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Star-filled Nights and Galileo Moments

KEN HEWITT-WHITE

Four hundred years ago, Galileo Galilei aimed his crude first telescope at the heavens and began a scientific revolution. This summer, during the International Year of Astronomy, take a moment to look up and explore the night sky.

Creating Readable Electronic Articles

ALAN GOULD

Every year, more and more journals are switching from paper copies to making the material available online. Here are some simple things to keep in mind if you’re creating digital content — even if it’s just PDF handouts for your students.

Is Space Art Dead?

LYNETTE R. COOK

The field of space art continues to adapt as technology advances. But space artists feel the bottom is dropping out of their profession. In Part II of this feature, Lynette Cook explores the declining demand for space art and how artists are diversifying in order to survive.

Astronomy in the News

More discoveries at Mercury, a sharp view of a red giant star, and tidal debris from colliding galaxies — these are some of the discoveries that have recently made news in the astronomical community.
This summer, I'd like you to look up. No, I urge you to look up. After all, it's the International Year of Astronomy, and what better way to celebrate than to gaze skyward one evening by yourself, with a group of friends, or better yet, with a group of strangers who have never explored the night sky.

Mercury is not, and will never be, an observing magazine. But in this issue, I've included a feature article by Ken Hewitt-White that identifies several easy-to-find deep-sky objects. Some of them you can see even from a light-filled city sky. Well, I guess I have to qualify that statement. Ken's deep-sky objects can be seen from many, though not all, city locales.

I was reminded of the problem last month while in China for the July 22nd total eclipse of the Sun. Our group stayed in Beijing and Shanghai, and at some point every evening I'd step outside, look up, and see ... pretty much nothing except shades of white. My best night was a star count of three. On two mornings, Venus and the crescent Moon stood above the eastern horizon.

In Beijing, this lack of stars has little to do with light pollution. Looking south from our hotel situated on the northern fringe of downtown, I found the city surprisingly dark. But some days in both cities, even our nearest star was hidden from view — not because of clouds, but as a result of haze and smog. The situation was no different a year ago when I was in Xi'an.

As I wandered the streets near our hotel on my last morning in Shanghai — the day after the eclipse — I couldn't help but wonder if, for many residents, the previous day was the first time they had looked skyward hoping to see a celestial event. (Sadly, the eclipse was rained out in Shanghai. Our group caught totality, just barely, from a location southwest of the city.) After all, what's the point of looking up if you know, from experience, that there's nothing up there to see?

The same is likely true most of the time in the two other major cities I visited this year and last. And that means more than 40 million people in these three urban centers will likely never experience the joy of a dark sky or the thrill of seeing the Milky Way stretching overhead.

So this summer get outside and revel in the night sky. Look up and share the experience with others, especially those who may be stargazing for the first time. That is what the IYA is really all about.

Paul Deans
Editor, Mercury
I n October 2008, I attended a meeting of an advisory committee of which I’m a member in Cocoa Beach, Florida. And on the steamy, sunny afternoon of the meeting’s conclusion, our committee had an opportunity to drive over to the Kennedy Space Center for a tour — and a cook’s tour it was.

I’ve been on KSC tours before — mostly of the tourista variety — but this one was something special. First, we had a chance to wander through the cavernous facility where the components of International Space Station are assembled, watching workers securing the final panel of the four giant solar arrays for the trip up to the station (which has since been installed). We watched contractors filling Leonardo, one of the three Italian-made Multi-Purpose Logistics Modules, with supplies and goodies for the next shuttle resupply trip. (Raffaello and Donatello, the other two MPLMs, lounged empty nearby — their names supporting my theory that these “moving vans” are named for the Teenage Mutant Ninja Turtles; only Michelangelo is missing.)

Not far away sat the Cupola — one of the last components slated to go up (currently scheduled to do so in February of next year). It’s the six-window “Ten Forward” of the station, a combination observation tower and sun deck. It was satisfying to see the hustle and bustle of it all — a space program very much in operation.

Next came a special moment indeed: access to the Orbiter Processing Facility where the shuttle Discovery was being spiffed up for its next flight. It was simply thrilling to walk underneath the belly of the beast, looming over my head so near that it seemed I could reach up and touch the tiled underbelly that heats up to a couple thousand degrees Fahrenheit on every reentry (but I knew better than to try!). The shuttle’s cargo bay was lost in the surrounding support structures, but its black nose, wings, landing gear, and the cones of its powerful engines were all there for our visual inspection as we were escorted about the facility floor for an up-close-and-personal look at the shuttle.

A stroll around the Vehicle Assembly Building came next, daunting in its size, and then a bus ride out to Launch Pad A where Atlantis sat. The Hubble repair launch had just been postponed to accommodate the preparation of a backup for the science instrument command and data-handling unit that had just failed on the HST, but the shuttle hadn’t been rolled back to its hanger yet. And in the distance sat Endeavour on Pad B as the rescue vehicle in case something were to go wrong with Atlantis in flight. The Hubble repair mission has since flown — successful beyond all reasonable expectations — but we got to witness one of the rare instances when two shuttles sat ready to go on their launch pads.

And just this past spring, a chance to view the hardware of another part of the space program presented itself on a visit to the Northrop Grumman facility in Redondo Beach, California. At the end of another meeting, one of our hosts invited us to peek in on the James Webb Space Telescope (JWST), for which Northrop Grumman is the prime contractor. From a glassed-in perch high above the floor of a tall “clean room,” we watched workers, looking prepped for surgery, manipulating the section bearing the folded-up membranes of JWST’s sunshield. Across the room, other personnel fussed with the telescope’s backplane — the black framework that will hold the 18 hexagonal beryllium mirror segments when the contraption is fully assembled. Real parts of the largest space telescope yet.

It struck me, as I took in these behind-the-scenes visits, that I was seeing the US space program past, present, and future. The shuttle fleet, to be retired in a couple of years, represented the accomplishments of the past. The space station, which will soon be complete — with the six-person crew that was envisioned for it — represents the ongoing present, albeit with Russian Soyuz spacecraft doing the ferrying up and down once the shuttles retire and until their replacement vehicles fly. And the JWST, due presently to launch in 2014 to gaze into star-forming nebulae, probe extrasolar planets, and peer deep into the distant past of the universe where the light of nearly everything that glowed back then has shifted into the infrared, represents the future. There is a certain comfort in the continuum of the manned and unmanned programs, at least for those of us who care about space and the ongoing study of the universe. We’re still reaching, still stretching, and that’s a very good thing to see.
There's something analogous in all of this with your Society as well. This year we observe the 120th anniversary of the founding of the ASP — an event that has us also looking back, looking around, and looking forward. The Society has stood witness to an explosion in our understanding of the universe during the past century and more, including humankind's first tentative steps beyond the Earth. It remains a vital organization today through its publications and its varied education programs and networks, with a rearticulated mission that employs astronomy as a means to greater science literacy in a world that needs it. And as we begin preparations for a new five-year strategic plan, we are considering the future and how together we can move the Society forward to new opportunities to serve our common goals.

In fact, this year’s annual meeting (September 13–16 at the Westin SFO in Millbrae, California, with a weekend of education workshops September 12–13) has the future as its theme. Be sure to check out the meeting website to learn all about it. We hope to see many of you there as we look ahead and begin to plan for the next 120 years for the Society.

My recent behind-the-scenes forays into the US space program demonstrated something else, too. It's really true that “it takes a village.” The space program happens through the effort and vision of many people working together in common cause. The same is true for the ASP. It takes all of us to make the Society an advocate for astronomy, good science education, and scientific enlightenment for all. With your continued support, we can continue to be a positive force for the future.

See you at the meeting!

JAMES G. MANNING (jmanning@astrosociety.org) is the Executive Director of the Astronomical Society of the Pacific.
Mystery of the Missing Supernova

No definitive historical records of the Cassiopeia A supernova event exist. Why?

The Cassiopeia A supernova remnant, Cas A for short, is the second-brightest radio source in the sky. First discovered by radio astronomer Grote Reber in 1944, it is one of the youngest known galactic supernovae remnants. The light from the supernova event that created Cas A is estimated to have arrived at Earth no earlier than 1680, give or take a couple of decades, making Cas A about three hundred years old.

Given its proximity — roughly 11,000 light-years (3.4 kiloparsecs) — and its northern circumpolar location, it’s strange that there exists no unequivocal record of the Cas A supernova event, especially since both Tycho’s 1572 and Kepler’s 1604 supernovae were well-documented events. There has been some debate as to whether English astronomer John Flamsteed recorded the putative SN 1680 as the sixth-magnitude star 3 Cassiopeia (3 Cas) in 1680, which subsequent astronomers were unable to identify.

Steward Observatory astronomers Kristoffer Eriksen, David Arnett, Donald McCarthy, and Arizona State University astronomer Patrick Young recently examined three possible scenarios for the apparently unremarkable Cas A supernova event. Perhaps the simplest explanation is that the supernova reached its peak luminosity when Cassiopeia was high in the daylight sky. Or this particular supernova may have had such a low intrinsic luminosity that it was simply too dim for most 17th-century astronomers to notice. Alternatively, the Cas A event may have been a typical luminous supernova that was heavily obscured by interstellar extinction due to intervening dust.

Before we go on, let’s briefly review some important supernovae physics. Nickel-56 is produced in the final stages of nucleosynthesis just prior to the explosion. After core collapse, the optical luminosity of the supernova is powered by radioactive decay of nickel-56 and its daughter element cobalt-56. Meanwhile, in the less dense outer layers of the supernova remnant, the rare titanium-44, apparently an exclusive product of type Ia and type II supernovae, creates gamma radiation as it decays. The mass ratio of titanium-44 to nickel-56 is an important parameter in supernova explosion models.

The “missing” supernova of 1680 is an interesting historical mystery, but it also represents an important astrophysical problem. The ratio of the mass of titanium-44 (determined by gamma ray measurements) to that of nickel-56 (inferred from the apparent low luminosity of SN 1680) does not agree with theoretical calculations for a symmetric explosion. It has been argued that this is simply evidence that SN 1680 was asymmetric. Because the ratio of these two elements is important for supernova explosion calculations, Eriksen and his collaborators set out to make an accurate assessment of the mass of nickel-56 in Cas A. In the process, the group also examined why Cas A’s supernova (SN 1680) was apparently so faint as to escape any real notice.

Is it possible Cas A’s supernovae was unusually dim? Model calculations indicate that a delayed explosion after core collapse can result in gravitationally bound ejecta — within minutes of the explosion, much of the ejecta falls back onto the core. Since supernovae luminosity is proportional to the mass of nickel-56 in the ejecta, the resulting supernova is one of low luminosity. Eriksen suggests this scenario is unlikely for the Cas A supernova, based on the large quantity of iron-56 (the final decay product of nickel-56) detected in X-ray.

Eriksen and his colleagues used two diagnostic techniques that had not been used previously on this object and determined that interstellar reddening toward Cas A is roughly 20% higher than previously assumed. Based on iron X-ray emission and supernovae luminosity models, they estimated the absolute visual magnitude of SN 1680 at –16.5. Assuming a distance of 3.4 kpc and using their higher reddening value, the apparent magnitude of the postulated SN 1680 might have been as bright as magnitude 1 or as dim as magnitude 3 at its peak.

Flamsteed recorded the sixth-magnitude star 3 Cas on August 16, 1680. If 3 Cas was indeed the Cas A supernovae, it would have reached peak brightness between February and April 1680. Thus, the putative supernova would have transited during the day and would have been too faint to observe. On the other hand, it would still have observable during morning and evening twilight. If its peak brightness was near the higher estimate, SN 1680 would have been one of the twenty brightest objects in the sky, whereas if it was on the fainter end of the estimate, it could well have gone undetected. So it is just possible that Flamsteed’s observation of 3 Cas is a record SN 1680 caught in decline!}

ASTROPHYSICIST JENNIFER BIRRIEL likes a good mystery, cosmic and otherwise. She is an Associate Professor of Physics in the Department of Mathematics, \textit{Computer Science, and Physics at} Morehead State University in KY.
I spent a lot of late summer evenings during my early teenage years comfortably reclined on a backyard deck, gazing through binoculars across the Milky Way starscapes of the Summer Triangle. In the cool, humid silence of dark, northern Michigan nights, I would let my eyes and mind wander, imagining the innumerable worlds that surely filled my field of view.

It’s a topic that motivated my choice of a career in astronomy and focused my early professional ambitions in the field of planetary science. Back then, though, extrasolar planets had yet to be found. The theory behind the various observation techniques — from direct telescopic detection using astrometric measurement of the ‘wobbly’ barycentric motion of stars as they move through space, to photometric observation of mini-eclipses by planets passing across the disks of their parent stars — was certainly sound. But at the time the technology just wasn’t quite ready.

All that has changed during the last decade or so. The pioneering efforts of a small army of exoplanet hunters have revealed a veritable zoo of extrasolar planetary systems, replete with a variety of architectures. Many of these discoveries have challenged our naïve notions of what planetary systems should look like based on the layout of our own, what we thought to be ‘typical,’ solar system. Numerous exoplanetary systems have large, gas-giant planets huddled in close to their stars, rather unlike our own plan with rocky, Earth-size planets in close and large, Jupiter-like worlds orbiting farther out. Once again, we gain a deeper understanding of our worldly context by taking a broader planetary perspective.

Biases and limitations in the observational techniques and technologies used to detect extrasolar planets have so far limited most of the discoveries to the bigger, more massive worlds — the Jupiters and Neptunes of our stellar neighbors. With the hurdle of just detecting exoplanets at all now fully and marvelously surmounted, the next natural challenge is to find the terrestrial, Earth-size planets that must surely accompany their larger siblings. A new NASA mission is now setting out to do just that.

The Kepler spacecraft, launched into an Earth-trailing, heliocentric orbit last March 6th, is designed to detect extrasolar planets by the transit method. If a distant planetary system is, by chance, oriented so that our line-of-sight to its parent star is very near the plane of its planets’ orbits, we will periodically see transits, or little eclipses, of the star as the planets pass across its disk. The bigger the planet, the more of the star’s light it will block during the transit. This technique has been successfully employed with ground-based telescopes to detect and verify the presence of so-called “hot Jupiters” discovered by other techniques.

But Kepler is after much smaller game. In space, free of the twinkling distortions of Earth’s atmosphere, Kepler’s photometer is so sensitive that it can detect dips in stellar brightness of just 20 parts per million for 12th-magnitude solar-type stars — like a flea crossing a car headlight. That’s good enough to see transits of Earth-size planets, the holy grail of extrasolar planet searches.

