THE

FLINT RIVER OBSERVER

NEWSLETTER OF THE FLINT RIVER ASTRONOMY CLUB

An Affiliate of the Astronomical League

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Club mailing address: 1212 Everee Inn Rd., Griffin, GA 30224. FRAC web site: www.flintriverastronomy.org.

Please notify **Bill Warren** promptly if you have a change of home address, telephone no. or e-mail address, or if you fail to receive your monthly *Observer* or quarterly *Reflector* from the A. L.

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Club Calendar. Fri.-Sat., Feb. 5-6: JKWMA observings (at dark); **Thurs., Feb. 11:** FRAC meeting (7:30 p.m. at The Garden in Griffin, with public lunar & planetary observing from 7-7:30 and again after the meeting).

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Vice President's Message. Our decision to cancel **Georgia Sky View 2016** was not easily made – but it was necessary, due to recent policy changes at The Rock Ranch. **Dwight** will discuss those changes at the Feb. meeting, and you'll see that we had no choice but to cancel the event. It's unfortunate, not only because Dwight put a lot of time and effort into organizing the event, but also because our members always have a good time at our star parties. They bring us together for an extended period of fellowship and fun that our meetings and club observings cannot duplicate.

We will explore other avenues for staging future **GSV**s, whether in the fall or next year, and whether at The Rock Ranch or elsewhere.

-Bill Warren

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Last Month's Meeting/Activities. Fifteen members – **David Haire; Carlos Flores; Dwight Harness; Tom Moore; Erik Erikson; Truman Boyle; Steven "Saratoga Smitty" Smith; Rose & Ken Olsen; Cynthia Anderson; Sarah & David O'Keeffe; Joe Auriemma; Wayne Gardner;** and **yr. editor** – attended our Jan. meeting. Everyone made it back safely from our visits to the edges of the observable universe and a quark inside a proton in a white blood cell in a human hand in the dvd *Powers of Ten*.

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This 'n That. Don't forget: your 2016 club dues are up for renewal in February. Make your $15 check payable to FRAC and give it to **Truman** at the Feb. meeting, or mail it to him c/o: Truman Boyle, 1219 Hwy. 36 East, Barnesville, GA 30204.

*As you'll see, there are no astrophotos in this issue of the *Observer*. And that's a shame, too, because there are so many beautiful things in the winter sky that **Felix** and **Alan** could have shown us.

Seriously, guys, how could you let a few minor challenges – clouds, wind, rain, flooding, sleet and snow -- stop you from dazzling us with your gorgeous astrophotographs? The least you could have done was send **yr. editor** a photo of the night sky and say, "Behind these clouds lies **Rosette Nebula (NGCs 2237-39),** one of the largest and most spectacular nebulas in the night sky. And right there, near the center of the photo where the cumulonimbus clouds are darkest, you'd find **NGC 2244**, the bright and beautiful open cluster that lights up the entire nebula."

But *No*, you didn't do that. Instead, you stayed inside – warm, dry, getting over bronchitis (Alan) and watching "WWE Wrestling," "Honey BooBoo," "The Bachelor," "Celebrity Wife Swapping" or other such nonsense. As a result, you and your clubmates will have to settle in this issue for reading stuff written by those brilliant wits – okay, half-wits – yr. editor and **Tom Moore**.

So this is your warning: Don't make us send over a couple of members next month to drag you and your telescopes outside, regardless of the weather. (If, that is, we can get them to miss "Duck Dynasty.")

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Upcoming Meetings/Activities. Our Joe Kurz deep-sky observings will be held on **Fri.-Sat., Feb. 5th-6th**. We'll let you know via e-mail which site we'll use.

Our club meeting and public lunar/planetary observings will be from 7-10 p.m. on **Thurs., Feb. 11th** at The Garden in Griffin. We'll hold our officer elections, and our program will be "The Winter Sky," part of the *Our Night Sky* dvd lecture series by **Prof. Edward M. Murphy** of the University of Virginia. This segment focuses on the constellations *Orion* and *Taurus.*

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People You Should Know: Tom Moore. Like **Truman Boyle**, last month's subject, **Tom Moore** is the kind of person that every club needs -- a willing, tireless and hard worker who gets things done in a hurry and is unfailingly loyal to the club and its leadership.

