



## STAR FIELDS

Newsletter of the  
Amateur Telescope Makers of Boston  
Including the Bond Astronomical Club  
Established in 1934  
In the Interest of Telescope Making & Using

Vol. 24, No. 11 December 2012

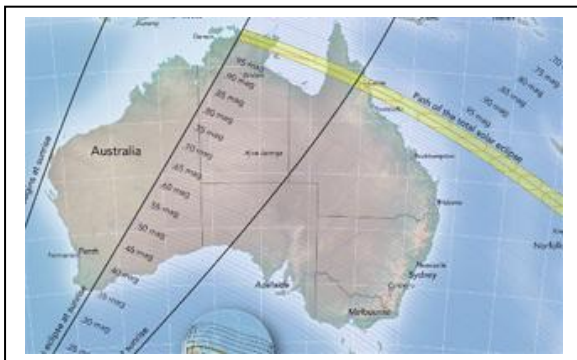
### This Month's Meeting...

**Thursday, December 13<sup>th</sup>, 2012 at 8:00 PM**  
**Phillips Auditorium**  
**Harvard-Smithsonian Center for Astrophysics**  
Parking at the CfA is allowed for the duration of  
the meeting.

Please join us for a pre-meeting dinner discussion at Changsho,  
1712 Mass Ave, Cambridge, MA at 6:00pm before the meeting.

### November 14<sup>th</sup> Solar Eclipse – Member Reports

This month we will hear from our members who traveled to Cairns Australia to view the total solar eclipse of November 14<sup>th</sup>. There were a good deal of members of the club who traveled halfway around the globe to see this spectacle and combine the opportunity to see a far-off part of the world. Come join us tonight to hear their stories and see some great pictures of their adventures down under.



## President's Message

A group of our members traveled halfway around the world last month on another ATMoB great eclipse adventure. The expectations were high for another wonderful experience under the darkened sky punctuated by the glow of the solar corona emanating from the blackened circular orb floating out over the eastern horizon. They were in Australia – the land down under. Unfortunately for most, despite meticulous planning and last minute decisions to travel even further out from their initial selected viewing location the eclipse expedition didn't pan out as hoped for. Clouds ruled the day and the event was not to be seen, at least not in the full glory as all had hoped for. This is the chance we take when we pin our hopes on the vagaries of the weather. The best planning can never take into account this sometimes predictable but always fickle variable. Fortunately for these seasoned eclipse chasers they never plan a trip with only the eclipse in mind. These trips always include secondary plans to do local sightseeing and to take advantage of opportunities that can only be experienced in the remote far-off locations they often venture to. In this case the Great Barrier Reef for scuba diving, pristine beaches, rain forests and for some, traveling to nearby observatories and visiting with local astronomers known before only through email correspondences. So as with any eclipse expedition it's all about planning. One can only hope for the weather to cooperate. But it doesn't always do so however the trip can still be a resounding success if other activities are padded in. I hope all our members that traveled such a distance come back smiling and happy they got to see another part of the world that most of us will never get to see. The next big one won't require such distant travels but will certainly include the weather factor. Planning, planning, planning. Now is the time to start . . .

~ *Mike Hill, President* ~



# October Meeting Minutes

Minutes of ATMOB meeting held November 8, 2012 .

Mike Hill, President: called the meeting to order at 8:00 PM.

The Secretary's Report of the October meeting was given by Sidney Johnston. Mike Hill gave Treasurers Report which was prepared by Nanette Benoit, treasurer. Tom McDonagh gave the Membership Committee Report. Glenn Chapel gave a Report on interesting sky objects for the coming month. Bernie Kosicki gave the observing Committee Report. Mike Hill gave the Clubhouse Report. Mike Hill made an announcement that at the last Board Meeting in October there was an agreement that the new observatory with new dome and the C-14 telescope would be named the "ATMOB Research and Imaging Observatory" (ARIO). There was an announcement that on 11 November 2012 the setting Sun would align with the MIT "Infinite Corridor".

Five Star Parties were announced. A work party on 1 December was announced. Paul Valleli asked for a summary of the Board meeting held in October. Mike Hill gave a summary based on Bruce Berger's notes.

Mike Hill introduced the invited speaker Jim Hand who gave a talk entitled "American Triumph, The Apollo Project".

