system (and others). These are 'constraints' in that any theory of solar-system formation must explain them. I will discuss Stardust, meteorite and IDP evidence that all bear on the processes at work in the earliest protoplanetary disk."

Ebel, a geologist specializing in the study of rocks from space, is the curator of the AMNH's meteorite collection. "Our mission is to make meteorite samples available for research by scientists throughout the world. Collections-based research is vital to the exploration of space and a better understanding of our origins."

In 2003, Ebel served as lead curator in reimagining the museum's new Arthur Ross Hall of Meteorites.

One focus of his research is modeling how gas, solid and melt phases interact at high temperatures and low pressures to understand formation of the first solids, and molten (liquid) rock droplets in the solar system, which eventually led to accretion of planets. He also applies X-ray, CAT-scan and microscopic imaging to meteorites to get two- and three-dimensional images of how they're put together. Ebel began his career by investigating how silver, copper, nickel and platinum-group metal ores form in the Earth. By seeing how sulfide minerals react, he was able to model their thermodynamic properties and develop predictive tools to find metal-rich rock in existing

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ring as newspapers cut science reporting.

Another thing that may fall by the wayside, Fienberg warned, are significant discoveries, such as comets, made by amateurs. The prevalence and quality of professional equipment, and the improvement of around-the-clock observing, make it less likely for amateurs to find a significant wedge through which to make such discoveries. The playing field has expanded to the point where, on this level, it has nearly defeated its purpose. (But Fienberg's successor at *Sky & Tel*, Robert Naeye, last month noted the major amateur role in exoplanet detection--see story on page 5.) ■

A Memorable Lights-Out Night in Inwood Park

By Jason Kendall

April 3rd. What a night. The result of collaboration with the Parks Department to create a darksky environment in Inwood Hill Park.

The clouds looked foreboding, but we persevered. I made the call to goforward at about 10 a. m. The Clear Sky Clock looked fine, even improving. I told the Parks Department we were on. The night before,the Park Rangers and I spoke about what we would do in case of clouds,which basically amounted to me standing under an umbrella saying I am sorry.

I was at the entrance at 6:30, with papers, bags and a GalileoScope,but no one else. It was just me and the clouds, lowering ominously over my head. However, I was confident the clouds would clear and amateur astronomers would appear. Very soon, they did. For about 20 minutes,clear sky popped out to show the Moon overhead in the blue sky. Feeling a bit cocky about the exiting clouds, I tried to hand-hold the Galileoscope up to the Moon. It was tricky, but I could see it nicely through the finder. I tripod really helps.

Shortly after 7:15, the telescopes arrived! Howard, Alice, Javier, Daryl, Tony, Tom and others. They walked into the park or drove in to drop off their wares. They were glad the event was going forward, even though clouds, and once or twice lightning, to the north gave warning. But here we were, and the Rangers showed up. We set up a table. Stragglers walked by. I started cutting up shreds of red cellophane for flashlights.

People unexpectedly started arriving. Jennifer Hoppa, head of Northern Manhattan Parks, showed up. The crowd was only a bit put off by drizzle at 7:50. People were lively and animated, but their faces wished it was a lazy summer night with stars above rather than a slightly rainy night with iffy possibilities. At 8:30, with 50 people waiting to go in, Jennifer and electricians drove into the park. The crowd then walked north into the park to waiting astronomers.

David Teich and I stood at the entrance in a slight drizzle, feeling forlorn and looking at the clouds. Then we saw the park lights go out. There we were, David and I, standing in front of a darkened park's entrance under an umbrella in a drizzle. The dream seemed a Pyrrhic victory. Working so hard and pushing so hard, only to see it cloudy and a bit rainy.

At this point, Manhattan Parks Commissioner William T. Castro and Fort Tryon Preservation Society President Nancy Bruning walked up. We had a brief chat, and David graciously stood at the entrance while I walked into the park with them. The commissioner was quite pleased with the event, and wanted to do it again. I was also able to tell him how the parks could save money with downward-directed lighting fixtures. He commissioner was all ears about saving money.

At the location, my spirits rose. Here were all these people, and the telescopes all set up, hoping the clouds would clear. The park lights were out. The work we had all done had reached fruition.

I hopped onto a table and started talking to the crowd, trying to keep the mildly let-down group from walking away. After introducing AAA members Tom Haeberle, Tony Hoffman and Alice Barner, I introduced the commissioner. Everyone noticed they could see better in the dark than they thought they could.

