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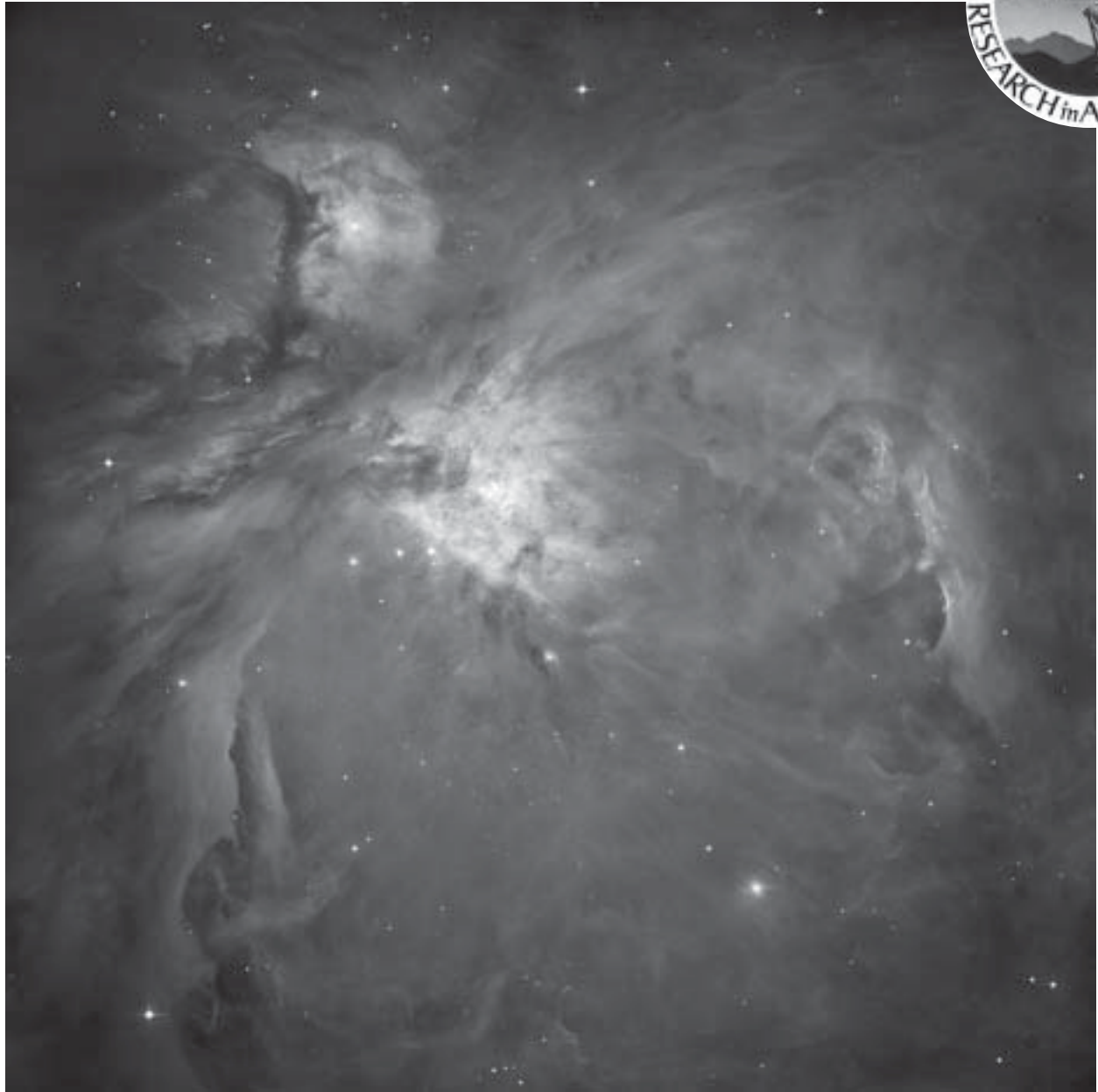
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# MIRA

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NEWSLETTER



## **M42, the Orion Nebula**

**The Star of The Winter Sky, p. 6**

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**Calendar of Events**

**Saturday, 10 January** The Bonestell Lecture: Dr. Edward F. Guinan of Villanova University on "The Once and Future Sun: The Impact of Solar Variations on Earth's Climate." **7:30pm, Monterey Peninsula College Lecture Forum 102.**

**Rebuilding MIRA Programs after the Fire**

**by Dr. Wm. Bruce Weaver**

We survived the summer fires. With the recent rains finally subduing the corrosive, wind-blown ash, we have been able to unwrap the telescope and instrumentation. Examination shows the delicate optics were successfully protected.