Jim Hand worked for Kollsman Instruments and at the MIT Instrumentation Lab during the Apollo years designing and integrating hardware and software for the command and lunar modules, particularly in the design and implementation of the navigation telescope. The telescope was used in determining mid-course position, navigation to a lunar landmark for landing on the Moon, and navigation for liftoff from the Moon and navigation to the Command Module which was orbiting the Moon during the Astronaut's exploring the surface of the Moon. He served in a supporting role during the first lunar landing mission at the Johnson Space Center. His work continued past the Apollo years with technologies developed for Apollo which were finding other applications, most specifically guidance and Navigation of space systems.

In his talk Jim highlighted the men responsible for the Apollo project's successful landing on the Moon and safely returning them to Earth. President John F. Kennedy announced before Congress on May 25, 1961, a vision to land a man on the Moon and return him safely by the end of the decade.

Previously Robert H. Goddard (1882 – 1945) began exploring the practicality of rocket propulsion at high altitudes, including to the Moon at least by the year 1912. Goddard fired liquid propelled rockets by 1926, launched a scientific payloads by 1928, installed vanes in rocket motors for guidance by 1932, used a gyroscope control for rockets by 1932, and introduced pumps for rocket motors and gimbals for rocket motors, etc.

Wernher von Braun (1912-1977) was a leader in Germany of the V2 rocket, came to the U. S. A. after World War II, became a U. S. Citizen in 1955, became director of NASA's Space Flight Center at Huntsville, Alabama, and developed the Saturn V rocket which lifted the American Apollo 11 astronauts into orbit on their way to the surface of the Moon.

Dr. Charles Stark Draper (1901-1987) was a MIT professor and Director of the Instrumentation Laboratory. Dr. Draper is known as "The father of inertial navigation", and contributed greatly to the Apollo 11 landing on the Moon. Dr. Draper integrated the components such as accelerometers, gyroscopes and electronics into an Inertial Measurement Unit (IMU), or stable platform. For Apollo the IMU was developed to a size about the size of an oversized basketball, an awesome machine which measured linear and rotary forces relative to a selected frame of reference. The IMU was a machine that enabled a self-contained guidance, navigation and control of spacecraft, and/or other vehicles. This system was mandatory for assuring that the astronauts could make their way home even if communications with the ground based support team broke down. The MIT Instrument Laboratory designed and developed the prototype stellar-inertial systems, and industry produced the flight units, led by General Motors/AC Spark Plug Division and Kollsman Instrument Corp.

An explosive fire on January 17, 1967, inside a locked, Oxygen-rich spacecraft during a mission simulation killed three astronauts Gus Grissom, Ed White and Roger Chaffee. Thereafter the spacecraft interior was re-designed.

The goal of the Apollo program was achieved in July 1969. Liftoff to Earth orbit with three astronauts was on July 16, 1969 and achieved an orbital velocity of about 17,500 miles per hour (mph). The astronauts were: Michael Collins the Command Module Commander; Edwin (Buzz) Aldrin the Lunar Module Commander; and Neil Armstrong the Mission Commander. Armstrong became the first man in history to step on another planet.

Escape from Earth orbit toward the Moon was achieved at a velocity about 24,200 mph. The trip to the Moon required about three days. Two men landed on the Moon at 4:18 PM July 20th; the two men walked on the moon, performed experiments, left seismic and retro-reflector instruments, and brought back rocks for analysis! The three astronauts launched homeward 23 hours later; hit earth atmosphere at roughly 36,000 feet per second (fps) and landed safely in ocean on July 24th. They were required to stay in quarantine for one week to avoid contamination of Earth.

The navigation telescope which Jim helped design provided essential inputs to the Guidance Navigation and Control System. The PRIMARY GUIDANCE NAVIGATION AND CONTROL SYSTEM (PGNCS) had the following features:

- Guidance – "Where am I going?";
- Use state vector (position, velocity, attitude) from uplinked data or onboard system;
- Execute required change in velocity and vehicle attitude for powered flight maneuvers;
- Navigation – "Where am I?";
- Inputs from sensors (IMU, optics, radar);
- Sense and compute vehicle state vector;
- Control – "How do I get there?";
- Inputs - required change in velocity; and
- Outputs - Commands to flight control effectors.

The Guidance Navigation and Control System had a self-contained capability so that it would function in the event that control from the ground were lost.

