TWIN CITY AMATEUR ASTRONOMERS, INC.

The OBSERVER

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TCAA EVENTS FOR NOVEMBER

With the approach of the colder months, the public observing sessions at SGNC have drawn to a close. Lee Green is currently working on the schedule for next year. If you have any special requests for topics during 2011, please let him know.

On Tuesday, November 2nd, the TCAA Board of Directors will meet at the offices of Lewis, Yockey, and Brown, Inc. in downtown Bloomington starting at 6:30 p.m.

The November members-only observing session will take place at SGNC on Saturday, November 13th. With the change from daylight saving time back to standard time a week earlier, sunset will occur at 4:40 p.m. on this date, with the end of astronomical twilight occurring at 6:14 p.m. Observing, in the main, will begin around 7 p.m.

STAERKEL PLANETARIUM FIELD TRIP

TCAAers traveled to Parkland College's Staerkel Planetarium for an evening of fun and frivolity on Friday, October 15th. Ten TCAAers, including their family members, attended this event: Tom and Carolyn Weiland, Dan and Paulette Miller, Brian Barling with Teresa and Thomas, Dave Osenga, Tony Cellini, and Carl Wenning. Our group attended both showings – the live *Prairie Skies* program at 7 p.m. and the feature showing *Violent Universe* at 8 p.m. Planetarium coordinator David Leake give the first presentation; Patrick Stewart (*Star Trek's* Captain Jean-Luc Picard) narrated the second showing. The live showing was fairly typical, but *Violent Universe* was amazing.

Violent Universe focused on celestial disasters (literally "bad stars") that potentially could affect human existence. Subject matter ranged from supernovas to gamma-ray bursters, from colliding galaxies to roving black holes, and from earth-orbit-crossing asteroids to rogue comets. It had a very much doomsday effect. Fortunately, after the program Mr. Leake reassured the audience (that containing a number of small children) that none of these events were likely to affect us personally. Still, even I left with a bit of an unsettled feeling given some of the information presented in the program.

The video imagery was truly memorable. Passing through huge interstellar dust and gas clouds gave one the impression that what was being seen was real. While many of TCAAers have visited and one even worked in planetariums, it is likely that none of us has ever had such a memorable experience under a dome. Attendees witnessed the raw power of the cosmos in this thrilling show that gave us a front-row seat to watch as worlds collided!

Violent Universe was produced by Evans & Southerland specifically for installations such as Staerkel Planetarium. The licensing agreement required a payment of $28,000 and the show may presented an unlimited number of times for the next 50 years. With a high production budget, programs of exceptional quality can be developed. *Violent Universe* is not your typical planetarium program and neither is the Staerkel Planetarium a typical planetarium.

The Staerkel Planetarium boasts the first Digistar 4 digital projection system in the state of Illinois. It was installed only recently. The system, manufactured by Evans & Sutherland, is essentially a software package that uses two JVC D-ILA projectors to cover the entire dome and immerse the audience in full sky video. The D4 allowed us to go on a journey never before imagined with the old slide projector based system.

With the installation of the all-sky projection system, the traditional Zeiss M1015 star projector has been outshined! The star projector will still be used, but only for programs that require the capacity to exhibit certain celestial phenomena that the Evans & Southerland system is incapable of showing. In some sense the planetarium has become a wrap-around movie theater experience.

Violent Universe will continue showing through November 20th. After that, *Season of Light* – a more traditional Christmas time program – will be shown. Given this reviewer's experiences, you might well want to visit the Staerkel Planetarium at Parkland Community College in Champaign, IL. Additional information can be found online.

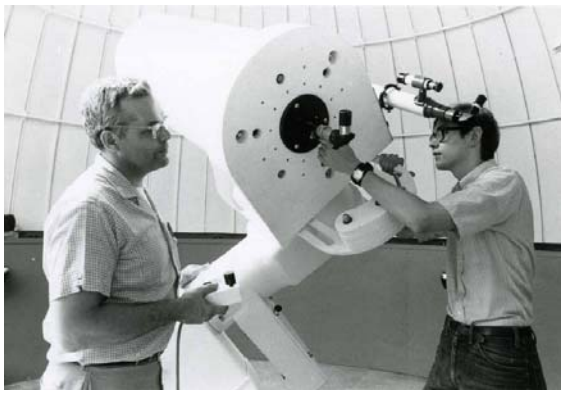
The OBSERVER is a monthly publication of the Twin City Amateur Astronomers, Inc., a registered 501 (c)(3) non-profit educational organization of amateur astronomers interested in studying astronomy and sharing their hobby with the public.

MARK EVANS OBSERVATORY ANNIVERSARY

The occasion of the "40th anniversary" of the dedication of IWU's Mark Evans Observatory was marked with a homecoming celebration honoring the work of retired astronomers Ray Wilson and Lew Detweiler. The Observatory was dedicated on March 18, 1969. NASA astronaut Frank Borman who had recently returned from a Christmas 1968 trip around the Moon was present at the dedication. He placed a medallion that journeyed around the moon on this historic trip in the cornerstone vault. (It is likely still in place to the best of everyone's knowledge at IWU. No one recalls its recovery that originally was intended to take place during the 25th anniversary of the observatory.) In attendance at this October 9th event were former TCAAers Barry and Carol Beaman, as well as Carl Wenning who taught astronomy and physics at IWU off and on for 15 years from 1982-1999.