Staring at the same large field of 100,000 stars for at least three-and-a-half years, Kepler will determine the percentage of terrestrial and large-size planets around a wide variety of stars in our neighborhood of the Milky Way. The mission will map out the range of sizes and shapes of planetary orbits, determine planet sizes and masses, and will probably find a good many planets in or near the habitable zone of their parent stars. Let that sink in — we’re going to know in the next few years just how common other Earth-like worlds really are.

This mission brings my early interests in this field full circle, for Kepler’s search field is a large patch of sky between the constellations Cygnus and Lyra — the same stars I so enjoyed musing over as a young teenager. When I’m back home in Michigan this 4th of July, I’ll have to break out the old binoculars and peruse the Summer Triangle for old time’s sake.

DANIEL D. DURDA is a Principal Scientist in the Department of Space Studies at the Southwest Research Institute in Boulder, Colorado.
A Black Hole’s Elusive Signal Revealed at Last

Although scientists and the public alike accept the existence of black holes as gospel truth, no one has actually seen one, and the entire concept — a singularity of infinite gravity trapping light itself — is frankly both mind-bending and unbelievable.

So far, scientists have been able to provide only circumstantial evidence for the black hole’s existence. In the case of a Seyfert 1 galaxy named 1H0707-495, the case was somewhat convincing. Indeed, the Seyfert is a class of galaxies thought to harbor a central, supermassive black hole by virtue of the strong, concentrated source of highly ionized gas in the galaxy core.

Yet is that enough evidence to prove the unbelievable? You could likely better assert that unicorns roamed Earth. Maybe it’s not a black hole we are detecting, the devil’s advocate would say. Maybe there’s a massive but nonetheless uneventful gas cloud that’s absorbing light and producing that spectrum in Seyfert galaxies and elsewhere.

For the last two decades many scientists have hinged their case for a black hole on the detection of a spectral line called the broad iron-K line. But, as with that picture of a vase that also can be seen as two opposing faces, the iron-K line can be seen in two different ways — either as an emission line or as an absorption line.

The emission line points to a black hole. In this scenario, the extreme gravity from the black hole is tugging at the light emitted from hot iron plasma very close to the event horizon. In a laboratory, the iron line would be a narrow spike at a precise energy. But around a black hole, models predict that the spectral line shifts to lower energies and that this produces a broad line spread out across energies.

But one also could say this broad line is due to the noise of poor resolution and that this is an absorption line of light from the galaxy’s core passing through dense iron clouds.

As reported in the May 28 issue of Nature, a team led by Andrew Fabian of the Institute of Astronomy at the University of Cambridge detected, for the first time, both iron-K and L lines coming from a Seyfert galaxy, namely the well-studied source 1H0707-495. The iron-L line cannot be explained reasonably as an absorption feature, Fabian said. The dual detection of K and L lines is by far the most convincing evidence to date that something compact and powerful is producing spectral emission.

And the team could go a step farther. “The bright iron-L emission has enabled us to detect a reverberation lag of about 30 seconds between the direct X-ray continuum and its reflection from matter falling into the black hole,” the authors state in the Nature paper. “The combination of spectral and timing data on 1H0707-495 provides strong evidence that we are witnessing emission from matter within a gravitational radius, or a fraction of a light-minute, from the event horizon of a rapidly spinning, massive black hole.”

That radius of 30 light-seconds or about 10 million kilometers, Fabian said, falls well within Mercury’s orbit of the Sun — again, by far, the closest we have observed matter near a black hole.

Fabian perfected his observation of iron-K lines during the past 15 years. With ESA’s XMM-Newton X-ray observatory, his team observed 1H0707-495 over four 48-hour periods. The elusive iron-L line emerged as a result of the long observation, clever data plotting, and of course, an abundance of iron.

Niel Brandt of Penn State University, co-author on the paper and longtime collaborator with Fabian, described the environment in the core of 1H0707-495 as a mad feeding frenzy. “Our observations reveal that the black hole appears to be spinning very rapidly and is eating matter so quickly that it verges on the theoretical limit of its eating ability, swallowing the equivalent of two Earths per hour,” Brandt said.

Fabian has much invested in championing his theory and method, and he has been battling non-believers for some time. Future X-ray missions would likely exploit the broad iron-K line phenomenon, if it truly is a result of strong gravity and the effects of general relativity near a black hole. Fabian said he already has found the same iron-K and L line features in another object, with a paper to be submitted for publication soon.

Expect the other side to offer a counter-argument. The report in Nature, a general-science journal, lacks the details that several experts contacted felt they needed to comment on Fabian’s work. Scientists want to believe but, with all the modeling needed to “see” a black hole, it remains a leap of faith.

CHRISTOPHER WANJ Eck is a communications director at the National Institutes of Health. Believing in black holes is one of several impossible things he does every morning before breakfast.
Twenty-five years ago astronomical observation from space was in its infancy. Space probes had traveled to planets as far out as Saturn (Voyager 2 would reach Uranus in 1986 and Neptune in 1989), and some small X-ray satellites had been launched, but a large telescope in orbit was still a thing of the future. In the 1984 July-August issue of Mercury, George B. Field wrote an article on space astronomy, its advantages, and some of the instruments that were planned. In the 25 years since then, many of these have come about.

He first discussed why space astronomy, which he defined as “remote observation of astronomical objects from Earth orbit above the atmosphere,” was important. One reason was the ability to observe in the ultraviolet, X-ray, and infrared regions of the spectrum, which are blocked by our atmosphere. Another major advantage would be the absence of atmospheric turbulence, which would result sharper images and the ability to see fainter stars. A third factor was escaping light pollution and radiation from molecules in the upper atmosphere. “The ability to avoid all these problems makes space astronomy even more attractive for the future.” Field went on to describe several proposed programs and instruments, of which the first and foremost was the Space Telescope. This was due to be launched from the space shuttle (the first of which had flown in 1981) in 1986 or 1987; it would be a 2.4-meter reflecting telescope and was “planned as a permanent observatory for ultraviolet, optical and infrared observations.” Its mirror would be precise enough to allow “images of galaxies 20 times sharper than those made by telescopes on the ground.” It would also be able to observe objects up to 100 times fainter than was possible from the ground. The hope was that this might help answer some of the big questions of cosmology, including the distribution and nature of galaxies billions of years ago.

The Hubble Space Telescope (named for Edwin Hubble) was scheduled for launch in October 1986. But in January 1986, the explosion of the space shuttle Challenger 73 seconds after liftoff put a stop to the whole US space program for several years. The telescope was finally placed into orbit in April 1990. It soon became evident that there were problems with the mirror, and the images did not live up to expectations. NASA sent up the first shuttle servicing mission to the HST in December 1993; the astronauts were able to correct the problem, and since then the telescope has produced spectacular images of star clusters, nebulae, and galaxies. The fifth (and last) servicing mission successfully occurred in May 2009.

Field discussed other proposed space instruments too. The Advanced X-ray Astrophysics Facility (AXAF), intended for permanent Earth orbit, was to make “high resolution images of cosmic X-ray sources with a sensitivity up to 100 times that of its predecessor, HEAO-2 (the Einstein Observatory).” This telescope was launched in July 1999, and renamed Chandra after Indian astrophysicist Subrahmanyan Chandrasekhar. Its nominal lifetime was five years, but as of this writing it is still working.

Among the space telescopes also mentioned by Field, the Compton Gamma Ray Observatory was put into orbit in 1991 and functioned until 2000, observing such things as the black hole at the center of the Milky Way galaxy. The Shuttle Infrared Telescope Facility (SIRTF) was launched in 2003 and renamed for Lyman Spitzer, a Princeton astronomer and early champion of space astronomy. It continues to operate, albeit with a reduced capability as a “warm” mission, which began after Spitzer’s cryogen ran out on May 15th. The Cosmic Background Explorer (COBE), launched in 1989 and operational until 1993, studied the radiation that pervades the entire universe, which is believed to have originated in the Big Bang. COBE made many important discoveries about the anisotropy (the uneven temperature distribution) of the cosmic background radiation.

These and many other astronomical satellites have added immensely to our understanding of the universe, but many new questions have been raised. The next generation of space telescopes will include the James Webb Space Telescope, a 6.5-meter telescope expected to go into orbit in 2014. So there is still a bright future for space astronomy.

KATERINE BRACHER (bracher@whitman.edu) taught astronomy at Whitman College in Walla Walla, WA, for 31 years. Retired in 1998, she currently lives in Austin, Texas. Her research focuses on eclipses and the astronomy of the ancient world; her other principal interest is early music.
In my Spring 2009 column, I mentioned the astronomer Christoph Rothmann, who worked on creating a star catalog. But Rothmann was no mere observer. His keen insights into physics helped demolish the hold Aristotle still held after 2,000 years. To make the case, he argued with none other than the world’s most famous astronomer (of the time), Tycho Brahe.

Their correspondence began in 1585. Tycho wrote to Rothmann: “If the Earth actually turns from west to east, then a cannon ball, which is shot toward the turning of the Earth, must continue to fly as fast as a projectile fired in opposite direction.” While this was the verdict of Aristotle, whose views were accepted even by the Catholic Church, it is incorrect. Rothmann countered that both the ball and the cannon would experience the same motion as the Earth.

Both Rothmann and Tycho developed their own versions of the solar system, and they were both published in 1583. Both men believed the Sun and Moon revolved around the Earth, while all the other planets revolved around the Sun. After working with Wilhelm IV on the star catalog starting in 1584, Rothmann had become convinced Copernicus was right, but Tycho never gave up his vision of the solar system, now known to history as the Tychonic system.

Events on the Continent were being closely watched from afar, including in the intellectual backwater of Scotland. Its golden age of great thinkers was not to happen until the 1700s; in the 1500s few Scots could read or write Latin, the language of scholarly discourse. George Buchanan (1506–82) was regarded as the greatest Latin poet of the century, and he undertook to write a Latin poem about astronomy. Called De sphera, it occupied his thoughts for 20 years.

In those days a poem was much more significant that it is now. Poetry was used to disseminate serious ideas to a wide audience, and we find 10 other poets in the 16th century who created major works relating to astronomy. This included Giordano Bruno, whose ideas created such a scandal that the Church burned him at the stake in 1600. Poetry was not for the faint of heart!

Buchanan worked for Mary, Queen of Scots. In 1570 she gave him the job of tutoring her son, the future King James I of England. He is best known today for giving his name to Jamestown, the first colony in the New World, and for his edition of the Bible — the King James version — that is still in use worldwide.

Buchanan instructed James in astronomy and history, often using books he had written himself. Book V of De sphera was particular in presenting a warning to people in high places who have been misled by astrology. It’s thought this was meant to counter Tycho’s book De nova stella (The New Star), in which he propounded his belief in astrology.

Like many pupils, James took a dislike to his tutor, and five years after Buchanan’s death James made a pilgrimage to visit Tycho. They spoke of De sphera, which Tycho had read with disdain. He pointed out to James that in Book II of De sphera, Buchanan said that the stars were fixed and unchangeable. But new stars had appeared—Tycho had discovered one himself in 1572. Tycho further asserted that comets existed beyond the Moon, whereas Buchanan was certain they were in Earth’s atmosphere. One can be certain Tycho also affirmed his belief in astrology, again in contradiction to James’ tutor, but James apparently did not regard astrology highly. When he came to the throne, he dismissed the court astrologer John Dee (Mercury, Winter 2008, page 11).

Nevertheless, as a token of his regard for Tycho and antipathy towards Buchanan, James gave Tycho two fine mastiffs. Even though Tycho and Buchanan disagreed about many points, they were both anti-Copernican. Neither believed the Sun was the center of the solar system, with all other objects in orbit around the central star. While they never worked together, their separate efforts served to erect roadblocks to the acceptance of the Copernican worldview and thus stalled the advance of astronomy for many years.

As for the text of the De sphera, it was not translated into English until 1948 by James Naiden at the University of Washington. Dr. Naiden, who was born in 1915, died last year. This column is dedicated to the memory of this great historian of astronomy.

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CLIFFORD J. CUNNINGHAM was recently photographed with the historic 15-inch Great Refractor, dating from 1847, at Harvard College Observatory.
Every year as I retool lesson plans and restructure my student workbook, I confront stellar magnitudes. Is it time to stop asking students to find distances to stars? Most years, I plodded ahead with magnitudes, hoping for the best.

Magnitudes present several difficulties for students, starting with its ordinal numbers. Even though students understand places in a track meet, when they see magnitudes displayed, they resort to the cardinal numbers (bigger is brighter). The logarithmic scale is a problem because most students in my introductory course are in remedial math (pre-algebra).

I have explored defining apparent and absolute brightnesses. If we set the Sun’s absolute brightness to 1 and Sirius’ to 100, the apparent brightness of Sirius would be 1400. A simple inverse square law calculation would yield a distance of 2.7 parsecs.

Two problems immediately emerge: the inverse square law is beyond many of my students (many can’t square integers past 4 without a calculator), and what happens for stars farther than the standard distance? With ratios of apparent to absolute brightness of less than 1, I have just traded magnitudes for the horror of fractions!

So I continue with magnitudes. But in the end, this decision wasn’t based solely upon the difficulties of developing a different system. Upon reflection, I decided that it fit my course goals of developing analytical thinking. Magnitudes now fill the first two weeks of my one-term Astro 101 course. Instead of being just one of many stellar characteristics, it becomes a focus.

Many students will never master finding a star’s distance from its magnitude. So I approach the problem in steps and establish several mastery levels. I also use the idea of “quantitative reasoning” promoted by Ed Prather (University of Arizona) and Tim Slater (University of Wyoming). Quantitative reasoning asks students to deduce something using a relationship, rather than determining a numerical value. Instead of asking how much brighter Star A is than Star B, we ask the simpler and more conceptual question: Which star is brighter?

This “step approach” then proceeds to asking how each star’s apparent magnitude compares to its absolute magnitude — again, relationships and not values. Next we ask what the comparison means in terms of distance: Is the star closer or farther than the standard distance? The next step asks which star is closer. The combination of discrete steps and relational thinking to this point is achievable by most of my students, whereas the numerical approach was guaranteed to be problematic. Finally, we add a third star to produce the desired cognitive load.

I challenge students to see magnitudes as symbols that mean brighter and fainter. Every time I hear “8 is bigger than 3," I try to get them to “speak as astronomers” and say 8 is fainter than 3. That is the learning moment, when they perceive a magnitude as something different from a number.