It stayed cloudy until about 10. Then the clouds began to break, and the astronomers jumped at the chance to show people the sky. The Moon shone fiercely through, then Saturn in the high east. The clouds suddenly parted to show the entire Big Dipper. Castor and Pollux leaped out. All the stars were bright against the high darkness. Without the park lights, people could make out the brightest stars. Everyone had a chance to see Saturn, with its brilliant edge-on rings. One attendee even used his iPhone to snap a shot through Javier's 8" Celestron.

There were a lot of people who'd never looked through a telescope. That was the most important aspect of the evening. For the next half-hour, oohs and aahs could be heard.

During the evening, everyone I talked to said they knew a few people who would have come if it were not cloudy. By counting their estimates, the parks people and I thought a clear night would have produced 2,000 people.

Commissioner Castro told me we need to do this again. And we shall. AAA Members should write a letter thanking him for putting on the event, the first lights out of a New York City park. Borough Commissioner William T. Castro is at Arsenal West, 24 West 61st Street, 5th Floor, New York, NY 10023. We need to show the city our appreciation for finding the resources to do something that was thought impossible by most. ■

The AAA's Annual Meeting
Is Wednesday, May 20
See President's Letter on page 3
for Details

Democratic Takeover of State Senate May Aid Light Bill

By Dan Harrison

The Democratic takeover of the New York State Senate in last year's election creates a "really good chance" of passage of light-pollution legislation this year, Assemblywoman Linda Rosenthal (D-Manhattan), lead sponsor of such legislation in the Assembly, told *Eyepiece* last month.

Further enhancing chances of passage is the fact that Senator Antoine Thompson, the new lead sponsor in the upper chamber, heads the Senate's Environmental Conservation Committee, to which the bill has been referred.

Rosenthal terms the bill (A7281, S2714), introduced in late March, one that Republicans and Democrats can agree on. "The whole topic of light pollution and people's growing interest in seeing the night sky without glare" should be further boosts to the bill, she said.

Another factor that may help the bill is that Thompson is from upstate. He represents a district that includes Niagara Falls and part of Buffalo. Observers believe that the combination of New York City and upstate prime sponsors often enhances chances for a bill's passage. "Buffalo is a good balance," Rosenthal said. "It signals support from disparate areas. You can't use excuses based on geography."

Yet another factor, says a source, is that "Thompson won't check with New York City the way [Nassau Republican Carl] Marcellino [the previous prime sponsor in the Senate] did."

On the other hand, Democrats have a razor-thin majority of three seats in the Senate, and no Republican voted for the state budget.

In an interview with *Eyepiece*, Thompson agreed that chances for passage of light-pollution legislation have been tangibly enhanced by the Democratic takeover of the Senate.

As for why he is lead sponsor for the bill, he said, "Being chair of the Senate Enviroment Conservation Committee, I'm trying to move New York into more 'green' initiatives, and this is just another way of doing that. The environment is very important and we need to take care of it.

But Thompson disagreed that lead sponsors from New York City and upstate enhance the chances for legislation: "We're not upstate or downstate. We're one New York and it's not about where the sponsors are from. It's about what is good for New York."

For the past decade, such legislation has usually been bottled up in Senate committee. The one time a light bill was passed by the full Senate, in addition to typical passage by the Assembly, it was vetoed by then-Governor George E. Pataki. Rosenthal said she expects a full Senate vote this time around.

The Healthy, Safe and Energy Efficient Outdoor Lighting Act restricts installation of new lighting by state agencies or public corporations operating in the state to fully-shielded luminaries. Various exemptions to the requirement are contained in the bill.

The Public Service Commission is directed to require that every electric corporation or municipality providing electric service include educational pamphlets in bills to customers. Luminaire-efficiency and lamp-luminous-efficacy standards must be developed. The Department of Environment Conservation (DEC) is empowered to identify and nominate areas for dark-sky preserves.

State agencies, public corporations and electric corporations providing roadway lighting under contract to a public corporation are exempted from light-trespass restrictions. This is viewed as a key concession.

However, the DEC, in consultation with relevant authorities, must promulgate regulations on light trespass.

The DEC must prepare and distribute a model outdoor lighting ordinance to municipalities. And the department would be required to develop and widely disseminate a pamphlet describing the purposes and provisions of the act.

In addition to this bill, Rosenthal has introduced several others:

• A 5769 "expands the powers and duties of the Department of Health to engage in and support research into the health effects of artificial night light."

•A 5655 "adds the elimination of wasteful artificial night lighting to state lighting efficiency standards.

• A 5656 "expands the type of energy information compiled by NYSERDA to include energy-efficient and environmentally sound outdoor lighting."