This was in the nick of time as one of the research programs calls for annual observations of hot shell stars in the Pleiades star cluster. These are stars that every forty years or so blow a shell of gas off of their surface. MIRA astronomers have detected a new shell event in one, and possible two, of the monitored stars. Missing a set of observations this year would have broken the multi-year series of observations needed to decode these fascinating events. Luckily, a window between bright moon time and rainy weather allowed these critical observations to be made on 11 November.

But there is a lot of work yet to do. Bulldozer damage to and around the Oliver Observing Station road has made the roads vulnerable to destruction by winter rains. Damaged gates have to be repaired. Our education programs, especially our summer high school intern program, on hiatus this year because of the fires, have to be reconstituted.

We are going to be very busy in 2009 rebuilding our education and research programs and bringing our recently renovated Bette M. And William R. Weaver Student Observatory telescope into full operation. We hope you'll be able to help by joining me in making an end-of-the-year donation to MIRA.



*This feature is inspired by the questions we have received over the years from interested readers. If you have a question about an astronomical topic, please send it to us.*

Vanessa Bredthauer asks, "How big is the Universe?"

Hi Vanessa,

The problem with discussing the size of the Universe is the question of when. Not only is it expanding but looking across it is looking back in time. Looking back in time means that its size THEN was very small. You cannot look at it now because you cannot move information faster than the speed of light. That is why astronomers don't talk about the size of the Universe, only the age. We can't measure it directly, which makes us observers a bit uncomfortable. However, using the Next Generation Space Telescope, we hope to be able to see far enough away/back in time to see when the Universe was opaque.

You cannot measure it but, if you assume certain models of the Universe, you can infer a minimum size in the not-realistic, but comfortingly familiar, concept of all of it now from some satellite microwave measurements and/or further modelling of it from its age, expansion rate, and some relativity considerations.

The current minimum size estimate seems to be a radius of about 24 gigaparsecs, which is about 78 billion light years radius or 156 billion light years across. The 'across' part is also a problem as it implies both edges and a center. The 'edge' is (at least) 24 gigaparsecs from us and would look like that for anyone, anywhere. The two dimensional equivalent is to think of yourself confined to the surface of an expanding balloon. No matter where you are on the balloon, there is a great circle distance around the balloon which is the same no matter where you are on the balloon.

Anyway, 48 gigaparsecs calculates out to about  $1.5 \times 10^{24}$  kilometers or 150000000000000000000000 km, if that number makes any sense to you. It doesn't to me.

Now in terms of the size of our galaxy, the visible part is about 50 kiloparsecs in diameter (the dark matter size is about four times that) so the size of the Universe is 500,000 times the size of the Galaxy. Or  $25 \times 10^{15}$  times the volume (assuming a spherical Galaxy).

I hope this helps some while not confusing you too much.

Thanks for the question.

## A Sad Fire Loss

by Dr. Wm. Bruce Weaver

There are many wonderful aspects of MIRA's corner of Chews Ridge. Many of those were damaged by the fire but will soon spring back to life and, from our past experience with fires, often in some new, but equally lovely, form.

The Basin Complex Fire, however, apparently has destroyed what I think is one of the most serene parts of our area. It appears that most of the tall pines directly below and to the west of the Oliver Observing Station were killed by the fourth and final run of fire toward the OOS. This area, which we've called 'the Meadow,' was populated with mature, Coulter-Jeffrey hybrid pine trees.

These trees were planted after a major fire in the area in



*Shrouded in Basin Complex Fire smoke, the smoldering remains of an ancient oak are surrounded by hundred-year old pines that are now showing that they too were destroyed by the fire. Photo by Bruce Weaver.*

the first decade of the 1900s, so they were probably over a hundred years old. They are not fertile—at least in our area—so they will not reproduce after this fire. In the few months after the fire, their needles are turning brown from the lower levels skyward. By spring, we'll know if a few survived. Intermixed with the pines are much older oaks, which are highly resistant to fire and, except for a few essentially dead ones, survived with no apparent problems.

The Meadow was always a favorite spot for me. Protected by the trees and topography, it was a quiet refuge from the noisily windy top of the ridge. The soporific tones of the breezes through the needles high above and the crunch of my footsteps on discarded needles below seemed the only sounds that could penetrate the magic. Like all good magic, the Meadow pervaded every sense: on hot, bright days, the light was filtered and the air was cool. But most subtle, yet most memorable, was the vanilla scent declaring the presence of the Jeffrey parent in the sticky drops of pine resin.