From analysis of in-class activities and exam problems, I believe this approach is more successful than “math” routes. My math-phobic students relax when told they don’t have to calculate anything, they just have to reason out a comparison. While students perceive this as easier, I see this as a way to get them to do the harder things: synthesize concepts and apply them to new situations. If we want them to learn how to think, making them work out relationships is stronger pedagogically than allowing them to plug-and-chug their way to distances.

I try to use real stars when possible but round off fractional magnitudes. Differences between apparent and absolute magnitude are limited to multiples of 5 so distance factors are multiples of 10. Simple values are used because I am not trying to evaluate their math skills. Rather, I am trying to see who can utilize the ideas of brighter/closer, fainter/farther, and the inverse square law together in a larger problem. Questions are often broken into parts, so students who have mastered only some of the ideas can still be rewarded.

My resolution to stick with magnitudes has nothing to do with their historicism, or because one can’t walk through an astronomy book without tripping over them unexpectedly. Now I use them to promote students’ thinking skills. Not all astronomy instructors will agree with my resolution, but I say the choice of topic isn’t the important thing — building thinking skills is.
Have you been to a science fair recently? Probably nothing at your local city or state level can compare with the annual INTEL International Science & Engineering Fair (ISEF). Here, finalists from all the state science fairs, as well as students from around the world, come to share their projects and compete for prizes and scholarships worth nearly $4 million.

For the past 10 years, the ASP and the AAS (American Astronomical Society) have jointly awarded the Bart and Priscilla Bok Award at the INTEL ISEF. After serving as a judge for the past several years, I wanted to share the experience with Mercury readers. Although only a very small number of the projects are in astronomy, the ones that these high school students are undertaking are really spectacular.

Every year the fair is held in a different US city. This year it was in Reno, Nevada, from May 10 to 15. Some 1,563 high school students, their accompanying teachers and parents, and about 1,000 judges descended on the city. (As a group we paid little attention to all the slot machines!) Students participating are ninth through twelfth graders who earned the right to compete by winning top prize at local, regional, state, or national science fairs.

All the 1,225 projects were set up in a vast convention hall. Physics and astronomy accounted for slightly more than 100, and of these, there were about 17 astronomy projects. Why are less than 2% of them in astronomy? Don't we all feel that this field is one of the most interesting imaginable?

There are a number of factors. Astronomy isn't a class taught in most high schools, nor is it an important part of the curriculum. And as amateur astronomers know, getting involved can be both expensive and time consuming. But this makes an award like the Bok all the more important for encouraging students.

The titles give a flavor for the sorts of projects undertaken: **Optimization of CCD Parameters for High Resolution Lunar Imaging;** **Identifying T Tauri Stars using Small-scale Optical Telescopes;** **Determining the Orbital Elements of Minor Planet 23265;** **A Time Dependent Impact Parameter Model Sheds Light on the Evolution of Galaxy Morphology in Compact Clusters of Galaxies;** **Sensitivity to Initial Conditions in a Solar System Model;** and **A Study of Quiescent Flicker Behavior in a Dwarf Nova.** These are not topics easily judged by someone without an astronomy background, so it's important to have specialized judges at the fair.

There were three of us judging: Dr. John Glaspey from the National Optical Astronomy Observatory, Dr. Greg Schultz from the Space Science Lab at Berkeley, and me. The INTEL fair is very well run, with a format that allows judges time to first review the posters without students present, and then on the following day to interview the students about their work. John, Greg, and I spent a full afternoon and most of the evening reading the posters. The next day all the student finalists were at their posters for interviews. It was not an easy task: all the projects were very high quality, and these students were articulate and excited.

The Bok Award

The Bok prize is named for Bart and Priscilla Bok. Bart Bok was an outstanding research astronomer who made important contributions to our understanding of the Milky Way and of star formation.
He received the ASP’s **Bruce Medal** in 1977 for lifetime achievement. Throughout his life, and especially as an ASP Board member, Bart was a strong advocate for outreach and education in astronomy. His wife Priscilla was also a very distinguished astronomer, and those of us who had the honor of knowing them have many fond memories. (One of this year’s judges, Dr. John Glaspey, was Bart Bok’s student.) Upon his death in 1983, the Society established the Bart Bok Memorial Fund to support educational projects.

About 10 years ago, at the suggestion of the AAS, the activities supported by the Bok Fund were expanded to include the joint sponsorship of an astronomy award at the ISEF. The main criterion for selecting the Bok Award is scientific merit. Observational, instrumental, or theoretical projects are all eligible, as are interdisciplinary projects involving physics, mathematics, computer science, and engineering. The awarded funds are intended to be used by the recipients to further their education and research efforts.

The ISEF is sponsored jointly by the **Society for Science & the Public** and **INTEL**. (Originally sponsored by Westinghouse, INTEL has provided the major support since 1998.) Awards are presented both by INTEL and by special judges representing more than 60 scientific, professional, and educational organizations such as the ASP/AAS. There are monetary awards, scholarships, summer internships, book and equipment grants, and scientific field trips. All of the 2009 finalists can be found at this [website](http://www.societyforscience.org).

### The 2009 Winners

The Bok first prize ($1,000 this year) went to Keith Austin Hawkins for his project: **A Time-dependent Impact Parameter Model Sheds Light on the Evolution of Galaxy Morphology in Compact Clusters of Galaxies**. Keith is a high school senior and will be majoring in physics and astronomy at Ohio University next year. He worked on this project with help from Dr. Steven Cederbloom of Mt. Union College, and they hope to submit a paper to the Publications of the Astronomical Society of the Pacific (PASP).

Second prize ($500) went to Caroline Julia von Wurden for her project: **Determining the Orbital Elements of Minor Planet 23265**. Caroline is also a senior and will be attending Berkeley, majoring in physics. She chose this asteroid, which she observed through creative access to imaging data, because it was named for her at the INTEL fair in 2007 when the LINEAR project named an asteroid for all the top winners.

The INTEL ISEF 2010 will be held in San Jose, California, from May 9 to 14. I’m looking forward to judging again.

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**The Society for Science & the Public (SSP)**

The **SSP** is a nonprofit 501(c) (3) organization dedicated to the public engagement in scientific research and education. Our vision is to promote the understanding and appreciation of science and the vital role it plays in human advancement: to inform, educate, inspire. **Inform** – To deliver the events and news of the scientific world daily. Through online and print media, we keep the world informed of the latest scientific news and advances. **Educate** – To further the many disciplines of science by reaching students, teachers and the public. **Inspire** – To encourage and nurture the next generation of scientists, engineers, and teachers through our acclaimed science competitions.

Founded as Science Service in 1921, the SSP has, through its award-winning magazine **Science News**, and through world-class science education competitions, conveyed the excitement of all areas of science and research directly to the public.

— **K. G.**
STAR-FILLED NIGHTS AND GALILEO MOMENTS

During this summer of the IYA, take a moment to look skyward.

by Ken Hewitt-White
Four hundred years ago, Galileo Galilei aimed his crude first telescope at the heavens and began a scientific revolution. During the International Year of Astronomy, Galileo’s legacy is being celebrated in special activities all around the world. Among the great man’s biggest fans are the many backyard astronomers who channel their inner Galileo every time they gaze skyward.

I’ll never forget my first “Galileo moment.” It was January 15, 1966, and the sunset sky over Ottawa, Ontario, was crystal clear. A novice stargazer, I was outside with my 2.4-inch refractor (a telescope with a main lens 2.4 inches in diameter) that I’d bought with the profits from my newspaper route. I wanted to see some planets and on that particular evening I had a fielder’s choice: Venus and Mars were sinking in the west, Saturn was a bit higher, and Jupiter was ascending in the east.

With the exception of dot-like Mars, I was pleased with the views that my modest scope delivered. Venus looked like a miniature crescent Moon. Saturn was a tiny elliptical orb bisected by a straight line — the rings seen nearly edge-on. Jupiter presented a somewhat larger disk girdled by a pair of dark cloud belts. Better yet, the great planet was flanked on one side by its four biggest moons — the famed “Galilean” satellites discovered by you-know-who exactly 356 years earlier. Before going to bed that night I logged my observations, complete with drawings, in a notebook I’d bought expressly for the purpose. Galileo would have been impressed.

Today I live in a small city near the mountains of southwestern British Columbia. I own a variety of telescopes but the ones I use most are a 4¼-inch equatorially mounted reflector and a 10-inch “Dobsonian” reflector — fine instruments, both.

However, there’s a major downside to backyard observing in the 21st century — the pervasive light pollution that swallows up our urban night skies. Sadly, I can’t see much more than planets from home. If I want to expand the range of my two favorite telescopes, there is only one solution: head for the hills!

When the weather is clear, I drive to a mountain lookout in BC’s Cascade Range 75 miles away. Under that pristine sky, I’m able to explore celestial treasures far beyond what Galileo’s simple telescope could detect. Countless misty nebulae, powdery star clusters, and remote galaxies are within my grasp. Some of these “deep-sky” objects are within your grasp, too — even if you’re a city dweller with light-polluted night skies.

During this summer of the International Year of Astronomy, I urge you to head outside and stargaze. To help, I’ve selected a number of targets you can explore with small optics (or just this article and your imagination) that are visible from early summer to early autumn. Ready? Let’s gaze skyward.

**Getting Started**

Summertime, nightfall. The best-known star pattern of any season — the Big Dipper — hangs high in the northwest, slowly sinking into the north as the night (and the season) progresses. This large asterism of seven bright stars inside the even bigger constellation of Ursa Major, the Great Bear, makes an excellent starting point for our sky tour.

I like to ease into a night’s observing with an easy double star. The star marking the bend in the Dipper’s handle is zeta (ξ) Ursae Majoris, better known as Mizar. Stare at Mizar and see if you can spot a dimmer star, called Alcor, next to it. The unequal dots are separated by less than half the width of the full Moon. Sighting both

The International Space Station appears as a streak heading almost directly toward Mizar and Alcor, the pair of stars in the middle of the handle of the Big Dipper.
Mizar and Alcor is a good test of eyesight. Even so, the stars aren’t so close to each other that they form a true binary pair. Mizar is 78 light-years from Earth and Alcor, though in the same line of sight, is three light-years more distant. The stars are too far apart to be bound by gravity. However, Mizar itself is a binary star. Its components show in my 4¼-inch reflector at low magnification. Mizar was the first binary to be discovered, way back in 1650.

**Summer Splendors**

Our Milky Way Galaxy is an elegant spiral system. Think of the Milky Way as a vast “metropolis” of several hundred billion suns spanning roughly 100,000 light-years of cosmic real estate. The Sun and its family of planets reside in a suburban neighborhood called the Orion Arm, which is located roughly two-thirds of the distance from the downtown core to the city limits. Viewed from Earth, portions of several galactic spiral arms blend together in our sky to form the band of the Milky Way. This glittering archway is seen to best advantage on clear summer nights far from the glare of city lights.

The Milky Way is broadest in the southern constellation **Sagittarius, the Archer**, which appears fairly low in the south (but somewhat higher for observers in the southern United States). Revel in these billowing star clouds, for they represent the convergence of stellar populations near our galaxy’s central hub, some 30,000 light-years from Earth. If you sweep this portion of the Milky Way with binoculars you’ll discover broad, rich star fields populated with clusters and nebula of every description — almost all of them never seen by Galileo. Remember, most household binoculars are greatly superior to anything Galileo had.

In Sagittarius, your binoculars should pick up the **Lagoon Nebula, M8**. Some 5,700 light-years away, M8 looks like a patch of steam issuing from the *Teapot*, an attractive asterism formed by the eight brightest stars of Sagittarius. M8 is an *emission nebula*, a cloud of hydrogen gas heated to incandescence by the hot, young stars inside it. My 4¼-inch reflector presents a lozenge-like nebula cut in two by a curving lane of dust — the dark “lagoon” that gives the object its name. The lacy eastern portion of M8 envelops a sparse group of newborn stars that formed from the gas a few million years ago. The more luminous western part surrounds a massive adolescent star that energizes the entire nebula. See page 42 for a chart of the Sagittarius (and Scorpius) region.

Like humans, stars slowly age and die. Indeed, evidence of stellar expirations can be found all over the sky. A famous example is the **Ring Nebula, M57**, located 2,000 light-years away in *Lyra, the Harp*, now high overhead. M57 is a *planetary nebula*, an immense shell of ballooning gas that has been expelled from a very old, decaying star. Viewed in a telescope, most planetary nebulas resemble little more than out-of-focus planets — hence the name “planetary” — but the Ring Nebula is an impressive exception. Its annular structure materializes in my 4¼-inch scope at high power as a little gray doughnut floating in space. Those who explore the heavens with small telescopes know that nothing else looks quite like the Ring!

Lyra boasts the most lustrous gem in the late summer sky. Called **Vega**, this blazing sapphire is absolutely dazzling in binoculars. If you hold your binocs steady, you’ll spot a closely spaced pair of faint stars just northeast of Vega in the same field of view. The twin suns, 160 light-years away, are together named *Epsilon (ε) Lyrae*. They form a binary system, rather like Mizar that I described earlier. Ah, but there’s more. Viewed at high power in a telescope, both stars “split” again into very tight binaries. This famous “pair of pairs” is called the **Double-Double** in Lyra; there’s an image on the next page.

For a star chart showing the location of these two objects in Lyra, see page 41 in the Summer 2008 issue of *Mercury*.

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It’s a shame the eye can’t see the colors of deep-sky objects such as the beautiful Lagoon Nebula in Sagittarius.
Easing into Autumn

By mid-September I often shift my attention toward two key pairs of autumn constellations low in the east-northeast around nightfall. One set, rising in a roughly vertical formation, consists of Cassiopeia, the Queen, and (below it) Perseus, the Hero. (See page 43 for a chart of this area.) Both these constellations reside in a relatively narrow portion of the Milky Way, opposite Sagittarius, that defines the galactic limits some 20,000 light-years away. The Cassiopeia-Perseus sector is noted for its open clusters. Open clusters vary greatly in size, richness, and age but a typical specimen is an extended family of several hundred comparatively young stars loosely bound together by gravity.

A scintillating example (actually, two examples) is the Double Cluster, NGC 869 and NGC 884, in northern Perseus. Roughly 7,000 light-years away, these adjacent clusters span almost two full Moons of sky. They’re visible to the eye as a single, fuzzy “knot” in the Perseus Milky Way just under the W-shaped star pattern of Cassiopeia. My 7×50 binoculars show the Double Cluster as tandem clumps of haze pierced by stars too close together to count. However, my 4¼-inch reflector reveals subtle differences in each glittering group. NGC 884 includes a few reddish suns among dozens of blue-white gems, while NGC 869 is brighter, denser, and slightly more populous.