The SELF-CONTAINED CAPABILITY comprised:

Inertial Measurement Unit (IMU);  
Optical Subsystem (OSS);  
Alignment Optical Telescope (AOT);  
Back up Reticle on window;  
Apollo Guidance Computer and Software;  
Radar for rendezvous and landing;  
Lunar Module rotation and translation hand controls;  
Navigation Base; and  
Abort Guidance System.

The INERTIAL MEASUREMENT UNIT (IMU) comprised the following features:

Three degrees of freedom, three gyros and three accelerometers; servos and angle; resolvers on each axis for control and angle readouts;  
Isolation of stable member from vehicle rotations;  
Sense angular forces relative to fixed-coordinate-system stars;  
Senses translation forces (“delta Vs”);  
Star and landmark coordinates stored in computer;  
Realignment of IMU with star sightings; and  
Realignment required from standby mode (in order to conserve power).

The ALIGNMENT OPTICAL TELESCOPE (AOT) had the following functions:

The PERISCOPIC TELESCOPE;  
Determine inertial orientation of IMU stable member relative to preselected stars;  
Total of 23 stars for the total mission;  
Used on moon to prepare for launch and rendezvous;  
Two-star sighting sequences for IMU realignment;  
Two degrees of freedom for each star; shaft and trunnion angles;  
Manual operation – one angle counter, one Mark button to snapshot IMU gimbal angles; and for each reticle crossing

The trip from the Moon back to Earth (Comin’ Home) had the features:

Recognize constellations & guide stars – sight, center in SXT field; MARK, IMU fine alignment.  
Star- Landmark Navigation  
Change in velocity maneuvers (delta V maneuvers)  
Jettison Service Module.  
Star Check of IMU  
Steer Command Module – Auto or Manual  
Commit no procedural Errors!  
No equipment reliability Errors!  
Don’t skip out of atmosphere or go too deep!

SOME LEGACY PATHWAYS from the Apollo project are :

See also “NASA Spinoffs, Bringing Space down to Earth”;  
Self-contained guidance and navigation for commercial airplanes!;  
Technical pathway toward inertial systems without gimbals (floated Advanced IMU) See also, “Inventing Accuracy”, Donald MacKenzie;  
Strapped down IMUs. Smaller, more portable IMUs;

Systems technology for spacecraft - Space Shuttle, International Space Station, Hubble Telescope, etc.;  
Science of earth-moon system;

Meteoroid/Asteroid collision avoidance technologies;  
Precision pointing and tracking technologies;  
Proven Technologies for surviving/working in space;  
Management systems for large projects;  
Jobs (e.g., 370,000 on Apollo in 1965) and income tax revenues;  
Research and Development ‘profit’ about 7\$ per \$1 invested;  
and  
New perspectives in R&D.

The COST OF PROJECT APOLLO was approximately:

Total cost, approximately: \$25.4 Billion; roughly \$156 billion in 2011 dollars; and the second largest undertaking by U.S. compared to Panama Canal Project.

The benefits are the legacy of Project Apollo and include:

The legacy came through the people who did the Apollo job.  
Example: technical pathway by the contractor engineers resident at MIT/IL who returned to their companies to develop new Guidance, Navigation and Control (GN&C) systems.  
Example: defensive systems work at MIT/IL and then at Draper Laboratory, its spinoff company;  
orbital navigation software for the Space Shuttle and International Space Station;  
far advanced follow-on technology for rendezvous and dealing with meteors that might pose a threat to hit the Earth;  
technology legacy path from Apollo to advanced GN&C systems including floated, gimballess IMUs (Advanced Inertial Measurement System) and even strapped-down IMUs;  
See also Draper.com for examples of other legacies.

## IN CONCLUSION

The successful Apollo Project was a **TURNING POINT IN AMERICAN HISTORY:**

Before Apollo success: Engineer/Scientist approaches manager with advanced project proposal;  
Manager replies: “Your advancement is impossible!”  
After Apollo success, manager replies: “If we can go to the Moon, anything is possible. We’ll get together a project team, find a bucket of money to support your research and development proposal!”