• A 7276 "amends the Environmental Conservation Law to include the preservation of the "nighttime sky" as part of the declared policy of New York State." ■

Amateurs Will Still Play Big Role in Exoplanet Detection

By Dan Harrison

Amateur astronomers, who have played a major role in detecting exoplanets, will continue to do so and broaden their activities, *Sky & Telescope* editor-in-chief Robert Naeye told the Northeast Astronomy Forum in Suffern, N. Y., April 19.

"Against all predictions, amateurs in their own backyards are involved in exoplanet discoveries," Naeye said. "They've made very significant contributions in transiting discoveries and gravitational microlensing. Very few astronomers would have predicted this 20 years ago, when planets outside the solar system were unknown."

Professionals depend on amateur data and want amateurs to continuethis work, Naeye said. "Professionals are very deeply respectful and appreciate the role played by amateurs. Thanks to the combined efforts of professionals and amateurs, we're starting to get pretty good ideas of what the numbers are."

Of the 340 exoplanets discovered since 1991, there are 58 known transiting planets, and then number is rising fast, Naeye noted. "Most have been detected by amateurs, including all of the really scientifically significant ones.

Amateurs are focusing many efforts through transit search.org, which focuses on longer-period planets, ones that professionals won't or rarely bother to observe because of the low probability of transits. Naeye expects that many transiting exoplanets will be found, including those smaller in size than gas giants will be found.

The radial-velocity or "wobble" method has borne the most fruit, Naeye said, resulting in a large majority of exoplanets found. "An alien could easily find Jupiter and Saturn by this method." The wobble method is geared to finding massive planets relatively close to their host stars.

"Amateurs have detected exoplanets using radial velocity. There haven't been amateur discoveries yet, but stay tuned," Naeye said. "Lower-mass exoplanets have the best prospects for finding life as we know it."

A key to all this amateur activity has been improvements in technology. "By 2000, amateurs had access to very high-quality and affordable CCD cameras that allowed them to monitor stars' brightness to a precision of about 1%. This is easily enough to detect a drop in a star's light from transit of a hot Jupiter.

"So suddenly amateurs could enter this game and play a meaningful role. Since then, with improved equipment and software, precision is now down to 0.1%." This brings in a whole host of transiting exoplanets amateurs can detect. They can also detect elements and molecules in some exoplanets, at least in upper atmospheres, due to absorption lines in the spectrum.

"In one case, the data were so good that some professionals monitoring this used his data in a paper. It helped narrow down the diameter of the planet. And the amateur did this just a few days after hearing of the transits."

In 2005, Naeye recalled, an exoplanet was detected by professionals. "Before the transit was announced, an amateur detected it and a much smaller planet with only a .003 magnitude decrease in the star's brightness. Early amateur successes motivated some professionals to start organizing amateur efforts to find transiting exoplanets. This led to transit.org, which has assembled a worldwide network of amateurs to measure brightness to a precision better than 1%. It's organized at least 20 observing campaigns, concentrating on stars known from radial-velocity surveys."

The 1%-10% probability of a planet transiting a star isn't good enough for professionals, Naeye noted, "but you have an eager group of skilled amateurs around the world.

The jackpot for transitsearch.org came in 2007, when a transiting planet that wasn't a hot Jupiter was found transiting its star. It has a 21-day orbit vs. the previous record of five-to-seven days. Since then, the new record has come in at 111 days. The two planets have highly eccentric orbits.

Gravitational microlensing, another key way of discovering exoplanets, has been fruitful for amateurs, Naeye said. In 2005, amateurs not only discovered a transit but the planet itself. "Gravitational microlensing could reveal the existence of an Earth-mass planet. It's a very sensitive method." Amateurs have helped discover a system containing a star with two planets, analogs of Jupiter and Saturn.

In the future, Naeye predicted, amateurs will be able to discover new planets in a system in addition to a transiting planet by observing seeing variations in timing—i. e., gravitational perturbations indicating a second body. In addition, there will be more amateur discoveries of long-period transiting exoplanets. There will be more gravitational-microlensing discoveries, including low-mass exoplanets perhaps just a few times Earth mass. Finally, "Amateurs could discover or confirm a moon orbiting an exoplanet through a wobble by a planet from a massive moon. ■

Review: Do Exoplanets Crowd the Universe?