The program began at 4:30 p.m. with hors d'oeuvres, refreshments, and small talk. At 5:15 p.m. Physics Department Chairman Narendra Jaggi provided formal introductions of Ray and Lew and talked about their work. He included a very brief overview of the history of the Mark Evans Observatory in doing so. Mention was made how the architects of the observatory completely ignored advice from Wilson, Detweiller, and Gary Kessler – the third member of the physics department at that time – when the observatory facility was designed and built. The Ealing 16-inch classical Cassegrain telescope was mounted upon an 18-inch diameter column that was plagued with vibrations. Within a short time the support structure was augmented by a 22-ton concrete addition (approximately 5 feet square) making the telescope mounted under the dome literally rock solid. Shortly after the telescope was installed, its electronics failed. Lew spent two days working with a student to repair the drive system. The telescope drive has worked flawlessly ever since.

From the 1970s through the 1990s – when the TCAA actually had monthly membership meetings – our group met regularly at Mark Evans Observatory. Following a meeting and a chalk talk, members frequently repaired to the dome and observed brighter celestial objects through the telescope housed there. Because most of the membership failed to attend monthly meetings at that time, they were eventually canceled and the TCAA became primarily a group of observers and astrophotographers. So it remains to this day.



The TCAA has been invited back to use the Mark Evans Observatory now that the research lab formerly housed on the ground floor has been removed. It might be nice to arrange a nostalgic membership meeting there during the colder (and often cloudier) months ahead.

ANNUAL MEETING DATE SET

The TCAA will celebrate its 51st anniversary with its Annual Meeting on Saturday, February 5, 2011. Our membership will be gathering at ISU's Turner Hall, room 104, starting at 6:00 p.m., with a banquet commencing at 6:30 p.m. The business meeting will follow. There is no basketball game that evening, so parking should be freely available just west of Turner Hall in the faculty parking lot.

At the annual business meeting we listen to annual reports, elect a board of directors, and hear from an invited speaker. This event is the social high water mark for the club each year, so you'll want to be certain to join us. If you want to attend this gala event, put it into your schedule book now. Coordinating this event will be Carl Wenning. He is working with Nancy Koch of ISU's Family and Consumer Science Department and advisor of the Food, Nutrition, and Dietetics Club, to plan the menu. Details will be provided as they become available.

PROFILES IN AMATEUR ASTRONOMY: JOHN WERNER

My interest in astronomy began early, as the nights were dark in farm country south of Streator, Illinois. The stimulus for my interest was the space race of the late 50's and the first department store telescopes. (I still have them!) I used to observe the Moon and planets. There was even the youthful enthusiasm of writing Yerkes observatory thinking I had discovered a new comet, but the nice return letter told me I was mistaken. These early years were the days of using cab-less farm tractors and seeing daytime bolides (fireball meteors reaching magnitude -14) on a couple of occasions as I was doing field work – just breathtaking.

Math and science were strong subjects for me and I decided to go on in physics at the University of Illinois and then to Iowa State University, finishing with a Masters in Science. My interest was advanced by taking astrophysics courses at Champaign and rooming with future Space Telescope Science Institute astronomer Dr. Charles Keyes, who spoke at NCRAL 2010. Receiving a teaching certificate also at Iowa State, I began my career at Bloomington High School, 1971-1973, creating a new general science course in astronomy (but no longer offered).

I then had the chance to teach physics and astronomy at Anderson University, Anderson, Indiana. As Observatory Director of the then 2nd largest university telescope in Indiana, I began my interest in film astrophotography and working with the local astronomy club.

In 1977, I began my career at State Farm Insurance Companies in the Research Department, advancing to Director-Strategic Resources, leading the Technology Research Division, with oversight of two laboratories – vehicle and building technology. I have been able to journey to two total solar eclipses, traveling to Helena, Montana in 1979 and north of Puerto Vallarta in 1991. A total eclipse is a must-see experience. In the case of Puerto Vallarta, I was able to share the experience with resident Mexicans along with three sons and wife Joyce.

Although I had attended a couple TCAA meetings in the early 70's, it wasn't until local Bloomington resident Sherri Rodgers encouraged me, through wife Joyce, to attend a Public Observing Session in 2007, that I decided to reconnect.

And reconnect I did. There was this guy that I started talking to about my background and before I knew it, I was adjunct professor at Millikin University and planning Spring Break and Summer Immersion courses that included topics in archaeoastronomy and observing/photography in astronomy, that have been highlighted in this newsletter. Thank you Dr. Dan Miller!

So, now that I am ready to take the next step in my life's journey. I plan to leave State Farm in February 2011, spending more time at Farm View Observatory at the family farm, assisting with the farm operations, keeping in touch with Millikin University, and doing those things that one never gets to when advancing a career and raising a family. Future scientific interests include photometry and spectroscopy in astronomy – fertile areas for the amateur astronomer.

FOR THE RECORD: TCAA HISTORICAL WORK DISTRIBUTED

The 50th anniversary edition of *History of the Twin City Amateur Astronomers 1960 – 2010* is now being distributed. If you have received you copy and have not yet given your $49.50 payment to Carl Wenning, please do so as soon as reasonably possible. Checks should be made payable to Carl and sent to him at 21 Grandview Drive, Normal, IL 61761-4071.