The other constellation pair, Andromeda, the Princess, and Pegasus, the Winged Horse, rise side by side. The torso of Pegasus is outlined by a large quadrilateral of stars called the Great Square. Extending westward from the lower right of the Great Square is an angled line of stars suggesting the horse’s neck and head. Follow that line on a chart and you’ll see that the nag is sniffing a fuzzy “carrot” called M15. M15 is a globular cluster, a densely packed ball of thousands of ancient suns. In my little reflector at high magnification, M15 is but a tiny fuzzball that grows smoothly brighter toward the center. Tantalizingly, I can detect a few dim stars sprinkled around its wispy outskirts. My trusty 10-inch does much better, resolving the misty sphere into a hive of pinpoints. Residing in the galactic boondocks 34,000 light-years from Earth, M15 is one of 150 globulars that surround our galaxy. M15 and its kindred clusters are among the oldest things visible in a telescope; they formed not long after the universe originated almost 14 billion years ago.

Our tour ends at the V-shaped star pattern of Andromeda, home of the Great Andromeda Galaxy, or M31. “Only” 2.5 million light-years away, M31 is the nearest major spiral to the Milky Way. In a dark sky I can detect it with my unaided eyes as a tiny, elongated cloud between the W of Cassiopeia and the Great Square of Pegasus. M31 appears in good binoculars as a lens-like nebulosity. Only the bright central portion of the slightly inclined galaxy is visible in telescopes from a city, but away from town wispy “wings” spanning
nearly six full Moons of sky flank the luminous core. In my 4¼-inch, I see a starlike nucleus inside the core and I also notice that the galaxy’s broad western periphery sports a sharp edge. My larger reflector clarifies that well-defined rim — it’s caused by a dark lane of dust skirting the galaxy. A second threadlike lane, parallel to the first, runs closer in. And both scopes show that M31 harbors two “dwarf” companion galaxies, called M32 and M110. Wow — three galaxies for the price of one!

Star charts for Pegasus and Andromeda can be found in back issues of Mercury. Pegasus is in the Summer 2008 issue, page 41; Andromeda is in the Autumn 2008 issue, page 40. These back issues are available in the Mercury digital archives.

The Big Picture
Occasionally I stand back from my scopes and gaze upward to admire the entire starry scene. I start with the Milky Way stretched across Cygnus. This vibrant belt of starlight is a sector of the same spiral arm that our Sun inhabits. I glance to the south, where the star clouds in Sagittarius mark the hub of the galaxy. I then cast my gaze to the northeast, toward Perseus and the galactic boondocks. If I eliminate all mental distractions, I can project past the nearby constellations, beyond the edge of the Milky Way, through the extragalactic abyss, all the way to the “island universe” of Andromeda. In my mind’s eye I see our galaxy as an immense galactic structure, one among many, adrift in a virtually endless cosmic sea.

You can make the same connection. Some moonless night this summer, put the bright lights of the city behind you and let some delicate starlight seep into your consciousness. Feel the scale of the galaxy. Bridge the gulf to Andromeda. Sense the big cosmic picture. If you can manage all that, you’ll experience a “Galileo moment” that even the great man himself didn’t have.

Astronomy popularizer and night-sky observer KEN HEWITT-WHITE has been writing and lecturing about the cosmos for more than 40 years.

Star Parties
One way to tour the cosmos (and also “kick the tires” on a wide variety of telescopes) is to attend a star party. These popular events bring telescope enthusiasts together under one starry roof, usually on summer weekends. Astronomy clubs arrange these star parties in rural locations to take advantage of good sky conditions. At a star party you can wander among telescopes large and small. This summer, try to get out to the star party nearest you. You’ll find a list of annual star parties on Sky & Telescope’s website; at the bottom of that webpage you’ll find a link to a page where you can drill down to star parties at a local level.

— K. H-W.
CREATING READABLE ELECTRONIC ARTICLES

Crafting a layout for an easily readable digital publication has some pitfalls.

by Alan Gould
Every year, more and more journals are switching from mailing paper copies to subscribers to putting material on the Internet either for free or via password-protected access. The primary driving force behind this is simple economics: the cost of publishing material online is a minuscule fraction of the expense of printing articles in a paper journal and mailing it.

A secondary reason, which probably should be the primary reason for the switchover, is that publishing online is far more ecologically benign than paper-based distribution, which currently involves cutting trees for paper, burning fossil fuels during production, and releasing quantities of pollutants and greenhouse gases during every step of the printing and distribution process.

My Cold Dead Hand

The majority of people over 40 greeted the advent of online journals with much sadness and even some derision. “You’ll take my hard copy out of my cold, dead hand before I’ll read a journal online” has been the overt or implied attitude of many readers. Yet those same readers, simply by the sheer convenience and richness of information available on the World Wide Web, are forced to admit that they are reading more and more material on their computer screens.

Many go through a phase of printing every article that they want to read because of their preference for paper. This allows one to read the article “anyplace” rather than being stuck reading it on a desktop computer that is fixed in one location. A laptop provides a little more flexibility since it is highly portable, but it’s not a very practical reading platform in places such as a brilliantly sunlit outdoor setting or the bathtub. Laptops are also limited in terms of battery life when there are no electrical outlets handy. An even more recent development is the practice of reading material on portable devices such as Blackberries, iPhones, iPods, and electronic readers of various sorts.

Once you become accustomed to reading from a computer display, as many of us have just from the sheer necessity of our work, you start using tricks that actually make it easier to read on a screen than on paper. The most obvious technique is to zoom the view so the print is bigger. Of course you can do that to some extent with printed material by using a magnifying glass, but your options are a bit limited in terms of the degree of magnification and the ability to set a certain magnification condition and have it stay set that way with rock-solid stability.

Another advantage of reading from a monitor is the computer’s search function. If you know an article has a section about a particular subject, or you just know there was a paragraph with the word “Mercury” in it, you can find the exact place, lightning fast, by searching for the key word. This cannot be done with paper, at least not lightning fast. Currently, paper may have a slight advantage in the “page flipping” department — you can scan many pages quickly by flipping the pages. However, the scroll function on computers can be very nearly as fast as page flipping, if not as tactfully satisfying. The paper advantage goes away completely if the pages are not cut and bound so the page edges are uniformly even. Have you ever had the experience of flipping through a book with even slightly ragged page edges? You can end up skipping sections and even whole chapters because the odd “big” page gets stuck on your thumb.

But enough of this “which is better” pontification. Sometimes the question “Which is better?” isn’t even relevant, since we often have little choice in the matter. Instead, let’s make the best use of whatever method is available to us. So the remainder of this article is concerned with how the creation of articles is different for the electronic media, and how reading and using the articles can be made easier and more enjoyable.

Page Layout Guidelines

One common pitfall that publishers fall into when making the transition to electronic publishing is believing the idea that it’s impossible to design a page layout that works well for both paper and computer display. This is actually a commonly held view by many in the publishing profession. But I refuse to accept that limitation — it does not apply universally.

Since 2001, I have worked for a high school curriculum materials project called Global Systems Science (GSS). GSS books are designed for an integrated interdisciplinary course, and each book deals with a societal issue that requires science for full understanding. They’re
modular in such a way as to serve as supplementary material for existing high school biology, physics, chemistry, Earth science, or social studies courses.

When we first set out to make documents suitable for use on a computer display, we started with the premise that the computer monitor is basically a landscape style platform, longer horizontally than vertically. One series of GSS books was even designed to print pages in landscape format, with the binding on the short edge of the page. However the print size in those versions was too large — and didn’t do a very good job of conserving paper.

We finally realized that we could use normal print size on paper pages in standard 8.5- by 11-inch portrait format (longer vertically than horizontally) as long as we designed each page as if it were two half-pages, one above the other. That way, if the reader magnified the page so that only a half page was visible at a time, they would be able to scroll from half page to half page without any irritating back-and-forth or reverse scrolling.

Over the years, the GSS project evolved a concept called Combined Online and Hardcopy Design style, principles of page design that result in ease of reading of both print and online documents. The trick is to keep in mind that a person viewing the document on a computer screen will likely take advantage of the magnification feature and display only a half page at a time (at roughly 150% magnification) to make the print size “larger-than-life” and easy to read. However, in that mode two-column formats — common in printed journals — can be very cumbersome in that the reader has to alternately scroll up and down to go from column to column.

The Good and the Bad

If the designer uses some version of the text-block/graphic arrangements (as shown below left) to layout each page destined for the digital domain, the reader will never have to scroll up to read from the bottom of the first column to the top of the second column. They can keep continually scrolling down continuously. On the contrary, undesirable layouts such as the one shown below right are “forbidden,” since they force the reader into unwanted up/down scrolling when reading from column to column.

The page layout illustrated on the next page shows an alternative to the two-column layout of this article. In one-column text blocks, it’s best to keep the column width to less than five inches (or about 60% to 70% of the page width), since it’s much harder to read very long lines of text. This is a time-honored standard of page-layout design that applies equally to paper and computer display. Other arrangements are possible, but these are the most common and provide plenty of flexibility. You can have three columns (appropriate even for small font sizes in hard copy); just apply similar principles and the “look” of the page will be fine. The key is to stick as much as possible to page layouts where each top and bottom half page is a readable unit unto itself.

The sample page layout (scaled-down) that appears on the next page shows one example of a page that conforms to JOHDI (Joint Online and Hardcopy Design Interface) principles, which help the user create documents that are easy to read both online and in paper print. The example is from the GSS book A Changing Cosmos, which contains the latest version of high school material from the Hands-On Universe project.

Use Hyperlinks

For the most part, authors do not have to worry about page-layout issues, since that is usually taken care of by professional designers employed by the journal organization. However, there are a few things that authors should keep in mind.
Online articles can make very practical use of hyperlinks (also called hotlinks) — active links that the reader can choose to click on to go to relevant, related material on various websites. If the article is a PDF document like Mercury, then there can be hyperlinks to active audio-visual material on associated webpages. For instance, here are links that goes directly to an animation of recent radar weather data for the southeastern US and northwestern US. (If you're interested, up-to-date radar images and their corresponding loops are on the National Weather Service's National Mosaic page.)

If the article is on a HTML-coded webpage, there can be audio-visual material (movies, animations, podcasts, audio files) directly embedded into the item. It’s not that difficult; the code to insert that animation of the southeastern US weather radar data onto an HTML webpage is as follows:

```html
```

Audio files can be similarly embedded. For example, the IYA (International Year of Astronomy) webpage 365 Days of Astronomy contains podcasts that are being produced for each day of 2009. You could embed the one for January 7 with the following code:

```html
```

Using such features can really liven up an article, to say the least. Don’t forget, when using material from the World Wide Web, be sure to give exact reference and proper credit for the source, the same as you would for normal article references.

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**Using Digital Material**

As mentioned previously, reading material on a computer monitor can be made easier by the proper layout of the content and a judicious choice of the zoom/magnification function. Well-done digital material is also valuable for use in classroom settings. The instructor can project reading material using a single classroom computer hooked up to a large-screen display (perhaps via a LCD projector) and have all the students read that display. There can be immediate discussions of questions that arise from any given piece of reading material. Students can silently read a projected page, with the assignment to pick a sentence or two containing a key idea that is of interest to them. Volunteers can read aloud their chosen sentences and explain why it is of interest, and everyone can easily follow along.

Also keep in mind that producing well-designed digital documents isn’t just for professional journals or magazines such as Mercury. With student access to computers on the rise, how long might it be before you’re asked to prepare digital handouts for your students instead of the paper ones you’ve produced for many years? And with educational and course-related websites proliferating, it’s important that your site be engaging and interactive — and as reader-friendly as possible.

Whether you’re approaching electronic articles as a reader, author, or publisher, I hope the general principles laid out in this article will help make the experience of creating and/or reading them effective and enjoyable for all who partake.

**ALAN GOULD** is the Director of Global Systems Science at the University of California Berkeley — Lawrence Hall of Science (LHS). He is also Co-Investigator for EPO on NASA’s Kepler Mission, the director of the Holt Planetarium (LHS), and the author of numerous works, some of which are listed on his LHS webpage.

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**Free or Password-accessible Articles**

Three examples of freely available electronic journals are:

- **Great Western Observer (GWO)**, the journal of the four (US) western planetarium associations: Pacific Planetarium Association (PPA), Rocky Mountain Planetarium Association (RMPA), Southwestern Association of Planetariums (SWAP), and the Great Plains Planetariums Association (GPPA). An archive of GWO journals since 2002 is at [www.rmpadomes.org/newsletter.html](http://www.rmpadomes.org/newsletter.html).


- **Universe in the Classroom** from the ASP is available at [www.astrosociety.org/education/publications/tnl/tnl.html](http://www.astrosociety.org/education/publications/tnl/tnl.html).

In the password-access category of journals, some examples include:

- The ASP journals ([Mercury, PASP](http://www.astrosociety.org/pubs.html)). Links to these publications are found on the ASP website [www.astrosociety.org/pubs.html](http://www.astrosociety.org/pubs.html).

The evolving demand for space art has created trying times for space artists (Part II).

by Lynette R. Cook

One of twelve illustrations I created for Dava Sobel to visually express the individual chapters in her book The Planets. Courtesy Lynette Cook.
Part I: From the Spring 2009 issue of Mercury

For nearly three years I have been haunted by a headline in the Los Angeles Times that read “Imagine That: NASA’s Photos Eclipse Space Art.” Befuddled and dismayed, my space art colleagues and I wondered how this message could have bubbled to the surface. While there is no doubt that space art (and artists) still exists, what is the state of its health? I determined to find out.

What especially strikes me by the feedback I received is how many artists are inspired by the universe and feel deeply committed to what they do. Yet, as wholeheartedly as some artists feel good, others are despondent because: “There should be more demand but there isn’t.” While some salaried, staff positions for space artists exist, 84% of International Association of Astronomical Artists members who responded to my questions create their work as freelancers.

Broad, sweeping changes in the art world at large have eroded the ground beneath freelancers since the 1980s. The royalty-free CD containing clipart and illustrations (and the appearance of stock-image libraries); the maturity of the personal computer and the sophistication of graphics software; and the availability of spectacular space imagery from the Hubble Space Telescope and other telescopes and probes are just three examples of why many space artists feel the bottom is dropping out of their profession.