By Tony Hoffman

We live in perhaps the most exciting period of astronomical discovery since Galileo first pointed his telescope to the skies 400 years ago. Nowhere is that more evident than the hunt for exoplanets. Since 1996, more than 340 such worlds have been discovered. In "The Crowded Universe: The Search for Living Planets" (Basic Books, $26), Alan Boss, a Carnegie Institution astrophysicist, provides a lively account (for the most part) of these extraordinary times through the eyes of someone who's been at the forefront of the quest for other Earths.

The book begins with an involved explanation of the Doppler Effect as it applies to spectroscopic observation of starlight. It's used to detect the slight wobble in a star's motion indicating the presence of an unseen companion that could be a planet. On reading that section, I was concerned the book would be difficult, delving deep into science, a necessary part of understanding the subject at the expense of readability. On that score, I was pleasantly mistaken. While it doesn't skimp on the science--Boss is particularly thorough on the subject of planetary formation, on which he is an expert--it's by and large fairly easy and often absorbing reading, a chronology broken into dated entries, spread over the past 14 years, from before the first exoplanet discovery in 1995 until late last year, as the Kepler mission to search for Earthlike worlds (for which Boss has served as a science advisor) awaited clearance to launch.

Much of the account describes discoveries of the growing and varied menagerie of exoplanets (loosely classed as Jupiters, Neptunes or super-Earths depending on their size, and hot or cold by how closely they orbit their star) by competing teams of astronomers using several techniques: spectroscopy (using the Doppler effect to detect changes in a star's radial velocity); the transit method (finding planets by measuring the slight, periodic dimming of a star when a planet passes in front of it); and microlensing (the bending of light by the gravity of an unseen object to cause a more distant star to brighten briefly).

Boss details the finding of ever-smaller worlds in the quest to find other Earths. We're not quite there yet, but are coming close, and he has every expectation the Kepler mission will find many of them. Kepler employs a 38-inch space telescope that will monitor a field of 100,000 stars for four years, looking for the minute changes in brightness that could signal the presence of a planet transiting a star's face. The smaller, European CoRoT space telescope is conducting a similar quest. The planets it's found so far have been larger than Earth.

Boss also touches on related topics such as the (alleged) discovery of micro-organisms in a meteorite of Martian origin, the demotion of Pluto and the controversy over defining what a planet is, and especially the turf wars and personnel changes at NASA as well as the agency's budget battles, particularly after the Bush Administration diverted money from NASA's scientific missions to its plans to return men to the Moon and eventually to Mars. This has resulted in downsizing or cancellation of exoplanet search missions, as well as delaying Kepler.

At the end of the book, Boss looks ahead to the Kepler mission, which was launched two months ago and released its first test images last month. The book's epilogue, "Why Don't You Ever Call?" tackles the subject of possible life elsewhere in the cosmos, based on the latest science and Boss' own informed speculation--he's clearly an optimist. He writes, "Given that Kepler will be able to produce a good measure of the frequency of Earth-like worlds, provided this frequency is 5% or more [that is, 5% of Sun-like stars possess such planets], there is every expectation that the Kepler Mission will succeed in determining this most basic parameter in any estimate of the prevalence of life in the universe. Even the CoRoT mission has a good chance of discovering an Earth or two in such a crowded universe." ■

Arthur Code Dies at 85

Arthur D. Code, one of the most noted astrophysicists of his generation, died March 11 at 85. He was a pioneer in space astronomy, leading initiatives to put telescopes and other instruments in space.

Long before the Hubble, Code worked to get telescopes into space. He built the world's first successful orbiting observatory, the Orbiting Astronomical Observatory, launched in 1968. The satellite carried light meters, spectrometers and other devices to read patterns of ultraviolet radiation too distant or diffuse to be detected from Earth. The observatory's instruments took the first measurements of a star, Beta Carinae, from an orbiting platform. The satellite revealed young stars in Scorpius and Orion were far hotter than thought, so the stars were aging faster than believed.

Code also developed and operated a space-shuttle-borne ultraviolet telescope. He also helped reveal the importance of the interstellar medium. By placing telescopes in space, Code and colleagues opened swaths of the electromagnetic spectrum. In 1990, he and a team had an ultraviolet-detecting telescope carried into orbit. The device studied polarized ultraviolet light. Observations found interstellar dust didn't change the direction of polarized starlight, suggesting such dust could be made of graphite and act to absorb heat when stars form. ■