Unless man intervenes, these large trees will take their time falling and Nature's plan of succession will unfold for my grandchildren. I wonder what it will be.

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## Eclipse of the Century? Join the 2009 MIRA Eclipse Tour to China

MIRA is planning a tour to observe the total solar eclipse of 22 July, 2009, from China. The period of totality is nearly seven minutes long, making this eclipse potentially one of the most dramatic possible. The tour will last from 12 July to 23 July, and there is an optional extension to Tibet..

For more information, visit [www.mira.org](http://www.mira.org) (click on "Event Calendar"), call Tami at 883-1000, or e-mail [mira@mira.org](mailto:mira@mira.org).

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## Join the MIRA E-mail List

MIRA volunteer Clarissa Conn is preparing an e-mail list for announcements of lectures and other MIRA events. If you would like to be included, send an e-mail to [MIRA@redshift.com](mailto:MIRA@redshift.com)

# The Remediation of Light

by Dr. Wm. Bruce Weaver

*The Draft Environmental Impact Report on the latest proposed version of the Monterey County General Plan found that increased light pollution was inevitable in Monterey County and no remediation was possible. Here is MIRA's comment on that conclusion:*

This letter, in response to the request for comments on the DEIR for the 2007 Monterey County General Plan, describes an effective but overlooked mitigation available to the County to reduce the overall light and glare (Impact AES-4) during the buildout of the 2007 General Plan.



*Perseid Meteor above the Salinas Valley. Friend of MIRA Robin Casady captured this image of a 1999 Perseid meteor above the lights of the southern Salinas Valley from Chews Ridge. The star images above are streaked due to the time exposure. The light pollution in this direction is substantially worse today. How long before such a dramatic sight will be lost in a brighter blaze of wasted energy from unshielded night lighting?*

Light pollution, including trespass and glare, has a significant impact on most flora and fauna, including marine.<sup>1</sup> Birds, amphibians, and insects are especially vulnerable but both nocturnal and diurnal mammals are also strongly affected.

<sup>1</sup>See, for example, Rich, C. & Longcore, T. 2006. Ecological Consequences of Artificial Night Lighting. Island Press, Washington, USA. and references therein.

The view of the night sky, once thought to be an undeniable human heritage, is so rare that a recent survey of CSUMB students revealed that 90 percent had never seen the Milky Way! Students, and even their parents, visiting the MIRA Observing Station on Chews Ridge, are often surprised to see a dark night sky filled with stars, planets, and galaxies.

The Santa Lucia Mountains of Monterey County provide one of the last high-quality dark sites in the United States for optical astronomical observations. These conditions<sup>2</sup> drove the decision to locate the MIRA astronomical observatory in Monterey County in preference to any other location in the U.S. The quality of these conditions is now being reduced by the light pollution from the growth of the Monterey Peninsula, the Salinas area and, especially, because of its proximity, the Salinas Valley.

For example, MIRA, funded by a NASA grant, has been researching zodiacal light, the reflection of sunlight off interplanetary dust, in order to decode what it tells us of the evolution of our solar system. Zodiacal light was easily observed over the Salinas Valley from MIRA's Oliver Observing Station on Chews Ridge in 1986. This delicate cosmic feature is now swamped

<sup>2</sup>Walker, M. 1970. The California Site Survey. Publications of the Astronomical Society of the Pacific, 82, 672.

by uncontrolled lighting from the rapidly growing developments in the Salinas Valley and it is now unobservable from this site.

In response to our previous letter commenting on the 2006 DEIR, it was claimed that the towns along the Salinas valley were too far away to have a significant impact. This is completely incorrect. Professional astronomers, including those in Monterey County, routinely observe cosmic objects five million times fainter than can be detected with the unaided eye. In extreme cases, we observe objects 100 times fainter than the intrinsic brightness of the unpolluted night sky. Almost all of the central Salinas Valley, from the Indian Springs development to Greenfield, is less than 20 miles from the MIRA Observatory. By comparison, the separation between Kitt Peak National Observatory and Tucson, the light from which has had a serious impact on the scientific capabilities of the national observatory, is over 40 miles.

Light pollution can be greatly reduced simply through restricting lighting and views of the light sources to only those specific onsite areas requiring illumination (Land Use Element Policy LU-1.13). Unlike most forms of pollution where the reduction increases costs, the savings in energy use reduces operating costs.