The Other Side of the Story

Are professional space artists just complaining, or do our comments reveal actual truths and major shifts in the space-art universe? To find out, I next took my investigation to a few key space-art users and sellers in order to get their perspective: Novaspace Galleries, which identifies itself as the world’s largest source for authentic space memorabilia; a number of astronomy and science magazines; and Science Photo Library, an image bank that pays their artists and photographers a royalty for every image used by their clients (unlike the stock houses described in the first half of the article).

Kim Poor, who has owned and operated Novaspace Galleries since 1978, says that only 1% of company sales are from artwork as opposed to memorabilia and autographs. Of this 1%, just 5% (in other words, .005% of total sales) is comprised of original art. These numbers certainly don’t indicate that space art is thriving.

I was especially eager for feedback from Sky & Telescope and Astronomy, since these two periodicals played such a role in my own beginning as a space artist and have been stellar in the number of space illustrations commissioned and published during their histories. I deliberately use “histories,” since in recent years these two magazines are using more photographic material and staff artists are creating some imagery that previously would have been generated by freelancers — much to the consternation of freelance space artists who are receiving fewer commissions from these sources.

Robert P. Naeye, editor in chief of Sky & Telescope and Astronomy, since these two periodicals played such a role in my own beginning as a space artist and have been stellar in the number of space illustrations commissioned and published during their histories. I deliberately use “histories,” since in recent years these two magazines are using more photographic material and staff artists are creating some imagery that previously would have been generated by freelancers — much to the consternation of freelance space artists who are receiving fewer commissions from these sources.

Feedback from Astronomy’s editor, David Eicher, confirms this overall trend, with Astronomy using photographic material as the bulk of its imagery (90%), and with 8% of the artwork created in-house and 2% out-of-house. When asked how the use of space art in Astronomy has changed during the past 25 years, Eicher replied: “We’re generally using somewhat less art because photographic imagery has become so much better, and the art that we do use now must...
be tighter and more photorealistic than some of the stuff we used in the past, which restricts the number of potential contributors."

In both cases there’s no question that what is disappointing for the freelancer is good for the staff artist. And there’s another contributing factor. Sandra Salamony, former Creative Director at *Sky & Telescope*, explains that as publishers increase their web presence, it’s necessary for them to rapidly generate images. Visuals of a technical nature are often best created on the premises so they can be posted on the company’s website within a matter of hours. That said, the fact remains that art usage is down and use of photographic imagery is up, a net loss when it comes to the amount of space art used.

*Science News* has numbers similar to *Sky & Telescope* and *Astronomy*. Editor Ron Cowan cites a 75-80% use of free photographic material, 10% use of newly commissioned artwork, 10-15% use of existing art from illustrators, and 5% imagery produced in-house. Regarding no-cost imagery, Cowen says, "We depend a lot on NASA and Hubble, and to lesser extent on other sources. We use a lot of NASA art."

Even *The Planetary Report* is making cuts. Editor Donna Stevens indicates that the use of astronomical art has dropped, because the imagery from Hubble and other photographic sources show places that once we could only imagine. In fact, Stevens seldom commissions new artwork from freelancers since she is able to find what she needs in existing imagery. While she recognizes the difficulties that professional space artists face regarding increased competition from amateurs and hobbyists, Stevens offers no solution. “I certainly understand this feeling and can empathize. But I can’t see any way around the situation. The Internet has changed so much about how business, art, and just about everything, is conducted.”

Even though commissions of new art are going down and use of existing imagery — both art and photo — is rising, extra dollars for the latter aren’t going right into the pockets of space artists. Although it would take more research to be certain, feedback from *Science Photo Library* (below) suggests that the existing imagery so often used is more likely to be free than purchased. Picture Editor Andrew Johnstone Simmen explains: "For us the market peaked in the early 90s with astronomy being our biggest revenue sector for some time. As we are now all painfully aware, after every boom there is a bust. Since the 90s, peak astronomy sales have fallen back dramatically as "space" has fallen out of fashion. The drop in sales is not confined to space art but affects all astronomy images across the board."

Of those contacted, only one publisher is bucking the trend. This is *Scientific American*, whose Art Director, Ed Bell, enthuses, “Since I've become Art Director, we've used much more original space art than in earlier years, especially for the planetary sciences. Astronomy is my favorite of all the scientific disciplines. I enjoy viewing the latest and evermore detailed satellite imagery of the nooks and crannies of our solar system, but my eyes are never wider than when a space artist magically takes me ‘there’ — to the surface, to the peaks, in the valleys, on the rings, in the mist, and all the other places that the satellite imagery only hints at. For me, it's the personalization of the scientific data. It's the artists saying, ‘This is what it means.’"

Regarding the availability of photographic material, Bell says: “In some ways it has increased our use of space art. The amazing images of the Hubble and of various landers has led to increased press coverage in the field and led to more articles in our magazine. Explaining what these photographs show means an increased use of technical illustrations. Here, also, we prefer to use artists who know the field of astronomy to execute these technical illustrations. However, in the area of technical illustration, there are far fewer space artists to choose from, and even fewer whose work I would consider excellent.”

**What’s an Artist to Do?**

Diversification is one way that artists are surviving. Just 19% of responding artists make 95 to 100% of their living from space art, with the average being 30% of one’s income. What kinds of work...
are these individuals doing besides space art? Many are involved with other types of art, graphics, video, and/or web design, while the rest claim various part-time jobs and professions: bookstore clerk, college administrator, engineer, space mission consultant, glass blower, teacher, medical doctor, musician, photographer, scientific researcher, writer, and pilot.

Given that the habitat of the science-oriented space artist is melting away like the ice floes of the polar bear, it may be necessary for these creatives to adapt further and move away from territory once held so preciously. Julie Jones is an artist who has done this, finding a niche creating liturgical stoles and banners with space imagery. Jones feels that in order for the genre to survive, space art must move beyond the scientific arena. “Space artists must find applications of their art where they will create some commonality with the public, incorporating it into everyday use, inspire the public and illuminate the future.”

Salamony muses along similar lines, “I wonder if the best ‘new’ arena for space artists to break into might be to go back to traditional media and sell their paintings in galleries or online? Or to add a surreal aspect to the work and go after other publishing clients who might need ‘think-piece’ illustrations to accompany articles on ‘reaching for the stars’ or something? ” As an example, Salamony mentions Bettina Forget, a Canadian fine artist who incorporates astronomical imagery into her art and finds the public enthusiastic about her work.

Could Forget’s experiences bode well for other space artists making it in the world of fine art? To date, realistic space artists have found such a migration difficult. While IAAA artists liken their work to the tradition of early landscape painters (the ‘Hudson River School’) — partly in the sense that space artists are opening up vistas of distant worlds in a similar fashion to Bierstadt showing the wonders of Yosemite to the American people of an earlier era — this has been neither validated nor welcomed by the gallery crowd. As space artist and lecturer Edwin Faughn puts it, “Many people I have spoken to say they really love this work but wouldn’t feel comfortable putting it over their living room couch. They think it is beautiful but don’t understand it or know what to do with it. It seems so far removed from everyday life.”

Graduate school experiences about my tug-of-war in the art school environment resurfaced in my mind as I further contemplated this issue. In the 1980s I chose to attend the California College of the Arts (CCA), since it offered a science illustration program that
led to a Master of Fine Arts degree. Yet once there I felt that I was an outsider in all but my scientific illustration classes. The school’s primary focus was fine art — establishing one’s style and exhibiting original work, which is in conflict with the traditions and constraints of the botanical and biological illustration that interested me at the time.

This said, perhaps a new day has dawned and getting some constructive feedback from my alma mater would be possible. What inspired me to find out was my recollection that Dugald Stermer had become the Chair of CCA’s Illustration Department. Stermer, a commercial illustrator, has used a significant amount of natural science imagery in his work. His illustrations were well known at the California Academy of Sciences, and it was there that I became introduced to his imagery. Surely, I thought, he would have an opinion about the rift between science illustration and fine art; perhaps he could suggest something that space artists could do to make their work more acceptable in the gallery environment. I e-mailed a list of questions and also provided links so that he could view current space art and be clear about the type of work to which I was referring.

Stermer’s response was short and to the point. “I don’t know why you’d ask me, since I know nothing about space art. However, I do think the divide between illustration and ‘fine art’ — I prefer gallery art — has narrowed considerably. The word ‘narrative’ was recently considered a pejorative when reviewing gallery art, but now it’s often a compliment. The difference is that illustration is mostly on commission and must communicate something, while gallery art is sold after the fact, and has no responsibility to communicate.”

Since many space artists create their work because they want to, rather than because they are first commissioned to illustrate a topic for a book or article, it seems that gallery acceptance ought to be easier than artists are finding it to be — that is, if the illustration/fine art divide really is closing. To be sure, a few space-art collectors exist who are inspired by highly realistic imagery. Yet they are few and far between, and even the most avid collector is likely to encounter expansion issues at some point in time. In fact, two of the three collectors I contacted have run out of wall space and seldom make new acquisitions because of this.

Why is the number of collectors so small? A possible key to this mystery comes from Dr. Robert Hurt, Visualization Scientist for NASA’s Spitzer Space Telescope mission. He feels that since so much of today’s space art rivals the imagery obtained from telescopes,
people don't "get" that this is art. Rougher traditional pieces showing the texture of the media, paint strokes, and great color, which tends to have more of an emotive quality rather than a focus primarily on realism, may have a much better chance in the fine art world.

This brings our discussion back in circular fashion to Forget's paintings, which are unquestionably "fine art that incorporates scientific subject matter" rather than science illustration. Despite the interpretive nature of her work, Forget stresses that accuracy is important to her. "I go to great lengths to create accurate star fields. I'll repaint a canvas if I find out there's a factual error...This way, when someone sees my work, they can learn a little something."

So...Is Space Art Dead?

In summing up the feedback I have collected, my conclusion is that space art is far from dead when one looks at the forest of the genre rather than at the individual trees, because the realities of the digital age appear to ensure its longevity. It's an exciting time for hobbyists and for the professionals who are wedded to the computer and revel in 3-D graphics and animation. For the amateur it seems to be a mixed bag: a time of uncertainty for some and rising sales and popularity for others. The remaining astronomical artists — the seasoned, science and realism-focused pros who are less computer oriented and the ones who once focused on hard copy print media, sales of original art, and products like posters and cards — are the equivalent of the elephant and the tiger whose ability to thrive is threatened by shrinking resources and habitat.

Those still wedded to hard science may not be completely out of luck. Andrew Simmen muses, "Even though this market has shrunk since its peak, there is still a sizeable market out there for top quality illustrators. The important thing is to develop an accurate yet distinctive style of imagery in order to stand out from the crowd."

The consensus of artists and publishers alike is that subjects too distant to be photographed or that are "unseen" will continue to be in demand as artistic depictions. This remains the unequivocal realm of the space artist even with the shrinking number of astronomical and astrophysical phenomena that cannot be imaged. Viable topics include black holes, dark matter, the Big Bang, multiple universes, and other exotic fields of study.

Given that the majority of responses I collected from artists were gathered before the serious economic downturn of recent months, the picture is likely even less rosy than it was when I began my research for this article. Space artists are increasingly challenged to

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**The IAAA**

The International Association of Astronomical Artists (IAAA) is an organization of more than 100 artists representing 20 countries. Founded in 1982 by a handful of pioneering astronomical creatives whose work was firmly grounded in science, members’ art has grown to incorporate numerous styles and approaches. Some step outside the bounds of a true scientific rendering, yet all are inspired by astronomy and space exploration.

The Artists’ Universe is an exhibition that introduces visitors to both the art and science of astronomical illustration. The exhibit experience instills a realization that artworks in this genre are not mere fantasy; they require disciplined study and meticulous rendering, and they can be essential extensions of real and rigorous science. For more information about this exhibit, visit The Artists’ Universe webpage.

— L.C.
adapt in order to survive. As Ed Bell says, “The digital revolution has dramatically affected and continues to affect many industries…. Yes, professional space artists recognize the problem. Their response to this problem will be critical.”

This said, the ultimate fate of astronomical artists — whatever it may be — will be a shared outcome. Collector Malcolm Currie points out: “Space art is undervalued in both the science and art worlds. Scientists expect to use it free, and the art snobs regard it with disdain as merely illustration. The art serves as an important historical record of our changing knowledge of the universe, and without collectors and scientists commissioning pieces much of this will be lost.”

Impossible though it may seem, there is always a chance that a new era will dawn. As I write these last words, the United States is just days away from inaugurating a new president, an unlikely individual who exemplifies a marked change from the past and who brings renewed enthusiasm both at home and abroad. I sit in my office, look outside, and think about the dry winter California has experienced to date — possibly portending water rationing during the summer months. Yet the baby-blue sky spreads its wings over my house and the sun pushes its warming rays through my office window, illuminating the room. I have hope.

LYNETTE R. COOK is a science illustrator best known for her collaboration with Geoff Marcy and depictions of extrasolar planets. Her artwork has been exhibited and published throughout the United States and internationally.

**Thank You**

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- **Spherical Magic**: B.E. Johnson & Joy Alyssa Day
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- **Art From the Soul**: Julie Rodriguez Jones
- **The Space**: Italo Rodomonti
- **Artweb**: Bettina Forget

The author would also like to thank all the members of the International Association of Astronomical Artists, who patiently answered her questions and assisted in the creation of this two-part article.

**LYNETTE R. COOK** is a science illustrator best known for her collaboration with Geoff Marcy and depictions of extrasolar planets. Her artwork has been exhibited and published throughout the United States and internationally.
MESSENGER Reveals a Dynamic Planet
NASA / JHUAPL

A NASA spacecraft gliding over the surface of Mercury has revealed that the planet’s atmosphere, the interaction of its surrounding magnetic field with the solar wind, and its geological past display greater levels of activity than scientists first suspected. The probe also discovered a previously unknown large impact basin about 445 miles in diameter.

The data come from the Mercury Surface, Space Environment, Geochemistry, and Ranging spacecraft, known as MESSENGER. On Oct. 6, 2008, the probe flew by Mercury for the second time, capturing more than 1,200 high-resolution and color images of the planet. The probe unveiled another 30 percent of the planet’s surface that had never been seen by previous spacecraft, gathering essential data for planning the remainder of the mission.

“This second Mercury flyby provided a number of new findings,” said Sean Solomon from the Carnegie Institution of Washington. “One of the biggest surprises was how strongly the dynamics of the planet’s magnetic field–solar wind interaction changed from what we saw during the first Mercury flyby in January 2008. The discovery of a large and unusually well preserved impact basin shows concentrated volcanic and deformational activity.”