Since joining FRAC in Dec., 1997 with his daughter **Katie**, Tom has: served two different terms on FRAC's board of directors; served (with Katie) as club librarian (a now-defunct position, FRAC having dissolved its library); and for the past eight years he has served as FRAC's webmaster. This year, FRAC has nominated Tom for the A. L.'s "2016 Webmaster Award"; go to our website and you'll see why. It's a splendid website, and one of FRAC's proudest bragging points.

Oh, and by the way: it was Tom who came up with the name for our star party, **Georgia Sky View: A Stellar Experience**. *(He also proofreads the newsletter before sending it out every month. So if you find eny typeing or speling errors, blame Tom, not me! –Ed. [Tom's response: " The only mistakes I look for is whether Bill spells my name right."])*

Another of the valuable assets Tom brings to FRAC is his off-the-wall sense of humor. For example, Tom once offered this sage advice for lunar observers: "If you're using the side of a tree to steady your binoculars, the feature you're looking for may be hidden in the **Moon's** dark half. Move to the other side of the tree."

(For more of Tom's illuminating lunar insights, see p. 6. –Ed.)

Tom works as a something-or-other (actually, he's the general manager) at Diversified Fabricators, Inc. in Griffin. He and his wife **Cathy,** a retired schoolteacher, have two children – **Katie,** who is director of the science curriculum at the Smithsonian Institute in Washington, D.C.; and **Bill,** who works with the main office of United Bank in Griffin.

Tom says, "Since I now am using FRAC's 10-in. Dob, there's a better than 6% chance that I may finish the Lunar Program in the next five years." (He began working on it nineteen years ago, but says that he doesn't want to rush through it.)

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Calhoun's Corner: Supernova Remnants

by Aaron Calhoun

On July 4th, 1054 a.d., Chinese astronomers recorded the appearance of a bright new star in the sky. It was so bright that, for a month or two, it could be seen in the daytime. The star remained visible in the night sky for more than a year before it eventually faded from view. There is no record of Europeans seeing it (although they must have), but American Indians painted images of it on the walls of caves in two locations.

That "star" was actually the remnant of an exploding star. We know it today as **M1**, or **Crab Nebula**, in the constellation *Taurus*.

M1. Moving ahead seven centuries, in Sept., 1758 the French comet hunter **Charles Messier** discovered "a nebulosity above the southern horn of *Taurus*…It contains no star; it is a whitish light, elongated like the flame of a candle." Later, in compiling his famous list of "Messier objects," he wrote: "This nebula had such a resemblance to a comet, in its form and brightness, that I endeavored to find others, so that astronomers would not confuse these same nebulae with comets just beginning to shine." He named his discovery M1.

Crab Nebula. Eighty six years later, in 1848, the Scottish astronomer **William Parsons**, the third Earl of Rosse, aimed his 36-in. telescope at M1. Lord Rosse saw wispy filaments extending from the nebula's glow, and because they reminded him of a crab's legs he gave M1 the name Crab Nebula.

Supernova Remnants. M1 is an example of a special and very important kind of nebula called a *supernova remnant*.

When the red giant star exploded in 1054 a.d., it sent gases and dust ionized by the blast into space at $1/10^{th}$ the speed of light, or about 670 million miles an hour. That material has been racing through the vacuum of outer space ever since. Eventually, it will thin out until it can no longer be seen in our telescopes. But here's the stunning part:

If supernovas like M1 did not happen, we would not exist! The oxygen we breathe, the iron in our blood, the calcium in our bones and the carbon that comprises most of our bodies -- all of it came from an ancient supernova explosion!

"Elementary, My Dear Watson." All of the elements in the universe except hydrogen come from the stars. The early universe was composed almost entirely of hydrogen, so there is much more hydrogen than any other element. Hydrogen is the fuel that triggers star formation.

Stars become stars when they begin fusing hydrogen atoms into helium at their cores. Eventually, the star runs low on hydrogen, but gravity doesn't stop at that point. Like the Energizer bunny, it keeps on going, converting helium into carbon, then carbon into oxygen, and so on, creating progressively heavier elements until it reaches iron, which represents literally a dead end for the star. Iron cannot be fused into anything heavier, so the fusion process stops there and, if the star is a red giant, it goes supernova. (Other, less massive stars have other fates in store for them, but that's a subject for another time.) The explosion disperses the star's contents into space, including the elements that comprise organic life on Earth.