For the historical record, here are the names of current and former club members who have received a copy of the volume as of this writing: Paul Pouliot, William Carney, Lee Green, Dave Osenga, Sharon MacDonald, Barry & Carol Beaman, Bill Blunk, Mike Ryder, Taylor Cisco, Bob Finnigan, Rebecca & Chrystian Vieyra, and Carl Wenning. Bill LaBounty also received a complimentary copy of the publication on behalf of the McLean County Historical Society on October 9th, and another complimentary copy was placed in the club's library at Sugar Grove Observatory on October 16th. Several copies remain to be distributed and may be claimed if reserved. After the next TCAA Board Meeting on November 2nd, unclaimed and undistributed copies will be sold at cost on a first-come, first-served basis. Contact Carl at carlwenning@gmail.com if interested.

NEW STAR IN THE CONSTELLATION VIEYRA

Thérèse Isabel Vieyra, the daughter of Chrystian and Rebecca Wenning-Vieyra, was born at 11:20 p.m. on Saturday, October 16th. Weighing in at 7 lbs, 6 oz, she was born in McHenry, IL. Rebecca was enrolled in the TCAA on the day of her birth in 1985. Congratulation to Rebecca and Chrystian and grandparents Carl and Carolyn Wenning.

NOVEMBER SKY GUIDE

04	The Moon passes 8° south of Saturn, 1 A.M.
7	The Moon passes 1.6° south of Mars, 4 P.M.
9	Asteroid Vesta is in conjunction with the Sun, 6 P.M.
	Mars passes 5° north of Antares, 10 P.M.
14	The Moon passes 5° north of Neptune, midnight
15	Mercury passes 2° north of Antares, 5 A.M.
16	The Moon passes 7° north of Jupiter, 10 A.M.
	The Moon passes 6° north of Uranus, 4 P.M.
17	Leonid meteor shower peaks
20	Mercury passes 1.7° south of Mars, 7 P.M.

OCTOBER EDUCATION/PUBLIC OUTREACH REPORT

Lee Green hosted a viewing session on October 15th. Ladies from the Vale Community Church gathered at the SGNC for their annual meeting. The TCAA was invited to bring telescopes so they could enjoy the wonders of the heavens. Lee Green and William Carney provided that opportunity to the 40 women in attendance.

Our final Public Observing Session for 2010 took place on Saturday, October 16th. We looked at the Perseus Double Star Cluster and explored the different types of stars to see how and why they change their brightness. Dan Miller gave a great presentation and Carl Wenning provided a laser-guided sky tour. We had 6 telescopes and Dan's Sky Scout, as well as the debut of a new Orion 12-inch telescope brought by Tony Cellini. Dan, Tony, Carl, Bob Finnigan, William Carney, Lee Green, and Paul Pouliot along with his granddaughters Eve and Amber assisted with telescopes. There were some 80 people who attended – our largest crowd of the year – in addition to our 9 club members. Thanks to everyone for making this year's public observing sessions so successful!

SGNC's Autumn Celebration was held on Saturday, October 23rd. Unfortunately, the event was plagued by rain through early afternoon and solar observing was not possible. A cold rain dominated the morning hours, but the afternoon permitted for a warming trend and a few rays of sunshine. A small cadre of volunteers – Tom Weiland, Duane Yockey, Lee Green, and Tony Cellini – spent most of the day inside SGO exhibiting the facility and distributing club brochures to the visitors. Carl Wenning was present but provided views of the landscape though his 22x100 binoculars from inside the barn to the east. Approximately 100 visited the observatory and barn over the course of seven hours. This was about 1/3 the number of individuals who usually visit during this event. Josh Lindsey and Melissa Shinke were also present for the day, volunteering directly for SGNC.

On Friday, October 29th, Carl and Lee held an observing session at Roanoke-Benson High School in Roanoke, IL. About 35 astronomy, physics, and chemistry students (including a few family members) turned out for the event that was held on the school's soccer field. The program ran from approximately 7 to 9 p.m. Jerod Gross, who has spoken to the TCAA about the Galileo Mission to Jupiter, was the host.

OBSERVERS' LOG FOR OCTOBER 2010

The first week of October presented an extraordinary opportunity for astronomical observing. The sky was nearly cloud free until Sunday, October 10th. The TCAA's real amateur astronomers took advantage of this nearly unprecedented opportunity for observing and imaging.

Carl Wenning spent 2 hours on Sunday, October 3rd, at SGNC observing planetary nebulae for his Astronomical League observing program. He found, observed, and drew 10 faint planetary nebulae that likely would not have been visible were it not for the dark, transparent skies. Tony Cellini stopped in to view with Carl for about an hour.

William Carney, Bob Finnigan, Lee Green, Tony, and Carl observed at SCNC on Monday, October 4th. Lee conducted astronomical imaging providing additional guidance to Bob, while others busied themselves with general viewing. William worked with the Meade 10-inch that is mounted temporarily in SGO. Carl set up both his CPC1100 and his 18-inch Obsession telescopes. The company of observers compared views of celestial objects as seen through both of Carl's telescopes. Toward the end of the evening, Carl was able to find, observe, and draw 3 additional planetary nebulae bringing his observing program total to 93. He spent a fair amount of time working with Tony searching globular cluster M15 for the Pease 1 planetary nebula without success.

The observing continued unabated due to the stretch of clear evenings and fair (if not a bit chilly) weather. On Tuesday, October 5th, William, Carl, Bob, and Lee spent more time at SGNC. William and Lee continued their astrophotography with Bob observing the process. Carl, armed with high quality finder charts, finally was able to view the planetary nebula in M15, bringing his tally up to 94 – some 85% of the 110 objects needed. Carl reports that it will likely take at least another year to complete the PN observing program – the most difficult but most enjoyable – that he started in 2008.