The spacecraft also made the first detection of magnesium in Mercury’s thin atmosphere, known as an exosphere. This observation and other data confirm that magnesium is an important constituent of Mercury’s surface materials. Finding magnesium was not surprising to scientists, but seeing it in the amounts and distribution observed was unexpected.

The Rembrandt impact basin, 445 miles in diameter, is seen at the center as night was falling across its eastern edge. The number per area and size distribution of impact craters superposed on Rembrandt’s rim indicates that it is one of the youngest impact basins on Mercury.

New Cause for Past Global Warming
University Corporation for Atmospheric Research

By simulating 8,000 years of climate with unprecedented detail and accuracy, a team led by scientists from the University of Wisconsin–Madison and the National Center for Atmospheric Research (NCAR) has found a new explanation for the last major period of global warming, which occurred about 14,500 years ago.

In a period called the Bølling-Allerød warming, global sea level rose by 16 feet and temperatures in Greenland soared by up to 27° Fahrenheit over several hundred years. The new study shows how increased carbon dioxide, strengthening ocean currents, and a release of ocean-stored heat could have combined to trigger the warming.

“To learn more about future warming, we need to unravel what happened in Earth’s past. This study is an important step toward better understanding of how the world’s climate could change abruptly over the coming centuries, especially with increasing melting of the ice caps,” says NCAR’s Bette Otto-Bliesner.

Because climate modeling requires so much computer time, previous simulations of past climate have either used highly complex models to study relatively short periods (a century or two) or simpler models to look at longer periods (thousands of years). This study is the first time a comprehensive, interactive model of the global atmosphere and ocean has portrayed thousands of years of climate.

To launch the experiment, scientists jump-started the model with known changes in Earth’s orbit and in carbon dioxide concentration deduced from ice cores and other evidence. They then observed how the atmosphere and ocean responded.
Hubble Captures Rare Jupiter Collision

NASA’s Hubble Space Telescope has taken the sharpest visible-light picture yet of atmospheric debris from an object that collided with Jupiter on July 19. NASA scientists decided to interrupt the recently refurbished observatory's checkout and calibration to take the image of a new, expanding spot on the giant planet on July 23.

Discovered by Australian amateur astronomer Anthony Wesley, the spot was created when a small comet or asteroid plunged into Jupiter's atmosphere and disintegrated. The only other time such a feature has been seen on Jupiter was 15 years ago after the collision of fragments from Comet Shoemaker-Levy 9.

"Because we believe this magnitude of impact is rare, we are very fortunate to see it with Hubble," said Amy Simon-Miller of NASA's Goddard Space Flight Center in Greenbelt, Md. "Details seen in the Hubble view shows a lumpiness to the debris plume caused by turbulence in Jupiter's atmosphere."

"Hubble's truly exquisite imaging capability has revealed an astonishing wealth of detail in the impact site," said Heidi Hammel of the Space Science Institute in Boulder, Colorado. "By combining these images with our ground-based data at other wavelengths, our Hubble data will allow a comprehensive understanding of exactly what is happening to the impact debris."

Simon-Miller estimated the diameter of the impacting object was the size of several football fields. The force of the explosion on Jupiter was thousands of times more powerful than the suspected comet or asteroid that exploded over Siberia's Tunguska River Valley in June 1908.

Vertical Structures in Saturn's Rings

The search for ring material extending well above and below Saturn's ring plane has been a major goal of the imaging team during Cassini's "Equinox Mission," the two-year period containing exact equinox — that moment when the Sun is seen directly overhead at noon at the planet's equator. This novel illumination geometry lowers the Sun's angle to the ring plane and causes out-of-plane structures to cast long shadows across the rings' broad expanse, making them easy to detect.

The 5-mile-wide moon Daphnis orbits within the 26-mile-wide Keeler Gap in Saturn's outer A ring, and its gravitational pull perturbs the orbits of the particles forming the gap's edges. The eccentricity, or the elliptical deviation from a circular path, of Daphnis' orbit can bring it very close to the gap edges. There, its gravity causes larger effects on ring particles than when it is not so close. Previous Cassini images have shown that as a consequence, the moon's effects can be time-variable and lead to the waves caused by Daphnis to change in shape with time and with distance from the moon.

However, the new analysis also illustrates that when such a moon has an orbit inclined to the ring plane, as does Daphnis, the time-variable edge waves also have a vertical component to them. This result is backed by spectacular new images taken recently near equinox showing the shadows of the vertical waves created by Daphnis, and cast onto the nearby ring, that match the characteristics predicted by the new research.

Scientists have estimated, from the lengths of the shadows, wave heights that reach enormous distances above Saturn's ring plane — as large as 1.5 kilometers (1 mile) — making these waves twice as high as previously known vertical ring structures and as much as 150 times as high as the rings are thick. The main rings — named A, B and C — are only about 10 meters (30 feet) thick.
Sharpest Views of Betelgeuse
European Southern Observatories

Using different state-of-the-art techniques on ESO’s Very Large Telescope, two independent teams of astronomers have obtained the sharpest ever views of the supergiant star Betelgeuse. They show that the star has a vast plume of gas almost as large as our solar system and a gigantic bubble boiling on its surface. These discoveries provide important clues to help explain how these mammoths shed material at such a tremendous rate.

Betelgeuse — the second brightest star in the constellation of Orion, the Hunter — is a red supergiant, one of the biggest stars known, and almost 1,000 times larger than our Sun. It is also one of the most luminous stars known, emitting more light than 100,000 Suns. Such extreme properties foretell the demise of a short-lived stellar king. With an age of only a few million years, Betelgeuse is already nearing the end of its life and is soon doomed to explode as a supernova. When it does, the supernova should be seen easily from Earth, even in broad daylight.

“Thanks to these outstanding images, we have detected a large plume of gas extending into space from the surface of Betelgeuse,” says Pierre Kervella from the Paris Observatory, who led the team. The plume extends to at least six times the diameter of the star, corresponding to the distance between the Sun and Neptune.

“This is a clear indication that the whole outer shell of the star is not shedding matter evenly in all directions,” adds Kervella.

New Methods to Find Alien Oceans
NASA / GSFC

Astronomers have found more than 300 alien (extrasolar) worlds so far. Most of these are gas giants like Jupiter, and are either too hot (too close to their star) or too cold (too far away) to support life as we know it.

Sometime in the near future, however, astronomers will probably find one that’s just right — a planet with a solid surface that’s the right distance for a temperature that allows liquid water — an essential ingredient in the recipe for life. But the first picture of this world will be just a speck of light. How can we find out if it might have liquid water on its surface?

NASA-sponsored scientists looking back at Earth with the Deep Impact/EPOXI mission have developed a method to indicate whether Earth-like extrasolar worlds have oceans.

“A ‘pale blue dot’ is the best picture we will get of an Earth-like extrasolar world using even the most advanced telescopes planned for the next couple decades,” said Nicolas B. Cowan, of the University of Washington. “So how do we find out if it is capable of supporting life? If we can determine that the planet has oceans of liquid water, it greatly increases the likelihood that it supports life.”

“We used the High Resolution Imager telescope on Deep Impact to look at Earth from tens of millions of miles away — an ‘alien’ point of view — and developed a method to indicate the presence of oceans by analyzing how Earth’s light changes as the planet rotates.” This method can be used to identify extrasolar ocean-bearing Earths.
Youngest and Lowest Mass Dwarfs Discovered

Astronomers have found three brown dwarfs with estimated masses of less than 10 times that of Jupiter, making them among the youngest and lowest mass substellar objects detected in the solar neighbourhood to date. The observations were made by a team of astronomers working at the Laboratoire d’Astrophysique de l’Observatoire de Grenoble, France, using the Canada-France-Hawaii Telescope.

The dwarfs were found in a star-forming region named IC 348, which lies almost 1,000 light-years from the solar system towards the constellation of Perseus. This cluster is approximately 3 million years old — extremely young compared to our 4.5 billion year old Sun — which makes it a good location in order to search for the lowest mass brown dwarfs. The dwarfs are isolated in space, which means that they are not orbiting a star, although they are gravitationally bound to IC 348. Their atmospheres all show evidence of methane absorption which was used to select and identify these young objects.

“There has been some controversy about identifying young, low mass brown dwarfs in this region. An object of a similar mass was discovered in 2002, but some groups have argued that it is an older, cooler brown dwarf in the foreground coinciding with the line of sight. The fact that we have detected three candidate low-mass dwarfs towards IC 348 supports the finding that these really are very young objects,” said Burgess.

The team set out to find a population of these brown dwarfs in order to help theorists develop more accurate models for the distribution of mass in a newly-formed population, from high mass stars to brown dwarfs, which is needed to test current star formation theories. The discovery of the dwarfs in IC 348 has allowed them to set new limits on the lowest mass objects.
**New Class of Black Hole Discovered**  
*University of Leicester*

A new class of black hole, more than 500 times the mass of the Sun, has been discovered by an international team of astronomers. The finding is in a distant galaxy approximately 290 million light-years from Earth.

Until now, identified black holes have been either super-massive (several million to several billion times the mass of the Sun) in the centre of galaxies, or about the size of a typical star (between three and 20 solar masses). The discovery is the first solid evidence of a new class of medium-sized black holes. The team, led by astrophysicists at the Centre d’Etude Spatiale des Rayonnements in France, detected the new black hole with the European Space Agency’s XMM-Newton X-ray space telescope.

“While it is widely accepted that stellar mass black holes are created during the death throes of massive stars, it is still unknown how super-massive black holes are formed,” says the lead author of the paper, Dr. Sean Farrell, now based at the Department of Physics and Astronomy at the University of Leicester. He added: “One theory is that super-massive black holes may be formed by the merger of a number of intermediate mass black holes. To ratify such a theory, however, you must first prove the existence of intermediate black holes. “This is the best detection to date of such long sought after intermediate mass black holes. Such a detection is essential. While it is already known that stellar mass black holes are the remnants of massive stars, the formation mechanisms of super-massive black holes are still unknown.”

**Discovery of New Tidal Debris from Colliding Galaxies**  
*Stony Brook University*

At the June 2009 American Astronomical Society meeting in Pasadena, astronomers announced the discovery of new tidal debris stripped away from colliding galaxies. New debris images are of special interest since they show the full history of galaxy collisions and resultant starburst activities, which are important in ‘growing’ galaxies in the early universe. In this study, new tidal debris were found with 8.2-meter Subaru telescope on Mauna Kea, Hawaii. The international team took extremely deep exposures of archetypal colliding galaxies, including “the Antennae” galaxies (located 65 million light-years away from us) in the constellation Corvus, “Arp 220” (250 million light-years away) in the constellation Serpens, “Mrk 231” (590 million light-years away) in the constellation Ursa Major, and 10 additional objects.

“We did not expect such enormous debris fields around these famous objects,” says Dr. Koda, Assistant Professor of Astronomy at Stony Brook University. “For instance, the Antennae — the name came from its resemblance of insect ‘antennae’ — was discovered early in 18th century by William Herschel, and has been observed repeatedly since then.”

Colliding galaxies eventually merge, and become a single galaxy. When the orbit and rotation synchronize, galaxies merge quickly. New tidal tails therefore indicate the quick merging, which could be the trigger of starburst activities in an Ultra Luminous Infrared Galaxy (ULIRG). “The new images allow us to fully chart the orbital paths of the colliding galaxies before they merge, thus turning back the clock on each merging system,” says Dr. Scoville, the Francis L. Moseley professor of astronomy at Caltech. “This is equivalent to finally being able to trace the skid marks on the road when investigating a car wreck.”
Hubble Constant Redefined
STScI

Whatever dark energy is, explanations for it have less wiggle room following a Hubble Space Telescope observation that has refined the measurement of the universe’s present expansion rate to a precision where the error is smaller than five percent. The new value for the expansion rate, known as the Hubble constant, or H₀ (after Edwin Hubble who first measured the expansion of the universe nearly a century ago), is 74.2 kilometers per second per megaparsec (error margin of ± 3.6).

The Hubble measurement, conducted by the SHOES (Supernova H₀ for the Equation of State) Team and led by Adam Riess of the Space Telescope Science Institute and the Johns Hopkins University, uses a number of refinements to streamline and strengthen the construction of a cosmic ‘distance ladder,’ a billion light-years in length, that astronomers use to determine the universe’s expansion rate.

Hubble observations of pulsating stars called Cepheid variables in a nearby cosmic mile marker, the galaxy NGC 4258, and in the host galaxies of recent supernovae, directly link these distance indicators. The use of Hubble to bridge these rungs in the ladder eliminated the systematic errors that are almost unavoidably introduced by comparing measurements from different telescopes.

Riess explains the new technique: “It’s like measuring a building with a long tape measure instead of moving a yard stick end over end. You avoid compounding the little errors you make every time you move the yardstick. The higher the building, the greater the error.”

More information

Heaven’s Touch
From Killer Stars to the Seeds of Life, How We Are Connected to the Universe
James B. Kaler

Informative and entertaining, Heaven’s Touch reveals how intimately connected we really are with the dynamic Universe in which we live.

“Jim Kaler, who has passionately and expertly described the stars and their vagaries, now brings the whole Universe—from the tides through hypernovae and gamma-ray bursts—to general readers. His writing is not only clear and straightforward but also correct and up to date, addressing both standard topics and the latest astronomical goodies.”

—Jay M. Pasachoff, Williams College

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News and information for Society members.

The 2009 ASP Award Recipients

Catherine Wolfe Bruce Gold Medal
Dr. Frank H. Shu, Center for Astrophysics and Space Sciences, University of California, San Diego
The Astronomical Society of the Pacific (ASP) recently announced that Dr. Frank H. Shu has been awarded the 2009 Catherine Wolfe Bruce Gold Medal for lifetime achievement in astronomy.

Dr. Shu's seminal contributions on the theory of spiral structures in galaxies and the theory of star formation have influenced the direction of both theoretical and observational work, shaping modern astrophysical research in these fields. He has made fundamental contributions in a number of diverse areas — from theorems regarding the density-wave theory of spiral structure in disk galaxies, to the processes of mass transfer in interacting binary stars, to modeling the formation of stars and planetary systems, and the origin of chondritic meteorites and their short-lived radioactivity.

He and his students, many of whom are now influential scientists themselves, continue to further refine the theories, to predict new observational tests, and to explain the latest results in planetary-system formation, structures of accretion disks, and other astrophysical phenomena.