As the late **Carl Sagan** put it, "We are literally 'star stuff.'"

When astronomers talk about *metals*, they aren't referring to aluminum, copper, iron, etc.; in astronomy, all elements heavier than hydrogen and helium are metals. (You didn't know that you're breathing metals, did you? Oxygen and carbon are classified as metals.)

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I stand at night and gaze up at the sky,
A huge, inverted bowl above my head,
Upon its blue-black concave surface spread,
Unnumbered twinkling lights intrigue my eye…
Across their background glows the Milky Way,
The cradle-place of new-born stars untold,
Whose light shall shine adown eternity,
When those now bright have long been dark and cold.

-A. C. Holm
The Infinite Stars (1925)

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One night I went for a walk by the sea along the empty shore. It was not gay, but neither was it sad – it was – beautiful. The deep blue sky was flecked with clouds of a deeper blue than the fundamental blue of intense cobalt, and others a clearer blue, like the blue whiteness of the Milky Way. In the blue depth the stars were sparkling, greenish, yellow, white, rose, brighter, flashing more like jewels than they do at home, even in Paris: opals, you might call them, emeralds, lapis, rubies and sapphires.

-Vincent Van Gogh, in a letter to his brother **Theo** in 1888

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Star Questions

***When did the first stars and galaxies appear?**

Immediately after the Big Bang, the universe was small, dense, hot and composed of subatomic particles – protons, electrons and neutrons – and light. During the earliest stages of expansion, light didn't spread, it just bounced around between the hot particles like bumper cars. As the universe continued to expand, it eventually cooled down to about $4{,}500^{o}$, at which point the protons and electrons began to bond and form hydrogen atoms. For the first time light was able to travel throughout the expanding universe.

That early light is seen today in radio telescopes as the cosmic microwave background (CMB). It shows what the universe looked like just 380,000 years after the Big Bang: soupy clouds of hydrogen forming into clumps, as shown in differences in density within the CMB.

After 100 million years, those clumps of densely-packed hydrogen atoms became the first stars. And over the next billion years, those stars became gravitationally bound into galaxies.

***Okay, we know that stars form out of gases and dust – but *why* do they form? What starts the process?**

The gases and dust in a molecular cloud aren't evenly distributed. Shock waves from the explosion that produced them -- and radiation pressure from nearby stars – creates pockets of hydrogen and dust in the cloud. When enough material gathers and congeals to form a mass that generates its own gravity, it begins contracting inward, while continuing to draw additional gases and dust into itself. The process is similar to what happens in a black hole, only less powerfully (or else the young star-in-the-making, or *protostar,* would itself become a black hole).

As the protostar's mass grows and compresses, its gravity continues to increase, forming an incredibly dense core of hydrogen atoms. When the inward compression reaches the point where no more hydrogen can be squeezed into the core, a thermonuclear reaction occurs in which hydrogen atoms fuse into helium, releasing massive amounts of heat and energy in the process – and a star is born. That's how the **Sun** became a star, and that's what keeps it going: its relentlessly powerful gravity converting 600 million tons of hydrogen atoms into helium every second at the Sun's core.

***How do we know that black holes exist?**

They are the best way that astronomers can explain the bizarre effects that accompany a supernova explosion.

When, at the end of its existence, a red giant star explodes, it also implodes. Outwardly, the blast spews so much energy from the red giant's outer layers of gases into space that, for a short period, the supernova may outshine the rest of the galaxy it's in.

Inwardly, the collapse of the red giant's core is equally violent and dramatic. In the tiniest part of a second, the core – which may have spanned hundreds of millions of miles – implodes with a ferocity and speed that nothing else in the universe can match, creating a black hole -- the ultimate gravity-powered vacuum cleaner. The gravitation within a black hole is so intense that anything – whether it be an atom, a star, a galaxy, light or even dark matter – that passes beyond the black hole's *event horizon*, or outer boundary, instantly becomes a permanent part of the black hole's mass.

Astronomers can't see that happening, of course – but they can detect and measure the effects of disturbances near the event horizon. In the **Milky Way**, for example, scientists have found stars revolving so rapidly at the center of the galaxy's core that nothing else but a black hole can explain their abnormal revolution rate.