Briefs: Lightest Exoplanet Found: 1.9 Earth Mass

The lightest exoplanet yet discovered has been detected. It has only 1.9 Earth-masses and is likely a rocky planet. The planet was found in the famous system Gliese 581 and has been dubbed Gliese 581 e. Measurements also helped refine the orbit of the planet's solar-system sibling, Gliese 581 d, placing it well within the habitable zone, where liquid-water oceans could exist. Planet Gliese 581 e orbits its host star, only 20.5 light-years away in Libra, in just 3.15 days. Being so close to its host star, the planet isn't in the habitable zone. With discovery of Gliese 581 e, the planetary system now has four known planets, with masses of 1.9 Earth-masses (planet e), 16 Earth-masses (b), five Earth-masses (c) and seven Earth-masses (d). Gliese 581 d, which orbits in 66.8 days, is probably too massive to be made only of rocky material. It may be an icy planet that's migrated closer to the star. D could be covered by a large, deep ocean, the first serious water-world' candidate. Low-mass red dwarfs such as Gliese 581 could be fruitful hunting grounds for low-mass exoplanets in the habitable zone. Because the habitable zone of cool stars such as Gliese 581 is so close to the star, planets within this zone exert a stronger pull, so the wobble of the star is more pronounced, though detecting the signal is still a challenge.

A newly found primordial blob may represent the most massive object ever discovered in the early universe. The gas cloud, spotted from 12.9 billion light-years away, could signal the earliest stages of galaxy formation back when the universe was 800 million years old. The cloud predates similar blobs, Lyman-Alpha blobs, which existed when the universe was 2 billion-3 billion years old. The blob holds more than 10 times as much mass as the next largest object found in the early universe, or roughly the equivalent mass of 40 billion Suns. At 55,000 light-years across, it spans about half the diameter of the Milky Way. Lyman-Alpha blobs remain a mystery because existing telescopes have a hard time peering so far back to nearly the dawn of the universe. The newly discovered blob sits on the doorstep of what's called the reionization epoch, which lasted between 200 million and 1 billion years after the Big Bang. The new blob may represent an ionized gas halo surrounding a supermassive black hole, or a cooling gas cloud that indicates a primordial galaxy. But it might also be the result of a collision between two young galaxies, the outgoing wind of a highly active star nursery or a single giant galaxy.

NASA's Kepler mission last month took its first images of the star-rich sky where it will soon begin hunting for planets like Earth. The images show the mission's target patch of sky, a vast starry field in the Cygnus-Lyra region of the Milky Way. One image shows millions of stars in Kepler's full field of view, while two others zoom in on portions of the larger region. One image shows its entire field of view, a 100-square-degree portion of the sky, equivalent to two side-by-side dips of the Big Dipper. The region contains an estimated 4.5 million stars, more than 100,000 of which were selected as ideal candidates for planet hunting. Two other views focus on just one-thousandth of the full field of view. In one image, a cluster of stars about 13,000 light-years from Earth, NGC 6791, can be seen in the lower left corner. The other image zooms in on a region containing a star, Tres-2, with a known Jupiter-like planet orbiting every 2.5 days. Jupiter's Great Red Spot, at least 300 years old, is shrinking as other spots emerge to challenge its status. Observations of cloud cover over the past decade or so suggested the tempest was getting smaller as Jupiter's climate changes. The Red Spot shrank along its major diameter by 15% from 1996 to 2006. It's not clear why the storm is shrinking, but it still manages to send out winds at 300 mph.

Armchair explorers can now spy on Mars orbiters and access raw spacecraft data as part of a "Live from Mars" update for Google Mars 3-D. NASA and Google launched a Mars add-on for the Google Earth platform in February. The March update includes features such as watching orbital tracks of spacecraft in real time, viewing historical globe maps of Mars and taking a guided fly-around tour of the planet. New Mars data will come almost immediately from orbiting spacecraft. The update also provides real-time tracking of Mars orbiters, and allows users to anticipate what the spacecraft might take pictures of.

Astronomers now have their best-ever view of the most extreme energy in the cosmos with a new map combining three months of data. The map is based on data collected by NASA's Fermi Gamma-ray Space Telescope, which has scopes and cameras that peer into the universe seeking gamma rays. The image shows how the cosmos would look if we could detect radiation 150 million times more energetic than visible light.

The Hubble has uncovered new evidence that galaxies are embedded in and protected by halos of dark matter. Peering into the heart of the Perseus galaxy cluster 250 million light-years away, Hubble discovered many small galaxies that have remained intact while larger galaxies around them are being ripped apart by the gravitational pull of neighboring galaxies.

Why some stellar nurseries of gas and dust give rise to ordinary stars and others birth stars 15-30 times as massive

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Briefs: VLT Shows Galaxies in Slo-mo Collision

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may primarily be due to turbulence. Astronomers probed two cocoons 15,000 light-years away in Serpens Cauda. The gravitational pull that condenses star-forming gas also tends to fragment it, fracturing the condensing cloud into smaller pieces. This may inhibit formation of massive stars because the pieces are too small.