~ *Sidney Johnston, Secretary*

## Notice of Change to Bylaws

The executive board has made a decision to amend the bylaws to include the new Family Membership class along with the other classes we currently have: Regular, Corporate, Honorary, Associate. A vote will be taken at the January meeting by the members present to approve this change. The bylaws as currently written may be view on our website at:

<http://atmob.org/about/bylaws/bylaws.pdf>

## Membership Report

Membership count as of 11/18/2012: 242

Same time last year: 254

The membership renewal period is now closed. I will be updating the 2012-2013 membership list on December 1<sup>st</sup>. If you have questions regarding your membership status, please contact me at 617-966-5221 or via email at [Membership@ATMoB.org](mailto:Membership@ATMoB.org) before this date. **New members as of 2012 are not required to renew till 2013.**

Other than the monthly newsletter, the atmob-announce and atmob-discuss mailing lists are the best way to keep up with club events. One can sign up for these email lists by logging into the ATMoB.org website and then pointing your browser to: <http://www.atmob.org/library/maillinglists.php> Feel free to contact me at Membership@ATMoB.org with questions.

Please take the time to reach out to our new and returning club members:

David Feinzeig

Ron Sampson

Bill Magnusson

Cassandra Robeson

The Amateur Telescope Makers of Boston, Inc. is a 501(c)3 organization. Donations are gladly accepted and are tax deductible to the fullest extent allowed by law.

*~ Tom McDonagh – Membership Secretary ~*

## Clubhouse Report

You will recall the last work session was delayed by the Astro Assembly gathering on the full moon Saturday on Sep 29th. Thus the second October work session was held as scheduled on October 27th. It was cloudy, foggy and a crisp 50 degrees at the 10 o'clock hour. Bill Toomey arrived to find his third student volunteer awaiting the start of the work day before 10AM. Shortly a cast of 20 member volunteers arrived to address projects at hand. As you will also remember, hurricane Sandy was creeping up the East coast with its undiminished destruction along its path. The clearing of undergrowth and the debris piles needed to be addressed, as did the repair of the clam shell observatory pulley bearings to allow the segments to close properly. Snow fence posts needed to be installed to beat the first ground freeze. The entire property needed be secured of all loose items that could cause damage due to suspected winds. Everyone pitched in and the property was secured by the close of business late that evening. The club owes a debt of gratitude to the following: Joe Bernardo(Bill Toomey's student), Bruce Berger, John Blomquist, Paul Cicchetti, Steve Clougherty, Nina Craven, Mike Hill, Eric Johansson, Dick Koolish, Bern Kosicki, John Maher, Eileen Myers, Ji Young Parks, Dave Prowten, John Reed, Phil Rounseville, Art Swedlow, Al Takeda, Bill Toomey and Sai Vallabha. These folks tackled the problems as needed as each team worked to finish their task. A job well done; tasks accomplished were:

\* The metal on metal bearing design flaw in the clam shell pulley finally put too much strain on the motor and defeated the closing process. John B. fabricated a new pulley bearing box with ball bearings to provide proper operation. A team led by John

Maher assisted by Dave P., Steve C., Bern K., Dick K., and others worked to bring the clam shell back to proper operation and secured it for the storm.

\* A team led by Paul C. measured out the proper location of snow fence posts to allow observers field access and still reduce snow drifting onto the observing pads close to the house. The posts were then installed. Access to the metal shed was not affected.

\* The 17" Wray dob was secured in its metal hutch against the storm by a team led by Eric J. and Sai V. The new heater rod appears to be operating as advertised and is keeping the mirror dry.

\* The C14 Observatory was secured after several hours effort by Bruce B. and Mike H. Straps were installed to keep the dome tied to the foundation of the building. A check by Bruce after the storm showed these efforts paid off.

\* The Knight observatory was secured after another cleanup and equipment checkup by inserting the pins in the front corners and the large hinges lagged in the rear. The post storm inspection showed considerable water blew into the North end through the gap normally protected by the rubber flap. Dave P. will lead a future redo with a more effective gap closure scheme.

\* Mike H. took advantage of a post lunch break and fabricated the wood supports needed to allow the new shelving in the metal shed to support the fuel containers without stress or distortion. The shelving received the first coat of white stain.

\* The entire pile of debris in the front driveway was barrowed to the rear pile behind the far barn. There considerable progress was made in continuing the clearing started last work session and the large timber pieces were cut to the proper length for transport off site and stacked. This was a huge effort by Bill Toomey and his student Joe Bernardo who was donating his day of community service to help our club. Later in the day they were joined by Ji Young P. and John R. cutting brush in the rear and providing covering to decrease blow around.

\* The hungry crew was fed through the efforts of chefs Eric J., Sai V., Nina C., and Eileen M. Beef dogs, beef burgers, roasted chickens on the grill, salad, condiments and cookies for dessert. After this delicious lunch, work continued outside culminating with the storing of all loose items in the far barn. Paul C. returned before Sandy struck to ensure all was secured; particularly dimension lumber that may have been missed.