William, Lee, Bob, Tony Cellini, and others continued observing and imaging through the remainder of the week. The MOOS on Saturday, October 9th, saw an incredible turn out of amateur astronomers at our SGNC observing site. In attendance for this function were 12 people current and former members: Barry and Carol Beaman, Tom Weiland, Tony Cellini, William Carney, Larry Leetzow with Nancy Sultan, Paul Pouliot with Amber and Eve, Lee Green, and Carl Wenning. Tony Cellini captured an excellent set of images of Comet Hartley passing near the double cluster in Perseus.

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PLANETARY IMAGING

By Lee Green

Planetary Imaging is difficult. While the targets tend to be bright, they are also very small. This small scale of planets makes their images susceptible to distortions from atmospheric turbulence. Jupiter is an especially difficult target because it rotates very quickly, so the images must be rapidly captured.

Jupiter's angular diameter varies between 30 and 50 arcseconds. For objects this small, it is hard to image the finer details because they are sampled by the CCD imaging cells that have a finite resolution. My camera has cell that are 6.9 microns in size. For my standard F/10 telescope, that works out to be about 0.35 arcseconds per pixel, so Jupiter's image is just over 100 pixels across. That causes the details on the surface of the planet to appear indistinct and blurry. The only way to cope with this small scale is to increase magnification using a Barlow lens, eyepiece projection or other technique.

Atmospheric turbulence, also known as seeing, is the more severe constraint on resolution. While the camera is exposing the image, the target is changing because its light gets continuously refracted as it passes through the column of air. These refractions cause the image to shift and change shape, so the resulting images seem less distinct than we would like. Short exposures help to "freeze" these atmospheric changes, but it is always a challenge to obtain sufficient detail in planetary images.

There are two basic approaches I have tried, webcam and regular CCD imaging using LRGB filters. I have the Celestron NexImage webcam. It is a handy unit that is equipped with a 1-1/4" nosepiece, so it easily attaches to the telescope. The software lets you capture successive frames of the target and saves them as a movie in an AVI file. Registax, the free image processing software, can read the frames from the AVI file and create a composite image. The downside of the webcam is the small size of the CCD chip.

With LRGB imaging, the challenge is to quickly take as many frames as possible and to complete a set of exposures as fast as possible. The time to download each image and the time to move from one filter to the next add up. During this time, Jupiter continues rotate, so when frames are combined, the effect is to wash out those finer details.

The images shown here demonstrate some of these issues. The smaller image was taken using the NexImage webcam at F/20, so Jupiter took up most of the size of the small sensor. The image was reduced from a series of 900 frames and processed by Registax. For the larger image, I used the LRGB technique with a 4x Barlow to achieve F/40 magnification, so the image spanned about 500 pixels. The higher magnification forced me to use longer exposures to get a healthy signal to noise ratio, so the benefits of the expanded image scale were limited by the effects of seeing.

OBSERVERS' LOG FOR OCTOBER 2010 (CONT.)

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The sky began to turn cloudy the next day and continued to be plagued by clouds and the crescent moon on October 10th and 11th. Thy sky again cleared on the evening of the 13th but the moon was beginning to interfere with evening observations. Following the POS on October 16th, and despite the partly cloudy sky and a moon just past first quarter phase, Carl was able to observe one more planetary nebula in Cygnus bringing his tally to 95.

With moon dominating the evening sky, Carl took to daytime observing on October 20th when he observed the Sun in both white and hydrogen-alpha light. He reported observing three large sunspot groups, one evidently in the process of splitting in two. He also reported seeing the thinnest crescent Venus ever. It was only 9 days prior to inferior conjunction with and 14 degrees away from the Sun.

The remainder of October was plagued by the moon and periods of overcast sky with wind and rain. Despite the presence of a waning crescent moon on the morning of October 31st, Carl was able to observe another dozen deep space binocular objects bringing his tally up to 54 – six shy of the 60 required to earn this Astronomical League observing award.

LIMITING MAGNITUDE OF A TELESCOPE

By Carl J. Wenning

With the recent acquisition of an 18-inch Obsession telescope, I have had the opportunity to compare how this telescope and my 2006 Celestron CPC 11-inch telescope perform in terms of limiting magnitude – the magnitude of the faintest stars visible at zenith through a telescope. I have during the past month taken several opportunities to compare telescopic views side by side, and have come up with a number of findings. While investigating the limiting magnitude of my 18-inch (for the purpose of generating better star maps), I was mildly surprised to find out that a large number of factors affect the limiting magnitude of a telescope. I'd like to share some of my thoughts and reflections dealing with limiting magnitude.

My first real question after acquiring the Obsession was, "What is this telescope's limiting magnitude?" More technically speaking, how faint a star can I see at zenith with the telescope under varying conditions? I have been stunned by the observed differences between the 11- and 18-inch telescopes. Typical views through the 11-inch telescope match very nicely the star maps generated by my iPad's *SkyVoyager* (recently renamed *SkySafari*) program. That program shows stars down to about 12th magnitude. When looking at the same star field with the 18-inch, however, the difference is amazing! While only a few stars might be found in a given 11-inch field, many times more stars can be seen in the same 18-inch field of view.