Awarded in most years since 1898, the Bruce Gold Medal is recognized as one of astronomy's most prestigious awards. Previous winners include such influential astronomers as Walter Baade, Edwin Hubble, George Ellery Hale, and Fred Hoyle.

Las Cumbres Amateur Outreach Award
Carol Lee Lutsinger, Brownsville, Texas
The ASP is honored to present Carol Lee Lutsinger with the Las Cumbres Amateur Outreach Award. It recognizes Carol for exemplary outreach efforts by an amateur astronomer to children and for sharing her vast knowledge of astronomy and science with children of all ages.

Known throughout her community as “Ms. Science,” Carol Lee Lutsinger has tirelessly and selflessly sacrificed her time, expertise, and energy to inspire youth in Texas and Mexico to look up and explore. Her presentations include weekly astronomy programs at the Brownsville Public Library. Her work with the Brownsville Children’s Museum reaches thousands of children from low-income families all across the region.

As an amateur astronomer, Carol is co-founder of the South Texas Astronomical Society and is a JPL/NASA Solar System Ambassador. An award-winning educator, Lutsinger's infectious enthusiasm and passion for science earn her admiration of her students and peers alike.

Her dedication and imagination have set her on a path to excel in science writing, presentations, hands-on demonstrations, and regularly organized public stargazing events. Lutsinger also works with the Texas Space Grant Consortium to develop special statewide science teacher workshops focused on space science and astronomy. Through this relationship, and in partnership with the University of Texas, Lutsinger has conducted special outreach programs for visually impaired and blind persons.

The Director of the Brownsville Alliance for Science Education included in his nominating statement: “Without Lutsinger's unwavering dedication, countless hours of volunteer service, and genuine love for teaching others about space, our community would be far less aware of what lies beyond the stars.” It is Carol's wish that the students and children that she reaches become inspired to do what it takes to pursue their dreams and that with time they will see their dreams come true. It is this heart and dedication that makes Carol Lee Lutsinger a true ambassador of outreach.

Amateur Achievement Award
Thomas Droegoe, Batavia, Illinois, Founder, The Amateur Sky Survey (TASS)
It gives the ASP special pleasure to announce that Thomas Droegoe is the 2009 recipient of the Amateur Achievement Award. The award recognizes Droegoe for developing CCD instrumentation and a worldwide sky-survey program for the love of astronomical scientific research.

A former engineer at Fermilab, Tom Droegoe designed and built instruments in his spare time. More than a decade ago, Droegoe decided to start building his own one-dimensional FAX scanning chip to make a drift-scan survey of wide areas of the sky. His development of these instruments led to The Amateur Sky Survey (TASS) that includes teams of amateur astronomers from around the world who are measuring vast areas of the night sky to learn more about the bright stars of the Milky Way. The TASS team wrote their own software and used a third generation of Droegoe's instruments to make measurements of more than 360,000 stars.

To know his level of commitment for amateur scientific research,
you have to understand the contributions that come from Droge's personal effort and his own pocket. Some of his telescopes, costing upward of $50,000 each, were given away to other committed TASS team members. His latest telescope design, the Mark IV, is a sophisticated twin-lens custom design that produces simultaneous two-color 4" x 4" photometric measurements of the sky.

With the participation of amateur and professional astronomers, Tom's Mark IV Survey was the only two-color photometric survey of the northern sky being conducted, providing data of stars down to 14th magnitude. Droge and the TASS team have devoted countless hours to assisting other team members and refereeing the scientific data. The resulting research has benefited many research astronomers, and has allowed amateurs to experience what it's like to be involved in a university-level PhD program.

Arne Hendon, Director of the American Association of Variable Star Observers, wrote in his supporting letter: "He has met the definition of amateur in its finest sense — one who engages in science for the love of it rather than as a profession." We of the Astronomical Society of the Pacific could not agree more.

Muhlmann Award
Swift Mission, (Ed Fenimore, Los Alamos National Laboratory)
NASAs Swift mission is a small innovative satellite dedicated to the study of gamma-ray bursts (GRB). Its trio of instruments works in concert to discover gamma-ray bursts and their afterglow, combining gamma ray, X-ray, ultraviolet, and optical data. Swift was launched on November 20, 2004 and includes gamma-ray detectors with 32,000 individual devices in the focal plane to give precise imaging. The observatory also has an innovative autonomous and rapid pointing system for response to gamma-ray burst triggers. The ASP is pleased to bestow the Maria and Eric Muhlmann Award — for important research results that are based upon the development of groundbreaking instruments and techniques — on the Swift Team.

Swift has exemplary performance with a number of major discoveries including the most distant gamma-ray burst ever detected, originating from an object z=6.29 seen in 2005. The signature of the burst was a long and smooth burst observed by the satellite. Detection in the infrared suggested a high redshift, confirmed by Subaru observations. In April 2009, Swift broke its own record with the discovery of a GRB at redshift z=8.2. The object detonated only 630 million years after the Big Bang and was likely a massive star.

Another remarkable observation pinpointed the origin of short gamma-ray bursts. Such a burst was detected in May 2005. The source appeared to be in an elliptical galaxy. Other short burst detections have led to the conclusion that these phenomena are caused by merging binary neutron stars.

Swift also shattered the record for the most distant object seen with the naked eye — a gamma-ray burst with associated afterglow in the optical. Through the rapid response mechanism, Swift has been able to catch the emission of gamma rays by comets in between its observation of cosmological sources.

In short, the Swift mission has produced an impressive array of results ranging from the solar system to the earliest cosmic times through a successful deployment of innovative instrumentation and observing techniques.

Klumpke-Roberts Award
Dr. Isabel Hawkins, Space Sciences Laboratory, University of California, Berkeley
The Astronomical Society of the Pacific gives the Klumpke-Roberts Award annually to an individual who has made significant contributions in the furtherance of public appreciation and understanding of astronomy. The Society is proud to present this award to Dr. Isabel Hawkins.

Dr. Hawkins fused her strong background as a researcher in astronomy with a passion of sharing her love of astronomy with the public. She has accomplished this by recognizing the power of the Internet as a means to reach the public, and by building coalitions of organizations with powerful tools and imagery that can be used effectively on the Internet to both teach and inspire the public. Her pioneering work with The Exploratorium and NASAs Goddard Space Flight Center to set up webcasts of eclipses, and to provide educational context for what was being seen, are examples of her efforts. The webcast "Eclipse 2006: In A Different Light" was viewed by tens of millions of people worldwide.

Additionally, Dr. Hawkins served as the Co-Director of the NASA sponsored Sun-Earth Connection Education Forum. In this capacity, she led the establishment of Sun-Earth Day as an annual national event, as well as developed a number of partnerships with observatories and planetariums to create programs that convey the excitement and value of astronomy to the public.

Dr. Hawkins has been a leader in bringing astronomy to Native American and Hispanic communities. She played a major role in the planning and implementation of the "Ancient Observatories — Timeless Knowledge" series of webcasts from Chichen Itza, Mexico, and she has developed multilingual materials on Mayan archaeo-astronomy and solar imagery. An example of her work in this area is "Traditions of the Sun, a Photographic Journey to the Yucatan" produced in collaboration with a Mayan archaeologist.

Dr. Hawkins is an outstanding example of the impact that working astronomers can have on public appreciation and understanding of
astronomy. The Society is confident that she will inspire others to follow in her footsteps and be future winners of the Klumpke-Roberts Award.

**Trumpler Award**
Dr. Kevin Bundy, Department of Astronomy, University of California, Berkeley
In his Caltech thesis, Dr. Kevin Bundy addressed a large and unresolved question in contemporary astronomy: just how do galaxies accumulate their mass and form stars? Most of the matter that becomes stars assembles into galaxies early, in roughly the first 30-40% of the age of the universe. Massive galaxies appear to form their stars early, but lower-mass systems are often still forming stars at a rapid rate later in their lives.

Dr. Bundy’s extensive observations using the Wide Field Infrared Camera (WIRC) at the Palomar Observatory were significant in showing why this “downsizing” in galaxy evolution was occurring — there is a mass limit beyond which some mechanism inhibits star formation so that massive galaxies become quiescent. What that mechanism is remains in question, though active galactic nuclei associated with central black holes may play a role. Bundy’s analysis of the evolution of star-formation rates and of galaxy morphology has been widely cited and provides an important constraint on theories of early galaxy formation.

In addition, Dr. Bundy was not just a user of WIRC; he played an important role in developing the software that allows online reduction of WIRC images. This software is now in widespread use by other users.

For his important, systematic observations of faint galaxies at intermediate redshifts, for his contribution to WIRC, and for his important papers on galaxy formation, the Astronomical Society of the Pacific is pleased to award him the 2009 Robert J. Trumpler Award — an award made to a recent recipient of a PhD degree whose research is considered unusually important to astronomy.

**Thomas Brennan Award**
Ardis Herrold, Plymouth, Michigan
The Thomas Brennan Award, founded by astronomy enthusiasts Terry and Cindy Brennan in memory of Terry’s father, recognizes exceptional achievement related to the teaching of astronomy in grades 9 through 12, whether by an active teacher or by someone whose work has had a substantial impact on high school astronomy teaching. The Astronomical Society of the Pacific is delighted to present this award to Ardis Herrold.

Ardis is an exemplary high school astronomy teacher. She formed an astronomy club, which developed into a high school Radio Astronomy Team in 1989. Her high school was the first in the
country to build a radio telescope from scratch. During spring break each year she takes her students to the National Radio Astronomy Observatory (NRAO) to perform additional research. She has inspired many students in research projects. Her students have won top astronomy awards in science fairs and have gone on to become Ph.D. scientists and engineers. She regularly shares her organizational techniques and programs at many teacher conferences, and she has appeared on the Michigan Gateways TV series featuring her astronomy classroom activities. In addition, she has written articles that have appeared in *The Michigan Earth Scientist, The Earth Scientist, The Physics Teacher, The MSTA Journal, The MSTA Newsletter,* and Project SPICA.

**Portal to the Universe Opens Its Doors**

Keeping up-to-date with cutting-edge astronomy and space-science breakthroughs has just become that much easier, thanks to Portal to the Universe (www.portaltotheuniverse.org), the latest Cornerstone project of the International Year of Astronomy 2009 (IYA2009). As a high-tech website embracing Web 2.0 technologies, the Portal to the Universe aims to become a one-stop-shop for astronomy news.

The site itself features news, blogs, video podcasts, audio podcasts, images, videos and more. Web 2.0 collaborative tools, such as the ranking of different services according to popularity, help the user to sift constructively through the wealth of information available and will promote interactions within the astronomy multimedia community. A range of “widgets” (small applications) have also been developed to tap into all sorts of existing “live data” such as near-live pictures of the Sun, live positions of spacecraft, or live observations from telescopes.

**Two New IYA/ASP Websites**

The ASP has created two new web sites for the International Year of Astronomy — one for the *Galileo Teacher Training Program* and one for the *Cosmic Clearinghouse.*

The *Galileo Teacher Training Program* is a new workshop program for teachers; a pilot workshop will be conducted in association with the Society’s upcoming annual meeting in September. Interested educators teaching Grades 4–12 are encouraged to check it out; spaces are available but limited.

The *Cosmic Clearinghouse* is a selection of astronomy education resource links for formal and informal educators, amateur astronomers, and the interested public. Check it out for some good links to cool stuff.

**Astronomy Behind the Headlines**

The Astronomical Society of the Pacific is pleased to announce the first two episodes of “Astronomy Behind the Headlines” (ABH), a series of podcasts for informal science educators. Each month, we’ll give you a look behind the latest headlines in astronomy and space science and provide links to related resources and activities so you can interpret these exciting topics for your audiences.

ABH is written and narrated by Carolyn Collins Petersen of Loch Ness Productions, in conjunction with the ASP. Episode 1 explores astrobiology and the search for life in the universe, and includes an interview with Dr. Chris McKay from NASA Ames Research Center. Episode 2 explores cosmic debris — meteors, asteroids, and comets — and includes an interview with Dr. Peter Jenniskens of the SETI Institute. Stay tuned for a new episode of “Astronomy Behind the Headlines” each month.

**The Great July 11 Total Solar Eclipse Expedition**

Did you miss the total eclipse of the Sun this past July 22nd? If so, don’t let the next one pass you by. Sign up now for our fabulous 2010 expedition to the Marquesas Islands.

Adventurers and artists such as Captain Cook, Herman Melville, Robert Louis Stevenson, and Paul Gauguin were mesmerized by the paradise found in the mysterious Marquesas Islands and Tuamotu.

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**A Gift That Gives Back**

**PLANNED GIVING with THE ASP HERITAGE SOCIETY**

The Astronomical Society of the Pacific is pleased to recognize our members and friends who have included the ASP in their estate plans. This support of our mission is truly appreciated.

Join the Heritage Society by making a planned gift today. Visit us online or contact us to request an informational brochure.

www.astrosociety.org/support.html
or
(415) 337-1100 x106
Today the inhabited islands of the Marquesas are so remote that few from the outside world touch the paradise of these islands. After the Marquesas, the Aranui III sails to the centerline for the extraordinary July 11, 2010 eclipse. A team of distinguished lecturers will provide an astronomical enrichment program and nightly stargazing deep in the Pacific.

To learn more about this tour, please visit the ASP’s July 11, 2001 eclipse webpage. Proceeds from this tour (and others offered by the ASP) help support your Society’s educational programs.

2009 ASP Meeting — Last-minute Reminder
Register now for the 2009 ASP meeting in the San Francisco Bay Area September 13–16 at the Westin San Francisco Airport Hotel in Millbrae, California. The conference theme is “Science Education and Public Outreach: Forging a Path to the Future,” with presentations and posters to be organized under four theme strands:

- Building on the Momentum of the International Year of Astronomy.
- Connecting the Sciences in the Year of Science.
- Defining our Practice
- Bridging to the Future

For our plenary sessions, we're planning for a series of provocative discussions during the meeting proper relating to the conference theme strands and designed to get the cerebral juices flowing and discussion ignited. The discussions will be centered on the following questions:

- IYA: Can We Keep the Party Going?
- Year of Science: Will Science “Speciation” Endanger Science Learning or Enhance it?
- Defining our Practice: Can We Really Make an Impact?
- The Future is Here: Can EPO Navigate the Digital Age?

To learn more about the meeting and to register, please visit our annual meeting webpage.

NEW MEMBERS — The ASP welcomes new members who joined between April 8 and July 1, 2009.