Great teamwork paid off. So as we go to press, we can only hope things recover soon for our fellow amateur astronomers in the New York and New Jersey areas where Sandy really was devastating. If any one hears of specific needs over the next months please let us know so we might be able to assist our friends down there. In the meantime we have our next work session at the clubhouse at 10AM on full moon Saturday December 1, 2012. We hope to finish all outdoor work and have our observing field and scopes in good working condition for cold weather observing. Come on out and join us. You'll enjoy it and the rest of us will appreciate your help. Remember the Thursday evening mirror grinding, Friday evening member Astronomy lecture series, and Saturday evening observing continues each week. See you on Dec. 1st!

*~ Clubhouse Committee Chairs ~*

*~ John Reed, Steve Clougherty and Dave Prowten ~*

## Clubhouse Saturday Schedule

Dec 15	Steve Clougherty, Al Takeda
Dec 22	Eric Johansson, John Reed
Dec 29	New Years Eve Preparations

## 2013 RASC Observer's Handbook...

The 2013 RASC *Observer's Handbook* will be sold at the monthly December meeting. Handbooks are \$20 each – a bargain price since they would cost \$28 plus S&H if purchased individually online.

This 352-page handbook is published annually by The Royal Astronomical Society of Canada (RASC). It is very readable. It puts all kinds of astronomical data and reference information at your fingertips in one small book, including what not to miss each month.

Free PC planetarium software, The Earth Centered Universe (ECU), is included with each Handbook

See <http://www.rasc.ca/handbook/> for more details.

*Submitted by Eileen Myers*

## New Year's Eve Party

Monday, December 31st - Starting at 6:30 PM

CELEBRATE FIRST NIGHT 2013 with your family and friends.

Festivities on Monday, December 31st will start at 6:30 PM and will go on past midnight. You can arrive at any time. The opportunity to shout "Happy New Year" will be every hour on the hour, starting with the Greenwich New Year's at 7:00 PM and continuing with each time zone through Eastern Daylight Time.

Please come and join the fun. Pot luck dinner, so please bring something to share: an appetizer, salad, entrée, dessert... Folks will be arriving and leaving all evening. There will be plenty of non-alcoholic beverages. It is not necessary to RSVP. Just drop in when you can.

The clubhouse will be warm. There will be an Observing the Waning Gibbous Moon Challenge with PRIZES for those who observe lunar features. All of the club's observatories should be open depending on the weather.

We hope that some of the November solar eclipse chasers will share their photos and stories with us too.

Don't forget your warm observing clothes and boots. We will also have indoor games and quizzes so do join us to welcome in 2013 together.

Any questions, contact Eileen at [starleen@charter.net](mailto:starleen@charter.net) or 978-501-6342 (cell) or 978-456-3937 (evening).

Thanks in advance to the Special Events Committee - Julie Kaufmann, Nina Craven, Eileen Myers, to all of the other hosts - Al Takeda, Dr. Art Swedlow, Eric Johansson, John Reed, Sai Vallabha, and to everyone else who helps out.

*Submitted by Eileen Myers*

## Thoreau on Astronomy

I stayed later to hear the pond crack, but it did not much. How full of soft, pure light the western sky now, after sunset! I love to see the outlines of the pines against it. Unless you watch it, you do not know when the sun goes down. It is a candle extinguished without smoke. A moment ago you saw that glittering orb amid the dry oak leaves in the horizon, and now you can detect no trace of it. In a pensive mood I enjoy the complexion of the winter sky at this hour.

Journal, 23 December 1858

This will conclude my series of Thoreau quotes - I hope you have enjoyed them. In early January, I will be moving back to my native state of Oregon, taking up residence in the city of Bend, just east of the Cascade mountains. This happens to be the best part of the state for astronomy, and home to the observatory of the University of Oregon (<http://pmo.uoregon.edu>). I will be joining a volunteer group that helps out there. I expect to visit Boston from time to time, so you have probably not seen the last of me.

## Request for Technical Writer

The C14 telescope is now up and running in the ATMob's newest research and imaging observatory along with all the associated accessories and software that make this the powerful instrument that it is. Trouble is – we need a good manual to assist members who wish to utilize this complex setup to learn how to use it and then have something to refer to as a guide once they have been trained. And to get a good manual written we need a good technical writer. We are therefore looking for someone to volunteer to take this on. It would require coming out there to the observatory and working with the telescope, cameras, and software to learn how it all works and then translate that knowledge into a comprehensive manual as well as a series of quick reference guides for turn-on and shut-down procedures. Please consider helping us out here if you have the time and the aptitude for this sort of stuff.