Clearly, the larger a telescope's objective lens or mirror, the more light it is able to gather into the observer's eye. Considering the objective only, the amount of light that it can gather is directly proportional to its surface area. The ratio of areas tells the number of times more light a larger objective can gather in comparison to a smaller objective. Consider the relative light gathering powers (LGP) of my 11- and 18-inch mirrors:

$$\frac{LPG_{18}}{LGP_{11}} = \left(\frac{18}{11}\right)^2 = 2.68$$

The 18-inch objective (not considering the secondary obstruction and other factors) gathers some 2.68 times as much light compared to the 11-inch objective all other things being equal. This aperture difference alone will provide views of stars just over one magnitude fainter ($2.512^{1.01} = 2.68$). Clearly, this doesn't entirely account for the differences observed between my two telescopes. Many other considerations also apply, and it is these that account for the major differences in what I have observed.

Type of telescope: Reflecting telescopes have a mirror for an objective. Most reflectors (but not a Shiefspiegler for instance) have a secondary mirror that blocks a significant amount of light from hitting the primary mirror. Mirrors aren't perfect either; they don't reflect all incident light. These factors work together to reduce the limiting magnitude. (Recall that the fainter the object the higher the magnitude.) The refractor has a lens as its objective and is free from a central obstruction. Still, refracting telescopes can backscatter a significant amount of light from their surfaces if suitable anti-reflective coatings are not in place. Lenses can also absorb some of the incident light. The Schmidt-Cassegrain has a lens-and-mirror combination. It is subject to all these problems of reflectors and refractors.

Mirror reflectivity/lens transmittance: The reflectivity of the mirror and the transmittance of a lens will place a cap on limiting magnitude. Both mirror and lens coatings and optical cleanliness can affect limiting magnitude. For instance, old pure aluminum coatings on mirrors had only an 88% reflectivity. Two mirrors (primary and secondary) in series would have an effective reflectivity to only 77% (0.88^2). Modern "enhanced" coating on primary mirrors is typically 95% reflective and on secondary mirrors 98% reflective with overall reflectivity of 93% (0.95*0.98). Similar considerations must be taken into account for refracting telescopes with and without anti-reflective coatings on critical surfaces. Also of concern with refractors is the clarity of the optical glass used to formulate the objective lens. The same is true with eyepieces. This article assumes the enhanced reflectivity of mirror coatings and the use of antireflective coatings. It is assumed that eyepieces do not play a direct role in terms of light reflection and absorption. Limiting magnitudes will be lower by approximately 0.2 magnitudes than those stipulated in this article if modern reflective coatings are not used on the surfaces of objectives and secondary mirrors (if employed). Poorly maintained (e.g., dirty or oxidized optical coatings) will further reduce the limiting magnitude of a telescope. "Clean optics" are assumed for the purpose of this article.

Magnification: The effect of magnification on limiting magnitude is surprisingly great. My recent experiences with observations of the planetary nebula Pease 1 in globular cluster M15 show that magnification is a major consideration. Higher magnification (e.g., 230X) with the 18-inch and a $9mm$ eyepiece shows disproportionally more stars in the same field of view than are visible at lower magnification (e.g., 52X) with the same telescope using a $40mm$ eyepiece. The higher magnification reduces the brightness of the background, making fainter stars visible. It's the higher contrast that makes the difference. Under stable atmospheric conditions, stars approximate point sources and cannot be magnified in size significantly; the background sky can be magnified, however, spreading its light over a wider surface area of the pupil and therefore reducing its intensity. This increases the contrast between sky and star. Greater contrast means greater visibility. (That's why you don't see stars during the daytime even though present in the sky – the contrast is too low.) So, limiting magnitude is clearly dependent upon magnification as well as aperture.

Atmospheric seeing: Seeing – essentially the turbulence of the atmosphere – can influence limiting magnitude. Seeing can

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LIMITING MAGNITUDE OF A TELESCOPE (CONT.)

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be measured by determining the diameter of a star image. Stars, while large objects, are so distant that they normally appear only as point sources. The Earth's atmosphere can play havoc with starlight, making the images much larger. Point sources are not affected by dimming as a result of magnification; the same cannot be said when stars appear as disks. Disks of light can be magnified, thereby reducing their surface brightness. The more turbulent the atmosphere is, the greater will be the size of stellar disks. Stellar disks can easily vary from 0.5 arc seconds under ideal seeing conditions to several seconds of arc under poor seeing conditions. Poor seeing decreases the limiting magnitude.

Sky darkness: Pursuing a knowledge of limiting magnitude of a telescope further makes one realize that sky darkness will also help to determine the number of stars visible in a telescope. This is analogous to the experience where more stars are visible in the sky on nights when it is especially dark. Anyone who has viewed the sky from both urban and country settings will clearly have a grasp on this. In an urban setting it is not uncommon to find a limiting magnitude at zenith of 3 or lower. Poor nights in the countryside will have a limiting magnitude of perhaps 4.5, typical nights of perhaps 5.5, and optimum nights of perhaps 6.5. A brighter sky will reduce limiting magnitude.

Sky transparency: Sky darkness and sky transparency are not to be confused. A sky can be extremely dark and yet stars cannot be seen if the sky is not transparent (e.g., overcast with clouds). High humidity, haze from forest fires and volcanic eruptions, dust from farm work, and thin layers of clouds can easily affect sky transparency. For the purpose of this article, high transparency is assumed. Low sky transparency will reduce the limiting magnitude.