Consider a sink full of water. When you pull the plug, initially you can't see the water going down the drain. Eventually, though, you see the water swirling rapidly as it nears the drain and sinks into it.

You can't see the water after it enters the drain, of course – by then it's gone from your view forever -- but you can see gravity's effect on the water as it swirls around and down the drain. If the drain were invisible, you'd still see the water reacting to its presence. That's how a black hole works, although on an infinitely more powerful level.

Observing Questions

***In writing or talking about observing, you often mention the term "resolved stars." What are resolved stars?**

Resolved stars are those that your eyes, binoculars or telescope can detect as individual points of light in the night sky.

Telescopically, at least, most open clusters can be fully resolved into their individual stars; none of the galaxies can. But some globular clusters show hundreds or thousands of individual stars around a tightly packed core of unresolved stars. And some globulars are so far away that the entire cluster is unresolved, appearing in our telescopes as a small circle of grayish light.

Many double stars such as **Albireo (Beta Cygni)** are far enough apart telescopically for us to resolve, or "split," them into two stars. Others are closer together, and therefore more difficult to split.

Perhaps the best-known double or multiple star resolving challenge is **Epsilon Lyrae,** the **"Double-Double."** To the naked eye, the Double-Double is a 4^{th}-mag. star forming an equilateral triangle with **Vega** and another nearby star. But in binoculars or a low-power telescopic field of view, Epsilon becomes two white stars of equal brightness. Switch to high magnification, and the double star becomes *four* stars – a pair of very close double stars. You'll have to take your time and look closely to split them, though: each pair is less than 3 arc-seconds apart. On many occasions, I've been able to resolve only one of them, with the other, closer pair remaining unresolved and seen as a single elongated star. And on nights of poor transparency and seeing, I can't split either of them into individual stars.

***What are transparency and seeing, and how are they measured?**

They are terms used to express the visual quality of the sky.

Transparency refers to how clear the sky is, as shown by the faintest star you can see naked-eye.

After locating that star, I use my **Seasonal Star Charts** atlas to find out its magnitude, which is shown as a whole number by the star. Half-magnitudes (e.g., 4.5) are shown by a line under the number (e.g., <u>4</u>).

The higher the magnitude of that faintest star you can see, the better the transparency is. For example, if you can see stars as faint as 6^{th} magnitude – which happens occasionally at JKWMA – you'll also be able to see all of the mag. 5, 4, 3, 2, 1, 0 and negative magnitude stars – about 2,000 stars at any given time. But if the brightest star you can see is mag. 2, you'll see only about a dozen stars. All you'll see in your telescope under mag. 2 skies is the very brightest objects in the sky.

Seeing, on the other hand, refers to the relative stillness of the atmosphere. Stars twinkle when the air between us and the star is moving. They usually twinkle more near the horizon because there is more air for their light to penetrate in order to reach us than when they're overhead. The more turbulence in the air, the more stars will twinkle and the hazier images will be of anything you see.

I use my telescope to estimate seeing. After centering a bright star in the field of view, I de-focus the star until it becomes a large black circle with spikes radiating out from it on all sides. The larger and faster the spikes tremble, the poorer the seeing is. I use a scale of 1-5 to estimate seeing conditions: **5** is *perfect seeing* (i.e., no movement at all); **4** is *good seeing* (small tremors with periods of calm between them); **3** is *average seeing* (constant small but weak tremors); **2** is *poor seeing* (constant large spiking); and **1** is *terrible seeing* (frenzied large and small spiking, like a sparkler).

If that sounds like a complicated grading system, think of the way we were graded in school: **A, B, C, D** and **F**. If the seeing is 2 or 1 (D or F), I won't bother to observe further, because everything I see will be hazy and indistinct.

But what do you do if you don't have a telescope to help you estimate the seeing? **Anthony Kroes** (Master Observer #15) told me, "I estimate naked-eye seeing based on how high up in the sky from the horizon the stars are noticeably unsteady and twinkling. On a perfect night (seeing: 5), stars are steady even down near the horizon; on a really bad night (seeing: 1), the stars are twinkling all the way up to the zenith overhead. 4, 3 and 2 are varying degrees in between. It's not an exact science, but nothing based on the observer's opinion ever is."