*Of all the pollutions we face, light pollution is perhaps the most easily remedied. Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere and, often, immediate energy savings.*

V. Klinkenborg National Geographic Nov. 2008

Mitigation beyond the 2007 General Plan policies. Current light pollution levels can be substantially reduced by correcting current bad lighting practices during standard upgrades and maintenance. In a ten year period, Tucson, while enjoying substantial population growth, reduced its light pollution to one-third its initial level through such techniques. That is, contrary to the assertions of the DEIR, mitigation techniques can reduce the level of light pollution in Monterey County to half its current level while the population increases by 39% by year 2020. Detailed mitigation techniques are described at the web site for the International Dark Sky Association ([www.darksky.org](http://www.darksky.org)).

As a specific example, 40 percent of urban light pollution is caused by early-design street lamps such as the 'drop-lens cobra' luminaires that populate much of the County. During maintenance or replacement, they could be replaced with modern, full cut-off fixtures. An effective and low cost technique is to attach a shield, a standard accessory for these

street lights, during bulb replacement. This technique is credited as one of the most successful in reducing the Tucson light pollution. These shields are now standardly installed when a consumer complains about light glare or trespass at a residence. A County policy would extend that remedy to the general public. This technique alone would completely mitigate the light pollution increment due to the predicted population growth by the year 2020.

A comprehensive policy should address issues such as lighting types and levels, outdoor lighting after closing times, curfews for outdoor illuminated signs, etc. As possible detailed models, specific ordinances have been adopted in many cities and counties in the United States and abroad. In addition, astronomers at MIRA are available to work with the County to develop light pollution ordinances that would be tailored to Monterey's unique needs.

In summary:

- Increased light pollution in Monterey County will have a significant impact on flora, fauna, and the natural patrimony of its residents to view their place in our Galaxy and the Universe.
- Research and education at MIRA's Bernard M. Oliver Observing Station, located at one of the best sites for optical astronomy remaining in the continental United States, will be significantly impacted by increased light pollution in Monterey County. This will be especially true for light pollution from the Salinas Valley.
- Unlike other forms of pollution, the mitigation of light pollution in new developments saves money by reducing energy costs and, concomitantly, lowers the carbon footprint of the County.
- Techniques for substantial mitigation of light pollution in existing developments are well understood and relatively inexpensive.
- Simple shielding of existing lights and the use of approved fixtures for new lighting would lower the level of light pollution below its current levels even with the population increase expected by the year 2020.



# The Winter Sky

by Rod Norden

The cold and crisp winter evenings are great for observing, as the sun is setting very early giving us longer nights. The stars of winter, dominated by brilliant Orion, are well up in the sky all evening.

## Fixed Stars

For naked eye observers, the bright stars of Orion dominate the Southern sky. The three belt stars, Alnitak, Alnilam, and Mintaka (from east to west) are bracketed on the north by the red supergiant Betelgeuse and on the south by the very hot young blue supergiant, Rigel. Betelgeuse is one of the largest stars known at about 1000 times the size of the sun. Mintaka is located just 18 arc-minutes south of the celestial equator.

The constellation is surrounded by the **Orion Molecular Cloud Complex**, which lies between 1,500 and 1,600 light-years away and spans hundreds of light years. There are numerous parts of this complex that are visible with the naked eye, binoculars, and telescopes, and they are some of the very best deep sky objects. The complex contains emission nebulae, reflection nebulae, dark nebulae, and is one of the most active regions of star formation. It is easy to spend more than one evening looking for the objects that are possible to see in amateur-sized telescopes!

The best known and easiest to see is the **Orion Nebula (M42, NGC 1976)**. Located in the sword of Orion, it is visible to the naked eye in fairly dark skies, and is rewarding in any size of optical aid from binoculars to the largest telescopes you may access. It and the closely

associated region known as M43 make up one of the largest nebulae spanning more than one degree in the sky, about four times the size of the moon. This is one of the objects that excite both beginners and advanced observers. I remember my first view with my 3" Edmund reflector. I was even fortunate to get to see it in brilliant color in the 90" at KPNO when I was a student! Please consider purchasing a good nebular filter and spend some dark sky time carefully observing the Orion Nebula – it will be time well spent. Don't forget to note how many stars you can see in the Trapezium, a small asterism in the brightest part of M42 containing four bright stars and a few others down to 16th magnitude, which are visible in large observatory telescopes. Check a close-up chart for locations of all of its stars.