The Very Large Telescope has taken one of the best images of two galaxies locked in a slow motion, disruptive collision. The image has also given astronomers a peek at an unusual exploding star in the same area of the sky. The colliding galaxies are known as Arp 261, about 70 million light-years away in Libra. Its chaotic, very unusual structure is the result of the galactic close encounter. Both interacting galaxies were probably dwarfs. The unusual exploding star, 1995N, is thought to be the result of the final collapse of a massive core-collapse supernova.

The Mars Express Orbiter has seen evidence of a large concentration of rust, revealed by erosion, on the surface--another clue that will help scientists piece together Mars' past climate. Bright red dust covering most of the planet is known to be enriched in ferric oxides, more commonly known on Earth as rust.

Telescope images have confirmed that red supergiants explode in so-called type II supernovas, the cosmic explosions that result from the internal collapse of a massive star. On average, a supernova occurs about once every 50 years in a galaxy the size of the Milky Way. Astronomers used Hubble and Gemini images from before and after two supernova explosions, SN 2003gd and SN 1993J. They found there were red supergiants in the spots where the blasts occurred beforehand, and that after, the progenitor star was missing.

A Hubble photograph captured a rare alignment of four of Saturn's moons lining up and transiting in front of the planet. The moons are the white icy moons Enceladus and Dione, the large orange moon Titan and icy Mimas. Due to the angle of the Sun, they're each preceded by their own shadow. These rare moon transits only happen when the tilt of Saturn's ring plane is nearly edge on as seen from Earth. This ring plane crossing occurs every 14-15 years.

Asteroid 2008 TC3 is the first space rock to have been spotted before it crashed to Earth. It streaked into the skies over northern Sudan in the early morning of October 7, 2008, then exploded at 23 miles above the Nubian Desert before the atmosphere could slow it appreciably. Scientists collected some 20,280 pieces of the asteroid. Never before had meteorites been collected from such a high-altitude explosion. The remnants are unlike anything in meteorite collections and may be an important clue in unraveling the early history of the solar system. The truck-sized asteroid abruptly ended its 4.5 billion-year odyssey only 20 hours after discovery.

Evidence is building that NASA's Phoenix Mars Lander plopped down on a microbe-friendly location. Descending on May 25, 2008, Phoenix was designed to study the history of water and habitability potential in the Martian arctic's ice-rich soil. Researchers say the landing site has or had the ingredients necessary to support life. A major Phoenix find in digging into and gulping quantities of Martian soil was identifying perchlorate salt. Perchlorate and chlorate are compounds used for microbial metabolism.

A new technique has uncovered an extrasolar planet hidden in Hubble images taken 11 years ago. This may allow researchers to uncover other alien worlds potentially lurking in more than a decade's worth of Hubble archival data. Astronomers knew of the planet's existence from images taken with the Keck and Gemini North telescopes in 2007 and 2008. The planet, estimated to be at least seven times the mass of Jupiter, is the outermost of three massive planets orbiting the young star HR 8799, 130 light-years from Earth. The other two planets couldn't be seen because the scope's coronagraphic spot--a device that blots out the glare of the star--blocked its view of the two inner planets.

Astronomers have caught their sharpest look of a double-star system in the heart of the Orion Nebula. The result is an ultra-clear glimpse of Theta 1 Orionis C, a mismatched pair of stars in orbit a round one another 1,350 light-years from Earth. The stars orbit each other every 11 years. The smaller is about nine times as massive as the Sun, while its larger partner is 38 solar masses.

The Hubble has photographed a group of colliding galaxies that won a cosmic popularity contest voted on by the public. The snapshot features Arp 274, a galaxy smashup occurring as three galaxies merge into one, drawn by mutual gravitational attraction. On April 1 and 2, Hubble photographed the site, 400 million light-years away. Arp 274 won the Space Telescope Science Institute's "You Decide" competition to determine the target of the next space portrait in honor of the "100 Hours of Astronomy" project, part of the International Year of Astronomy. The two biggest galaxies are spirals that appear mostly intact. The tiny third galaxy shows more signs of disruption.

When dark matter is destroyed, it leaves behind a

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Briefs: Discovery May Shed Light on Dark Matter

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burst of exotic particles, according to theory. Now scientists have found a possible signature of these remains. The discovery could help prove the existence of dark matter and reveal what it's made of. An Italian satellite found an overabundance of particles called positrons, the antimatter counterpart to electrons. This positron signature could have a variety of causes, but a prime candidate is dark matter. When two dark-matter particles collide they can sometimes destroy each other and release a burst of energy that includes positrons.