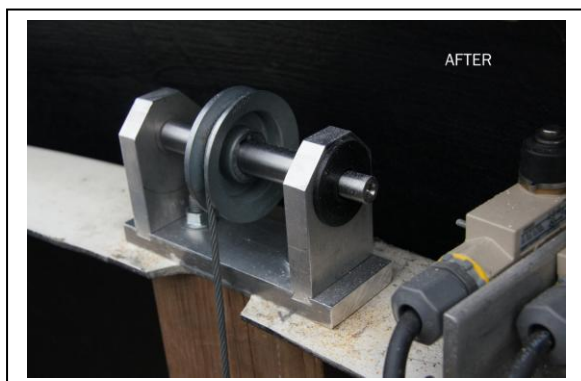
## John Blomquist - Machinist/Amateur Astronomer/Outreach advocate

The ATMoB over the last ten years has been very active in building observatories at our remote observing location in Westford. This has only been possible with the help and expertise of a number of members who have skill sets that cannot be overestimated for their value to us. One of these members is John Blomquist. John has been a member of the club since 2001 and brought to us knowledge and experience as a carpenter, machinist, welder and a millwright. These have all come into play in the construction of the EKO Rolloff roof Observatory, the Clamshell Observatory, and the latest and greatest the C14 based Research and Imaging Observatory (RIO). Two examples of his work are shown below. The first is the rebuild of the roller used to guide the cable that pulls open and closed the covers on the clamshell observatory.

**This is what the old pulley looked like:**

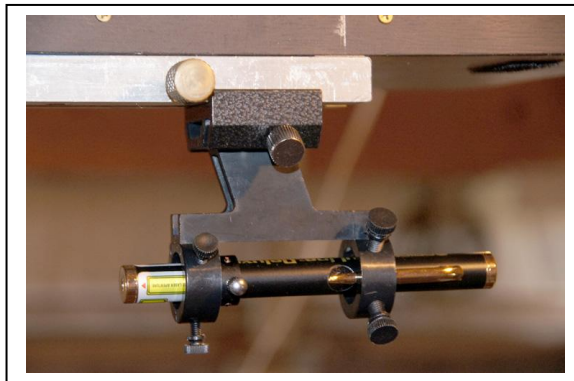
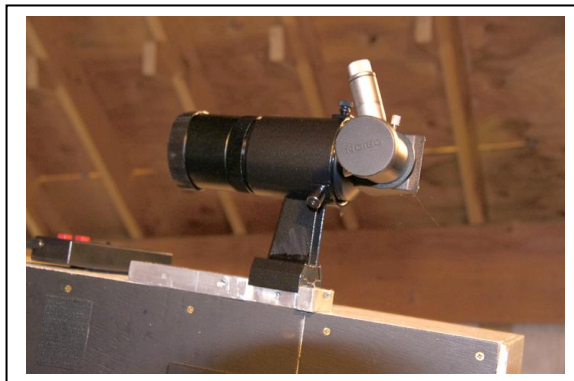


**And now we have this . . .**



The second example is a set of finder accessories installed on the Schupmann telescope housed in the roll-off observatory – A right angle 8x50 illuminated reticle finder and a laser pointer used for rough pointing. Both are mounted in a way to be very convenient to the visual observer.

## Schupmann Finders



Both fine examples of his precision and thoughtful work. John is a great asset to the club and on top of all this spends many an evening doing public outreach at our numerous star parties. Thanks John from all of us.