*It is easy to see how the Horsehead Nebula got its name. Image copyright Nigel Sharp (NOAO), KPNO, AURA, NSF.*

The **Horsehead Nebula**, also known as **Barnard 33**, while well seen in photographs, is one of the most difficult objects for most amateurs to see. It is obscuring the modestly bright, extended nebula **IC 434**, which extends south of the bright star Alnitak. Note that the Horsehead is just an extrusion of a large dark nebula covering one side of the complex. It is also much harder to see than one would expect from the photographs. It is 'easiest' to see if one

uses a Hydrogen-Beta filter to increase contrast between the emission and dark nebula, as well as a star chart showing the exact position of the indentation of the horse's head. I have seen it in a 7.1" refractor, but it is better to use a larger telescope at various magnifications. It was in this region that MIRA astronomers Bruce Weaver and Arthur Babcock discovered 38 newly-formed stars. Other astronomers have found several of the elusive brown dwarf stars in

this same star-formation region. While you are in the area, look for the small reflection nebula **NGC 2023** very near the Horsehead which shines in front of the dark nebula. On the other side of Alnitak, look for the brighter emission nebula **NGC 2024**. These three objects are often seen in wide area photographs of the Horsehead Nebula. North-east of Mintaka is the wonderful bright reflection nebula **M78**.

### Planets

**Mercury** reaches maximum evening elongation from the sun on 4 January, and reaches maximum morning elongation from the sun on 13 February. It is lost in the solar glare during March near Jupiter.

**Venus** will become much brighter to see in the evening sky reaching greatest elongation on 14 January. The crescent of Venus gets larger as Venus goes from greatest evening elongation toward inferior conjunction on 27 March, when Venus is farthest north of the sun since 1910. This gives us a very rare opportunity to see that large 55+ arc-second crescent with the naked eye on the same day in the evening after sunset and early the next morning if clouds spare us.

**Earth** is closest to the sun on 3 January. Perihelion occurs at 4:00 PM PST (0:00 UT on 4 January).

**Mars**, less than 4" in diameter, is lost in the solar glare from January to March. The plucky Mars Phoenix Lander finally froze in the oncoming Martian winter in November after making many discoveries.

**Jupiter** transits the meridian (directly south) near sunset in October, and gradually approaches the sun as the year progresses. In December, it will appear very close to Mercury, Venus and the moon.

**Saturn** is at opposition on 8 March. Note the rings are opening very slightly through the period as we approach ring plane crossing later in 2009. The inclination of the rings as seen from earth increases from 0.8 degree at New Year's to over one degree until the inclination lessens later in the spring, approaching an edge-on aspect on 10 August. The last ring plane crossing occurred in late 1995 and the rings were most steeply inclined in 2003.

**Uranus** and **Neptune** are lost in the solar glare from January to March.

**Pluto** reappears in the early morning before sunrise and will be much better placed for observation later in the warmer months of the year! Remember it is very faint and will require a good star chart to find.

### Meteor Showers

There is one major shower during the winter months and the moon is not going to interfere. On the early morning of 3 January, the **Quadrantids** will peak. The quarter moon will set at midnight and the maximum is due before dawn with the radiant in northern Boötes. The shower is named after the constellation Quadrans Muralis.

### Comets

There are a few interesting comets in the first months of 2009. **Comet C/2007 N3 (Lulin)** is predicted to begin the year in Libra at 6th magnitude in Libra and moves rapidly across the sky into Leo and Gemini in late March at 4th or 5th magnitude. **Comet 85P/Boethin** may reach 7th magnitude at New Year's in Pisces and fading rapidly through the period moving into Aries and Taurus toward conjunction with the sun. This comet may not live up to these expectations, as it has not yet been recovered and may be much fainter than expected or worse!

### Eclipses

There will be a penumbral lunar eclipse beginning at 4:37 am with middle eclipse at 6:38 am just before dawn on 9 February visible from Central Coastal California. It will be hard to see and not very interesting.

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## MIRA Director Visits the Second Grade



*"If the sun were the size of this small seed, how far would it be to the nearest star?" asks MIRA Director Bruce Weaver, who recently visited Ms. Bredthauer's second-grade class at the Bayview Elementary School in Monterey. The answer? "Across the Bay, in Santa Cruz." Photo courtesy Ms. Bredthauer.*

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## Friends of MIRA Membership

I would like to become a Friend of MIRA and receive the quarterly MIRA Newsletter.

Enclosed is my membership donation of \$\_\_\_\_\_

In addition, I am making a special contribution of \_\_\_\_\_

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The Monterey Institute for Research in Astronomy owns and operates the Richard W. Hamming Astronomy Center and the Ralph Knox Shops through an arrangement with the U.S. Dept. of Education.

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