A new Spitzer infrared image reveals the M33 galaxy, one of our closest galactic neighbors, to be surprisingly large, bigger than its visible-light appearance would suggest. With its ability to detect cold, dark dust, Spitzer sees emission from cooler material well beyond the visible range of M33's disk. M33, the third largest galaxy in our group, is moving toward the Milky Way. While M33 is a spiral galaxy like our own, it's quite different. It has little or no central bulge of stars, and astronomers figure if it has a central black hole, the mass is probably no more than 3,000 times that of the Sun. The Milky Way's central black hole is a few million solar masses.

An unusual large galaxy with a shape bordering between spiral and elliptical has been spotted by Hubble. NGC 7049, in the southern constellation Indus, is the brightest of a so-called Brightest Cluster Galaxy (BCG). Typical BCGs are some of the oldest and most massive galaxies, which provide excellent opportunities to study globular clusters lurking within. They contain some of the first stars to be produced in a galaxy. NGC 7049 has far fewer clusters than similar giant galaxies in very big, rich groups. This indicates how the surrounding environment influenced formation of galaxy halos in the early universe.

Scientists have finally pinpointed the so-called edge of space--the boundary between Earth's atmosphere and outer space--7320miles above Earth's surface. A lot remains very fuzzy, however, as the boundary is surrounded by a host of misconceptions and confusing, conflicting definitions. For starters, astronauts can say they've been to space after only passing the 50-mile mark. And the boundary recognized by many in the space industry is also a somewhat arbitrary 62 miles. NASA uses 76 miles as their re-entry altitude because that's where the shuttle switches from steering with thrusters to maneuvering with air surfaces. Others point out that at 13 million miles is where Earth's gravity is no longer dominant. In the new study, an instrument detected the boundary by tracking the relatively gentle winds of Earth's atmosphere and the more violent flows of charged particles in space.

A jet of gas spewing from a huge black hole has mysteriously brightened, flaring to 90 times its normal glow. For seven years the Hubble has been watching the jet, which pours out of the supermassive black hole in the center of the M87 galaxy. It has photographed the strange phenomenon fading and then brightening, with a peak that even outshines M87's brilliant core. Scientists aren't sure if it is an exceptional case, or if it represents a normal event for black hole jets, which continue to be not very well understood.

The solar system might once have had another planet named Theia, which may have helped create the Moon. Two spacecraft are heading to search for remnants from this possible object, which would have been destroyed when the solar system was still young. Some researchers believe it existed 4.5 billion years ago, and that it collided with Earth to form the Moon. Theia is thought to have been about Mars-sized. If the planet crashed into Earth, debris from the collision could have clumped together to form the Moon. Scientists are hoping NASA's twin STEREO probes, launched in 2006, will be able to discover leftover traces of Theia that may finally help close the case on the birth of the Moon.

Supermassive black holes that pack the heft of billions of suns have the capacity to regulate their energy during a tug-of-war with a hot radiation wind that blows in from their debris disks. Now 10 years worth of observations from Chandra have uncovered the first evidence of this mysterious phenomenon occurring in a small black hole just 14 times the mass of the Sun. Chandra has kept an eye on a notoriously unpredictable black hole that has 14 states of varying brightness. The small black hole stands out by having had active outbursts for 17 years. Its energy jet continually fights a seesaw battle with hot radiation wind, as revealed in Chandra's observations.

Astronomers have completed the most wide-ranging census of baby stars in and around the Orion Nebula, and found a stellar nursery that's both chaotic and crowded. The work represents the first complete study of young stars, their gaseous clouds of dust and supersonic jets of hydrogen molecules shooting from the poles of each star. Jets arise as young stars are born from a rotating cloud of gas and dust, but usually die out once a star has fully ignited and stopped consuming the surrounding material. In this case, the jets became signals that pinpointed the location of baby stars hidden within the stellar birthing grounds. ■

Events on the Horizon
May 2009

M: members; P: open to the public; T: bring your telescopes, binoculars, etc.;
C: cancelled if cloudy;
HQ: at AAA headquarters, Downtown Community Center, 120 Warren St.
AMNH: For ticket information call (212) 769-5200.
For directions to AAA observing events, check the club's website at www.aaa.org

Friday, May 1, 6:15 to 8 p. m.
AAA lecture, free, P
Denton Ebel of the AMNH will discuss "Stardust Findings and Meteorites--New Constraints on Solar System Formation Models" in the Kaufmann Theater of the museum. This is the final lecture of the AAA's 2008-09 series.