Zenith distance and extinction coefficient: The path length that starlight must traverse through the Earth's atmosphere depends upon zenith distance. The closer to the horizon one observes, the greater the amount of atmospheric extinction one experiences. We are all familiar with the fact that the sun can appear appreciably dimmer when near the horizon than when higher in the sky. That dimming results from the increased path length that light must travel through the atmosphere to reach the eye. Overhead, the path length is unity. At the horizon light must travel through as much as 5 times the amount of atmosphere before reaching the eye. This added path length causes dimming which is related to the extinction coefficient. Typically, extinction coefficients range from 0.2 to 0.6 magnitudes per unit air mass. Observing closer to the horizon will reduce limiting magnitude. Atmospheric extinction accounts for the dimming of the sun near sunrise and sunset and can amount to several magnitudes if the sky is not transparent.

B-V color index (CI) of a star: CI in this article is defined as blue minus visual magnitude (B-V). The bluer a star, the smaller the value of CI is. The CI of stars varies considerably and affects visual acuity. We all know, for instance, that stars come in a range of colors from blue to white to yellow to orange to red. This color can affect one's ability to see a faint star. We all know that we are relatively insensitive to red light (hence, the use of red light at night) and the much higher sensitivity to the blue-green portion of the spectrum (whose light can destroy dark adaption). Consider the following color indices: Regulus, bluish B7 spectral type, CI = -0.11; Sirius, whitish A0 spectral type, CI = 0.0; Sun, yellow G2 spectral type, CI = 0.63; and Betelgeuse, red M2 spectral type, CI = 1.85. The human eye is most sensitive to the yellow-green portion of the spectrum. Hence, observing faint stars outside this optimum color range will result in a reduced limiting magnitude.

Dark adaption: This article assumes complete dark adaption and good eyes...properly focused star images, etc. Dark adaption will allow for the eyes' pupils to dilate and for the chemical rhodopsin to form in the retina that sensitizes it to faint light. Clearly, people who are dark adapted will see more stars than someone who is not dark adapted – despite the fact that poorly dark adapted individuals will often claim that the sky is much darker than it appears to a properly dark adapted observer. Once fully dark adapted, an observer is more likely to see the sky glow in addition to the brighter stars.

Experience of the observer: Even the experience of an observer can affect limiting magnitude. Experience observers will use averted vision effectively. This helps to see dim stars, but this is a qualitative parameter and is not dealt with further in this article or the subsequent limiting magnitude calculations.

Liming magnitude calculations: So, the limiting magnitude of a telescope is not an simple thing to determine. It depends on lots of optical factors, observing conditions, and observer characteristics. Using the following website whose code was written by Larry Bogan (1998), I have been able to develop a data set for my 18-inch telescope to which I have made adjustments to include the newest antireflective optical coatings.

http://www.nature1st.net/bogan/astro/optics/maglimit.html

Table 1 shows what I have calculated to be the liming magnitudes of my Obsession 18-inch telescope depending on varying conditions:

Magnification	Poor Conditions*	Typical Conditions*	Optimum Conditions*
52X	12.7	13.7	14.7
230X	15.1	15.9	16.6

Table 1. *Limiting magnitudes of Obsession 18-inch telescope under varying conditions.*

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WHERE ARE THEY NOW?

By Carl Wenning, Historian

Last month I mentioned that the Twin City Amateur Astronomers was founded in 1960 under the able leadership of John and Bertha Kieviet. G. Weldon Schuette heard about the club through *Pantagraph* newspaper accounts while living in Gibson City, caring for his aging and sickly mother. In 1961, Weldon joined the TCAA. He regularly commuting from Gibson City for meetings and other club functions. This continued for three years until the death of his mother in 1964. At this time he moved to the Twin Cities after securing a job with Middleton and Associates as a draftsman where he was to remain for life.

The most beloved part of sky watching for Weldon was that of satellite observation. He saw the Sputnik I rocket, Sputnik II and III and their rockets, Echo I (which he sighted over 1,000 times), Echo II, Pageos, Skylab, Salyuts 6 and 7, space shuttles, and the MIR space station. According to Weldon's own estimate, he observed satellites over 2,500 times since his first sighting of Sputnik in 1957. That Weldon loved astronomy was evidenced by his numerous trips around the country to observe solar eclipses and to watch the space program develop. He traveled to Florida and the Gaspe Peninsula of eastern Canada to view total solar eclipses. He witnessed the one occurring in northern Florida, but it occurred under cover of clouds. Though he did not directly observe the eclipse, he was deeply impressed by the "sudden darkness" surrounding the event. Numerous trips were also made to Florida to see Apollo moon launches and shuttle launches. The club and its members were also objects of love for Weldon. This we know because he spent so much time working on its behalf and participating in its activities. Only two times between 1970 and 1986 did he miss club meetings – the reason being trips to see space shots in Florida.

Weldon was an integral member of the family known as the Twin City Amateur Astronomers. He held every major elected office and was an officer without break from 1971 to his death in 1986. He served as Treasurer for many years. He re-instituted the club newsletter, *The Observer,* in 1975 and was editor until his untimely death. He never missed an issue, nor had one ever come out late. For ten years he single-handedly kept up the grounds of the club's Fissel Farm Observatory. After club co-founder John Kieviet passed away, Weldon always drove Bertha to meetings because she couldn't drive at night. That was Weldon, serving the TCAA and others in many ways, large and small, some of which I am sure we will never knew. His dedicated work on behalf of the club was without comparison.