**Technical Membership**
- Alain Derman, Noumea, New Caledonia
- Kelly L. Graves, Calgary, Canada
- Shin W. Kim, Runkankaka, NY
- Andrew F. Macica, San Jose, CA
- Robert W. Myers, Liberty, SC

**General Membership**
- Jesse B. Barsugli, San Gabriel, CA
- David Bennum, Reno, NV
- Marcel W. Bigger, Zurich, Switzerland
- Kristin Black, Stanford, CA
- Bethany Cobb, Berkeley, CA
- Darlene English, Corner Brook, Canada
- Matthew Fillingim, Berkeley, CA
- Douglas Forbes, Massey Drive, Canada
- Renee Frappier, Berkeley, CA
- Karin Hauck, Berkeley, CA
- Inge Heyer, Hilo, HI
- Daniel Heywood, Reno, NV
- Tony P. Jurvetson, Los Altos Hills, CA
- Mary Ann Kadooka, Honolulu, HI
- Imseok Kang, Busan, South Korea
- Ann Martin, Ithaca, NY
- Dan Mayes, NV
- Madeleine Needles, Westford, MA
- Heather Nelson, University Park, PA
- Christopher E. North, Cardiff, United Kingdom
- Leela O’Brien, Reno, NV
- Janet Pittman, San Jose, CA
- Melodi Rodriguez, Reno, NV
- Igor Ruderman, Berkeley, CA
- Christine Shulpa, Houston, TX
- Robert Spearman, Bremerton, WA
- Gordon Squires, Pasadena, CA
- David L. Stroh, Vallejo, CA
- Alejandro A. Tey, McAllen, TX
- Leitha Thrall, Berkeley, CA
- Jerry P. Tinklenberg, Palo Alto, CA
- Kumiko Usuda, Hilo, HI
- Aleya Va Doran, Kensington, MD
- Angela Walters, Laurel, MD
- Darlene Yan, Berkeley, CA
- Dan Zevin, Berkeley, CA

**Family Membership**
- Leil T. Jurvetson, Los Altos Hills, CA
The Skies of August

Last call for Saturn (for a couple of months, anyway). It’s barely visible in the western twilight after sunset during the month; observers in the southern US have the best chance to see it before it vanishes into the solar glare. Little Mercury is also a poorly placed sunset planet, located even lower than Saturn in the west at the start of August. It’s within 3° of Saturn on the 16th, and a thin crescent Moon passes near both on the 22nd. But unless you’re blessed with a clear, flat western horizon, both planets will be extremely challenging to spot this month.

Fortunately, Jupiter rises in the east as the Sun sets at month start; the giant planet is up by 7:30 pm at month’s end. For 2½ hours starting at 10:00 pm EDT on the 26th, only one moon — Callisto — will be visible. Western viewers should look as soon as it’s dark.

Mars rises in the northeast around 2:00 am. On the 16th the crescent Moon will be to the red planet’s lower left; the next morning the Moon will be to the upper right of Venus. This brilliant planet rises some three hours before the Sun and stands high in the east before sunrise.

The Perseid meteor shower peaks during the pre-dawn hours of the 12th. Under normal circumstances, an observer watching from a dark-sky site might spot up to 60 meteors per hour after midnight. Unfortunately, there won’t be much darkness for this year’s Perseid watch. The waning gibbous Moon, nearly at Last Quarter, rises around 11:00 pm on the 11th. Its light will wash out all but the brightest Perseid meteors.

The Skies of September

August and September are the best months for Northern Hemisphere observers to explore the constellations that encompass the heart of our Milky Way galaxy — Sagittarius, the Archer, and Scorpius, the Scorpion. While an Archer is tough to picture, a Teapot (consisting of the eight brightest stars of Sagittarius) is easier to pick out. Compare the chart at the bottom of the page with the photo on page 15. Look just above the horizon and to the left of the bulge of the Milky Way; can you spot the four stars that form the handle of the Teapot?

There are deep-sky sights aplenty in this region of the sky, and binoculars are perfect for scanning these two constellations, particularly if you’re observing from a dark-sky site. (Though be warned; you won’t see the colors revealed by the camera in the photo on page 15.) The chart below marks only a few of these celestial wonders, including M8, the nebula mentioned in Star-filled Nights. The yellow circles mark a pair of fine globular clusters — M4 in Scorpius and M22, the Great Sagittarius Cluster.

The other four Messier objects objects on the chart are open star clusters. (All M-objects are from a list created by the man who discovered them — the 18th century French astronomer Charles Messier.) M6 and M7 are two lovely clusters at the tail end of the Scorpion; M7 is the larger and brighter of the pair. Above the Teapot are M23 and M25. They’re somewhat challenging to find amid the Milky Way’s swirl of stars, but are well worth the search.

The western sky after sunset is almost bereft of planets. At the start of the month, Mercury and Saturn are hovering just above the horizon 30 minutes after sunset; within days both planets will vanish into the solar glare.
Too bad Saturn is so low; its rings appear precisely edge-on (and will be invisible to us) on the 4th. By month’s end, Mercury is up in the morning sky, rising more than an hour before the Sun and standing 15° above the eastern horizon at sunrise.

Jupiter is now nicely placed in the southeast after sunset. Even steadily held binoculars will let you following the four large Jovian moons as they wander from one side of the giant planet to the other. On the 27th at 11:00 pm EDT (8:00 pm PDT), watch as Europa, Callisto, and Ganymede gather together on the western side of Jupiter. Our Moon is to Jupiter’s left on the 2nd and 29th.

In the morning sky, Venus remains a brilliant beacon. It passes just south of the Beehive cluster (M44) on the 1st and 2nd; a fine sight in binoculars. On the 20th, Venus is about ½° from Regulus, the brightest star in Leo, the Lion. Mars is also a morning object, rising by 2:00 am. The Moon is above the red planet on the morning of the 13th, three days later a thin lunar crescent makes a beautiful dawn pairing with Venus.

The Skies of October

As described in Ken Hewitt-White’s article, the Double Cluster in Perseus is a fine pair of open star clusters located between Perseus, the Hero, and the “W” of Cassiopeia, the Queen. Both are climbing into the northeast these evenings. Cassiopeia is easy to spot, as its five brightest stars resemble a large, backward letter “E.” Use the chart at right and your binoculars to track down the Double Cluster, starting with Cassiopeia as your guide.

Once you’ve found the Cluster, cast your gaze down to Mirfak, the brightest star in Perseus. With Mirfak in your binocular’s field of view, you’ll see a smattering of fainter stars just below it. That’s the Alpha Persei Association (also known as Merlotte 20), a loose group of stars that is not a gravitationally bound cluster.

Finally, if you follow the curve of brightish stars sweeping down from Mirfak, you’ll eventually run into a harbinger of winter: the Pleiades or Seven Sisters star cluster.

In terms of planets, the morning sky is pretty crowded. First up is Mars, rising in the northeast around 1:00 am. Next comes Venus, Mercury, and Saturn, but which one appears first depends on the time of the month. At the start of the month, Venus rises around 5:30 am, some two hours ahead of the Sun. Mercury and Saturn follow an hour later. On the 8th Saturn and Mercury will rise together, separated by a mere ½°. Five mornings later, Saturn and Venus will rise slightly more than ½° apart.

By the end of the month, the order of appearance of these planets has changed to Mars (still rising first), Saturn, Venus, and Mercury — with Saturn rising around 5:00 am, more than three hours before the Sun. If you need help keeping track of the planets, watch the Moon. On the morning of the 11th it hangs above Mars; the next morning it’s beneath the red planet. Then on the 16th Venus is left of the skinny lunar crescent, with Saturn above Venus and Mercury below.

Meanwhile, Jupiter is nearly due south at nightfall, making it well placed for viewing during the early evening hours. On the 26th the Moon will hover just to the right of the giant planet.

IYA Feature Sky Sights:

Meteor Shower, Jupiter, and Andromeda Galaxy

During each month of the International Year of Astronomy, one particular celestial object is highlighted. The ASP provides more information about each object, as well as downloadable lesson plans, on our Discovery Guides site.

August — Perseid Meteor Shower: Learn about meteors and how to observe them.

September — Jupiter: Discover what to look for on this giant planet.

October — Andromeda Galaxy: Learn about the nearest large galaxy to the Milky Way.
Thanks to *Sky & Telescope* magazine, *Mercury* readers have direct access to *S&T*'s online Interactive Sky Chart. While anyone can go to it on Sky's website, registration is required to load and use the charts. Registration is free and has some advantages, but it's not necessary for ASP members who just want to retrieve the monthly star chart.

*Sky & Telescope*'s Interactive Sky Chart is a Java applet that simulates a naked-eye view of the sky from any location on Earth at any time of night. Charted stars and planets are the ones typically visible without optical aid under clear suburban skies. Some deep-sky objects that can be seen in binoculars are plotted too.

**Using the Chart: The Basics**

When you launch *Sky & Telescope*'s Interactive Sky Chart applet in your Web browser, you should get a rectangular, naked-eye view of the sky on the upper left and a circular all-sky chart on the right. If the chart does not appear, see the “Tech Talk” section at the end of this article.

For instance, when you click on the link for the August Sky Chart, you should see, in a new window, a screen that looks like the image above. Each of the monthly links in Sky Sights will take you to a chart set for 40° north latitude and 100° west longitude (so it's useful throughout the continental US) at 10 pm local time at midmonth in August, September, and October. The chart can be used one hour later at the start of each month and one hour earlier at month-end.

If all you want is a copy of the circular All-Sky Chart to take outside, press the “Create PDF” button, and then print the result. You'll find the easy-to-use instructions included on the chart.

But Sky's Interactive Chart offers much more. Click on any area of the circular All-Sky Chart that you'd like to see in more detail. The green frame will jump to where your cursor is pointing, and the scene in the Selected View window will now show this area.

Or click and hold down your mouse button within the green frame on the All-Sky Chart, then drag the frame around the sky. The scene in the Selected View window will change as the location of the green rectangle on the All-Sky Chart changes.

Finally, click and hold down your mouse button in the Selected View window, then drag the cursor to move to another part of the sky. The green frame in the All-Sky Chart will follow your movements.

**Changing the Chart**

Below the Selected View window you'll find the latitude and longitude the chart is set for, as well as the date and time. These can all be changed.

To alter the *date and time*, click on the month, day, year, hour, or minute in the display at lower left, which will become highlighted. (You can change only one parameter at a time.) Then use the + or – button to increase or decrease the value you've selected. Each time you change a quantity, both the Selected View and All-Sky Chart will be updated instantly.

If you'd rather do a wholesale change, click the large “Change” button in the Date & Time display area. A pop-up window will appear. Here you can choose any date between January 1, 1600, and December 31, 2400, using the day and month pull-down lists and the year text-entry box.

To alter the *location* (and time zone), you'll need to click the large “Change” button in the Location display area. A pop-up window will appear that will let you select a new location (be sure to enter data in just one of the three sections of this page). A follow-up page will let you select a time zone. But note that unless you register, the system will not remember your new location.

You'll find more detailed instructions and hints for using the chart on the Help page. To really become familiar with this program, see the article: *Fun with S&T's Interactive Sky Chart*.

**Tech Talk**

The applet should work properly in most Java-enabled Web browsers. For best results on a PC, use Internet Explorer 6 or Netscape 7; on a Mac, use OS X 10.3 (or higher) with Safari. If you've installed a “pop-up stopper” to block advertisements that automatically open in new browser windows, you'll probably have to turn it off, as the Interactive Sky Chart needs to open in a new browser window.

If you have trouble getting the Sky Chart to open on your computer, please review Sky's detailed system requirements to check whether you're using a supported operating system. And don't forget to also review the Help page.
What would you ask a man who’s been to the Moon? From 1985 to 1992 I spent more than 150 hours interviewing 23 of the 24 Apollo lunar astronauts for my 1994 book, *A Man on the Moon: The Voyages of the Apollo Astronauts*. (The one lunar astronaut I didn’t talk to was Jack Swigert from Apollo 13, who had died in 1982.) More recently, as I worked with my wife Victoria Kohl to create our new book, *Voices from the Moon: Apollo Astronauts Describe Their Lunar Experiences*, which features excerpts from those interviews paired with high-resolution scans of their photographs, I found myself once again immersed in the astronauts’ recollections. Even after all this time, they have lost none of their power to amaze and inspire.

Bill Anders, who became one of the first three men to orbit the Moon on the Apollo 8 mission, told of the breathtaking beauty of Earth rising beyond the Moon’s desolate horizon into the infinite blackness of space. Apollo 11 moonwalker Buzz Aldrin described standing on the Moon’s stark landscape and seeing the ground curving subtly away in all directions, giving him the extraordinary visual sense of standing on a sphere. Apollo 16’s Charlie Duke related the surprising feeling of serenity he found in such a hostile place. His crewmate, Ken Mattingly, who orbited the Moon alone in the Apollo 16 command module, told me that as he flew over the lunar far side, out of contact with Earth, he felt not loneliness but exhilaration.

Apollo 11 commander Neil Armstrong revealed that the moment when he and Aldrin touched down safely on the Moon’s Sea of Tranquility was for him the mission’s greatest high, and, in his mind, the moment of human contact with the Moon — rather than the celebrated “one small step” he took onto the ancient lunar dust several hours later. Apollo 14’s Alan Shepard confessed that for him, the most powerful moment came as he took his first steps onto the Moon, gazed at a crescent Earth hanging overhead, and cried silently within his space helmet. And Apollo 12’s Alan Bean described a fleeting, stolen moment when he let himself absorb the awesome reality of walking on another world.

Of all the treasures the astronauts brought back from the Moon — hundreds of pounds of lunar rocks and dust, miles of photographic film, countless bits of scientific data — their stories are, to me, Apollo’s hidden bounty. Even as we mark the 40th anniversary of Apollo 11’s “giant leap for mankind” this summer, no one can say when a new team of explorers will follow in the astronauts’ lunar footsteps. Until then, the Apollo astronauts are our only link with that fantastic, otherworldly experience, and they remind us that going to the Moon was more than a stunning technological achievement, more than an extraordinary voyage of scientific discovery. It was also a spectacular human adventure, one that marks the very beginning of humanity’s progression toward becoming an interstellar species. As far as we venture into space, Apollo will always stand as the first step in a journey that has no end.

Award-winning science journalist and space historian ANDREW CHAIKIN has authored books and articles about space exploration and astronomy for more than 25 years. His latest is *Voices from the Moon: Apollo Astronauts Describe Their Lunar Experiences*.