Saturdays May 2, 9, 16, 23, 30, Wednesdays May 6, 13, 27, 8:30 to 10:30 p.m.
Observing at Inwood Hill Park, Manhattan, P, T, C
Next dates: Wednesdays and Saturdays in June except June 20, when the sessions will be at Fort Tryon Park.

Tuesday, May 5, 7 to 10 p. m.
Lecture and observing session at Salt Marsh Nature Center, Avenue U and East
33 Street, Brooklyn, P, T
A lecture on what's up in the sky followed by observing (weather permitting). Parking available. Info and directions: www.aaa.org or Rich Rosenberg at 718-522-5014.

Monday, May 11, 7:30 p. m.
Hayden Planetarium lecture, P, AMNH
Michael Lemonick will discuss "The Georgian Star: William Herschel and the Birth of Modern Astronomy." In the late 18th century, a self-taught astronomer discovered, through a homemade telescope, the planet Uranus, the first planet found by an individual observer. Though it made him famous, Herschel considered it a relatively minor event in his astronomical career. Lemonick discusses how, in retrospect, he was right.

Thursday, May 14, 6 to 8:30 p. m.
Recent Advances in Astronomy Seminar, M
239 Greene Street, Room 801, M
Next date: June 11.

Friday, May 15, dusk to 10 p. m.
Observing at Carl Schurz Park, Manhattan, P, T, C
Next date: June 26.

Friday, May 15, 8 to 10 p. m.
Observing at Floyd Bennett Field, Brooklyn, P, T, C
On the model airplane flying field.
Next date: June 12.

Saturday, May 16, dusk
Observing at Great Kills Gateway National Park, Staten Island, P, T, C
Next date: June 27.

Tuesday, May 19, dusk to 10 p. m.
Observing at Cadman Plaza, Brooklyn, P, T, C
Next date: June 23.

Wednesday, May 20, 6 p. m.
AAA Annual Meeting, M, HQ
Buffet dinner, reports of officers and committee chairs, election of board members. A brief meeting of the board of directors follows the meeting.
Next date: May 19, 2010.

Tuesday, May 26, 7 to 9 p. m.
Observers' Group, M, HQ
Upcoming celestial events, astronomy resources on the Internet, using telescopes and binoculars. Observing afterwards, weather permitting.
Next date: June 30.

Wednesday, May 27, 8 to 11 p. m.
Observing at Prospect Park, Brooklyn, P, T, C
Next date: June 10.

Saturday, May 30, 10 a. m. to noon
Solar Observing, Central Park, P, T, C
At the Conservatory Waters.
Next date: June 27.

How to Contact the AAA

If you want to join, volunteer your time, participate in events, have a question or need to change your address, e-mail secretary@aaa.org, or leave a message at AAA hq: (212) 535-2922. Also, visit us on the web at www.aaa.org. If you're interested in writing an article for *Eyepiece*, contact editor Dan Harrison at editor@aaa.org.

AAA Annual Meeting May 20

In accordance with the AAA bylaws, the 2009 annual meeting
of the AAA will be held on Wednesday, May 20, 2009.
AAA headquarters, 120 Warren Street, between Greenwich and West streets

6 p.m.: Social gathering, for all AAA members
7:15 p.m.: Annual meeting, for all AAA members
Board of directors meeting will follow.

The 7:15 p. m. meeting will include elections to fill vacancies on the AAA board of directors. Nominations, besides those made by the Nominating Committee, may be presented to the AAA president or to the recording secretary no later than seven days before the annual meeting. Each such additional nomination requires the signature of at least 18 AAA members.

Galileo/Medici Show in Philadelphia

The Franklin Institute in Philadelphia is the world exclusive host for "Galileo, the Medici and the Age of Astronomy," an exhibition that opened last month and runs through September 7.

Created through The Franklin's partnership with the Istituto e Museo di Storia della Scienza in Florence, the exhibit showcases Galileo's accomplishments, his relationship to the ruling Medici family, his discoveries and his impact on astronomy, physics and math. This is the first time one of the two remaining Galileo telescopes has left Italy. Also exhibited are other instruments belonging to Galileo, as well as paintings, prints and manuscripts from the Medici collection. The collections will showcase how the union of science, art and political power gave rise to Galileo's success.

Every weekend this month, there is astronomy-themed programming, covering a wide range of subjects, to coincide with the exhibition.

Info: www2.fi.edu/. ■

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