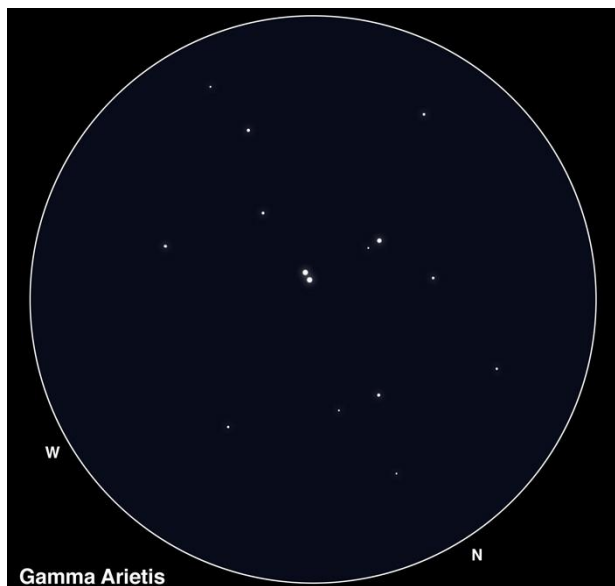
*~Michael Hill ~*

## Sky Object(s) of the Month – December 2012

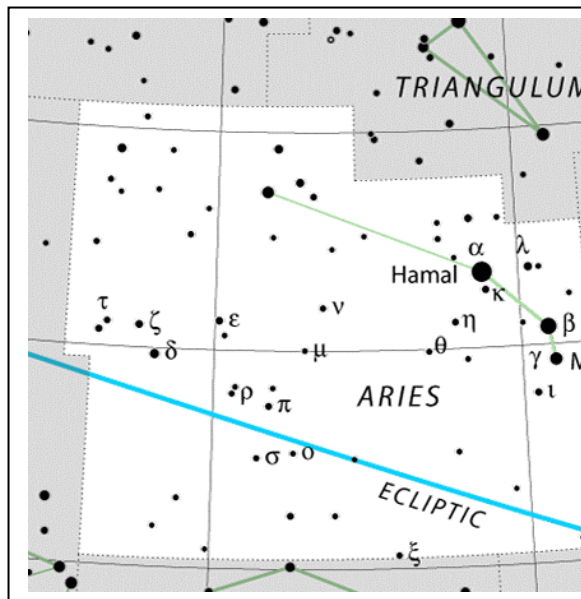
### Gamma ( $\gamma$ ) Arietis – Double Star in Aries by Glenn Chaple

I'm a double star aficionado; my sky gazing motto is "double stars are *twice* the fun!" Unlike the "faint fuzzies" most backyard astronomers prefer, double stars aren't hidden by light pollution or bright moonlight. They aren't the exclusive property of big-scope owners. In fact, many showpiece doubles are within reach of small-aperture instruments. The common 60mm refractor with its crisp stellar images delivers exquisite views of double stars - especially twin systems.

Case in point – gamma ( $\gamma$ ) Arietis, properly known as Mesartim. It's comprised of two stars, magnitudes 4.5 and 4.6, separated by 7.5 seconds of arc. Their spectral types – F9 and A1 - are also nearly identical. What you see when you gaze into the eyepiece are two gleaming pure-white specks, eerily evocative of the eyes of some cosmic creature gazing back. The sight is mesmerizing! Double stars are at their visual best when viewed with a magnifying power sufficient enough to allow for a comfortable split. Too little magnification, and the pair is unresolved; too much and the visual appeal is lost. In the case of gamma Arietis, you'll want to try 50-75X.



[www.astronomyhouston.org](http://www.astronomyhouston.org)



[www.constellation-guide.com](http://www.constellation-guide.com)

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**January *Star Fields* DEADLINE**  
**Noon, Sunday, December 23<sup>rd</sup>**  
**Email articles to the newsletter editor at**  
**[newsletter@atmob.org](mailto:newsletter@atmob.org)**

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**POSTMASTER NOTE: First Class Postage**

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**OBSERVING AND PUBLIC OUTREACH**

STAR PARTY COORDINATOR:  
Virginia Renehan [starparty@atmob.org](mailto:starparty@atmob.org)

**How to Find Us...**

**Web Page: <http://www.atmob.org>**

**MEETINGS:** Held the second Thursday of each month (September to July) at 8:00PM in the Phillips Auditorium, Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge MA. For INCLEMENT WEATHER CANCELLATION listen to WBZ (1030 AM)

**CLUBHOUSE: Latitude 42° 36.5' N Longitude 71° 29.8' W**

The ATMob Observatory and Clubhouse is open every Saturday from 7 p.m. to late evening. It is the white farmhouse on the grounds of MIT's Haystack Observatory in Westford, MA. Take Rt. 3 North from Rt. 128 or Rt. 495 to Exit 33 and proceed West on Rt. 40 for five miles. Turn right at the MIT Lincoln Lab, Haystack Observatory at the Groton town line. Proceed to the farmhouse on left side of the road. Clubhouse attendance varies with the weather. It is wise to call in advance: (978) 692-8708.

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