In February 1984 Weldon was granted lifelong honorary membership in the TCAA – an honor that he truly deserved and relished. He was the first of the club to recover Comet Halley and the last to bid it farewell. Only in June 1986 did he complete an odyssey of many years by finishing his observations of all 110 Messier objects. He was to receive his Messier citation in September 1986 but, unfortunately, death intervened. Weldon suddenly and unexpectedly passed away on the night of August 18/19, 1986 while at home, probably suffering either a stroke or a heart attack. He was dearly loved and highly revered by his fellow club members. Honors were paid to him – honors that he justly deserved. The club saw fit to institute a special society – the *G. Weldon Schuette Society of Outstanding Amateur Astronomers* – to honor one of their own in a way that the membership felt best exemplified the hard work and dedication, the prowess and knowledge of Weldon Schuette.

Weldon was born on January 17, 1917 on the family farm just northeast of Gibson City, Illinois. He was the second of two boys born to George and Ethel Scott Schuette. Weldon was named after his father George, but used his middle name throughout the majority of his adult life. Weldon was laid to rest in Drummer Township Cemetery in Gibson City, IL.

THE EVOLUTION OF AMATEUR ASTRONOMY: THE TCAA THEN AND NOW—PART II

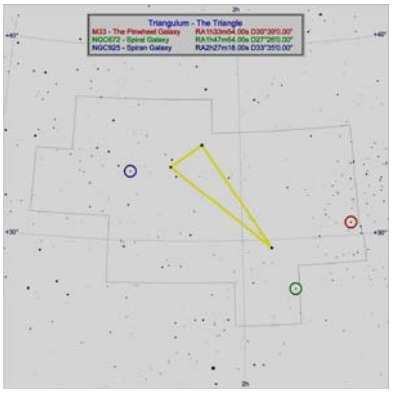
By Carl J. Wenning, Historian

Now that the historical volume History of the *Twin City Amateur Astronomers 1960-2010* has been published, I am reflecting on the last 50 years of change in amateur astronomy in general and the TCAA in particular. The changes in technology and society have been spectacular, and account for many of the event occurring within the club's official history.

Cameras and Astrophotography: Astrophotography by amateurs in the 1960s was next to non-existent. Only wealthy individuals could afford to purchase SLR cameras, which meant that the early TCAAers were not actively involved in astrophotography. The prices for SLR cameras were considered astronomical until they become more commonly available in the 1970s. In the early days of the TCAA – when they did astrophotography at all – members relied on "fast" film such as Tri-X and high contrast developers such as D19. Darkroom work was necessary in order to "push" film to its maximum speed – even though this often resulted in grainy pictures. With the 1970s and 1980s, two additional approaches became available to the club's astrophotographers – gas "hypering" of film and cold cameras. Single roles of film could be sent in to commercial suppliers who would sensitize film by subjecting it to certain gases. Alternatively, single frames of films could be subjected to very low temperatures by placing dry ice immediately next to the film. Bob Finnigan used one such device but dispensed with it as "too much trouble" after taking only one picture. Yet another way to improve astrophotography at this time was to use a Schmidt camera – a short focal ratio astronomical telescope with a single piece of film put into the image plane. The catch would be to move the film in and out of the camera without exposing it to stray light. The first accessible digital cameras for astrophotography became available in the 1990s, with widespread distribution occurring in the first years of the 21st century. The quality of astronomical imaging by amateurs approached the professional level in the first years of the new millennium with the advent of astronomically dedicated monochromatic digital cameras (such as those made by the Santa Barbara Instrument Group), RGB filter sets, color DSLR cameras, apochromatic refractors, and imaging software that allowed for stacking of images, removal of "darks", and so on. The quality of images obtained by several current club members during the first years of the new century rivaled the best that professional astronomers could achieve only a few years earlier with the most advanced systems available. Today's club members can obtain nearly Hubble quality still and video images at a very tiny fraction of the cost of commercial observatories.

Presentation Devices: During the earliest days of the TCAA, the membership was entertained with "chalk talks," words and images drawn upon blackboards in area classrooms. While movies were not commonly shown at early club meetings, at least one film about the moon and "featuring sound" was a real hit. Shortly after the founding of the club, the Kodak Carousel slide projector became available as did slide film. Within a few years, personal slides and commercially prepared astronomical slide sets (obtained from such places as the Adler Planetarium gift shop) became all the rage. Within a short time, public programs were presented using this new technology. Things in this arena didn't change all that much until the 1990s when the first computers and commercially accessible video projectors became widely available. Today, giving a slide show would be unthinkable. Computers linked to video projectors can show lots more than static pictures. Interactive computer programs have, to a large extent, replaced visits to the planetarium. PowerPoint presentations can be easily tailored to any topic for any audience using the resources of the Internet.

CONSTELLATION OF THE MONTH: TRIANGULUM—THE TRIANGLE



Triangulum has been recognized as a triangle from ancient times. It lies south of Andromeda and north of Aries, east of Pisces and west of Perseus. Triangulum is a small constellation that is best seen in late autumn and winter.

Triangulum was originally seen as an equilateral triangle, much like the Greek letter Δ, and commemorates their accomplishments in mathematics and science.

Triangulum is the 78th largest (11th smallest) constellation covering only 132 square degrees. It is the 64th brightest. Triangulum reaches opposition on October 28.

The most spectacular object found in Triangulum is M33 the Pinwheel Galaxy. M33 is a large galaxy twice the size of the full moon. M33 and M31, the Andromeda Galaxy are both members of our Local Galaxy Group. Due to its large size and low surface brightness, M33 can be difficult to observe with a telescope. Often binoculars are more effective observing M33.

Other notable galaxies in Triangulum include NGC670, NGC672 and its nearby companion (IC1727) and NGC925.

LIMITING MAGNITUDE OF A TELESCOPE (CONT.)

(Continued from page 7)

So, what does this mean in terms of Milky Way stars in the observable range? Consider Table 2. Under typical conditions, my CPC1100 can reveal about 5.3 million stars at low power under typical conditions. My 18-inch Obsession, on the other hand, can show nearly 380 million stars at high power under typical conditions – more than 70 times as many!

Magnitude	Range	Number of Stars in Range	Cumulative Number of Stars
12	+11.50 to +12.49	3,481,113	5,304,685
13	+12.50 to +13.49	10,126,390	15,431,076
14	+13.50 to +14.49	29,457,184	44,888,260
15	+14.50 to +15.49	85,689,537	130,577,797
16	+15.50 to +16.49	249,266,759	379,844,556

Table 2. *Numbers of stars visible by magnitude.*

So, the next time someone asks you the limiting magnitude of a telescope, be certain to tell them that the old tried and true formulas (method 1: $M_L = 3.7 + 2.5 * Log_{10}(D^2)$ where D = aperture in mm and taken from *Visual Astronomy for the Deep Sky* by Roger N. Clark; method 2: $M_L = 9.5 + 5.0 * Log_{10}(D)$ where D = aperture in inches and taken from *The Observational Amateur Astronomer* by Patrick Moore) aren't really very accurate. For instance, method 1 gives 17.0 for my Obsession telescope and method 2 gives 15.8 under who knows what conditions. Clearly, it is difficult to say precisely what the limiting magnitude of any telescope actually is without a detailed analysis such as that provided by Bogan and slightly modified to account for new anti-reflective mirror coatings and such. For additional information about limiting magnitude, see the article by Bradley Schaefer who first calculated the limiting stellar magnitude an observer can expect under various conditions with various types and sizes of telescopes. The process is fully described in *Sky & Telescope* magazine, November 1989, page 522.

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* "Poor conditions" consist of a 35 degree zenith distance, 4.5 zenith limiting magnitude, extinction coefficient of 0.6 magnitudes per atmosphere, dirty optics, seeing 2 arc second, and size of eyepiece exit pupil is less than size of observer's pupil. "Typical conditions" consist of a 35 degree zenith distance, 5.5 zenith limiting magnitude, extinction coefficient of 0.4 magnitudes per atmosphere, moderately clean optics, seeing 1 arc second, and size of eyepiece exit pupil is less than size of observer's pupil. "Optimal conditions" consist of a 35 degree zenith distance, 6.5 zenith limiting magnitude, extinction coefficient of 0.2 magnitudes per atmosphere, very clean optics, seeing 0.5 arc second, and size of eyepiece exit pupil is less than size of observer's pupil. These calculations also assume an "average" observer, neither expert nor novice, with well-adapted eyes and a properly focused telescope. Of course, the color of a star will also make a difference. Calculations are based on the presence of highly detectable A0 stars with a color index of 0 in the field of view.

TCAA Treasurer's Report – October 2010

OPERATING FUND BALANCE – September 30, 2010 -	$ 1,978.88
Income	
Tony Cellini (Dues) -	$ 40.00
Expenses	
LYB Inc. (September Observer) -	$ 43.32
OPERATING FUND BALANCE – October 31, 2010 -	$ 1,975.56

OBSERVATORY FUND BALANCE – September 30, 2010 -	$ 3,176.13
Income	
Interest -	$ 0.53
Expenses	
None -	$ 0.00
OBSERVATORY FUND BALANCE – October 31, 2010 -	$ 3,176.66

TOTAL TCAA FUNDS – October 31, 2010 -	$ 5,152.22

Respectfully submitted, L. Duane Yockey, Treasurer

Sugar Grove Observatory

Listing of Official Keyholders (Paid $10 deposit/$5 renewal)

Duane Yockey (renewed through 2009)
William Carney (renewed through 2010)
Carl Wenning (renewed through 2009)
Brian Barling (renewed through 2010)
David Osenga (renewed through 2010)
Josh Lindsey (renewed through 2010)
Dan Miller (renewed through 2009)
Lee Green (renewed through 2009)

MISSING OUT ON TCAA ACTIVITIES & EVENTS?

If you are missing out on club activities or celestial events, be certain to join the TCAA listserv. Many activities are planned at the last minute, and announced only hours in advance through the club's listserv. Reminders about celestial events are also broadcast to the membership through the club's listserv. To join this free service by Yahoo, send a blank email to TCAA-subscribe@yahoogroups.com. Unsubscribing is just as easy. To unsubscribe, just send a blank email to TCAA-unsubscribe@yahoogroups.com.

To keep up to date on celestial events not described in *The OBSERVER* or addressed in the listserv, visit Carl Wenning's observing page at www.phy.ilstu.edu/~wenning/observing_page.htm. It has been recently updated to include an extended sky calendar of events as well as additional space weather and satellite viewing links.

The OBSERVER
Newsletter of the TCAA, Inc.

Erin Estabrook, Editor
314 Covey Court
Normal, IL 61761

Are your dues due? ☐

The Dues Blues?

If you see a check in the box above, it means your dues are due. To retain membership, please send your dues renewal to our esteemed Treasurer:

Duane Yockey
508 Normal Avenue
Normal, IL 61761