Many of the A. L.'s observing programs ask for estimates of transparency and seeing. However you estimate them, though, the A. L. and FRAC doesn't expect accuracy. All they (and we) want is for you to understand why deep-sky objects, etc., sometimes are hard to see clearly on what appears to be a clear evening.

***What are GoTo and PushTo?**

They are computerized devices which, when mounted on a telescope, permit the user to find objects in the night sky quickly and efficiently. Both of them involve keypads in which you punch in the object's name (e.g., **Saturn** or **M31**) in order to locate the object.

PushTo is manually operated (i.e., you push the telescope tube vertically or horizontally), and numbers on the keypad show you whether you're moving the tube in the right direction. The numbers constantly change as you move the tube, and when both numbers reach zero you've located the object.

Orion Telescopes sells an 8-in. **Dobsonian SkyQuest XT8i Intelliscope** with a PushTo Object Locator for $659.99.

GoTo is even simpler, since the telescope does all the work. (The electronics are built into the telescope's motorized mount.) When you punch in the object's name, the telescope slews to the object and centers it in your field of view.

Small GoTo 'scopes is where astronomy is presently headed, at least at the entry level. Orion sells its **Star Seeker IV** 80mm (3-1/4") GoTo refractor for $499.99, and its **Star Seeker IV** 114mm (4-1/2") reflector for $449.99.

If you want the best of two worlds – the simplicity of PushTo or GoTo combined with the larger, brighter images that a larger aperture 'scope affords -- you can expect a significantly higher price tag. Orion sells one 10-in. PushTo Dob for $849.99; everything else that size or larger – including all of their large GoTos – sell for upwards of $1,000.

Still…If your budget is limited and you're willing to learn how to find objects yourself without computerized assistance, you can buy a basic 6-, 8- or 10-in. Dob for much less than a PushTo or GoTo 'scope of the same size would cost you. Orion's **XT Classic Series** offers a basic 6-in. Dob for $309.99, an 8-in. for $389.99, and a 10-in. for $629.99.

We've said it before, but it bears repeating: If you're new to astronomy, don't buy a telescope or accessories until you know exactly what you want, need and can afford. If you're unsure, your fellow club members can help you decide what is best for you by showing you what they use and/or suggesting inexpensive alternatives.

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The colorful bands (in **Jupiter's** outermost layer of atmosphere) result from upwelling materials that change color when they encounter the ultraviolet rays of the **Sun**, producing the dark bands, or "belts" that we see. The lighter bands, or "zones," are clouds of crystallized ammonia carried upward.

-**James Trefil**
Beyond Our Galaxy: Exploring the Vastness of Space (National Geographic, 2014, p. 34)

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Tom Moore: Mooning the Night Sky

Tom Moore is a man of many talents, most notably the ability to come up with good excuses for not completing the Lunar Program that he began working on in 1997. Tom has more prepared alibis than a Mafia hit man.

Apparently, Tom has trouble finding the **Moon** because it moves around so much. Still, as he says, "I can find it pretty easy in a photograph."

Hey, Tom, we'll give you a photo of a Lunar pin.

Here are fifteen of Tom's most creative excuses over the years for not getting his Lunar pin:

15. I wouldn't know a crater from a hole in the ground.

14. Every month there's a New Moon and I have to start over.

13. There's a tree in my yard, and when I stand behind it I can't see the Moon. Sometimes I have to wait several hours for it to reappear.

12. I can't pronounce the crater **Eratosthenes.**

11. My binoculars are out of focus. And they don't have a strap. And sometimes I forget to take off the lens caps.

10. I don't have a Moon filter for my telescope, and **Katie** says I look ridiculous wearing sunglasses at night. *(His wife **Cathy** says he looks ridiculous the rest of the time, too. –Ed.)*

9. The dog ate my lunar observing form.

8. You won't let me describe all 100 features as "something brown, gray, black or white."

7. The Full Moon looks like a pizza, and pizza gives me heartburn.

6. The dog ate my lunar map.

5. I keep one eye closed when I'm looking through my telescope. Sometimes I close the wrong one. And sometimes when I'm sleepy, I close both eyes.

4. I saw the Moon this time last month, and nothing has changed. Why do they call it a New Moon if it's just the same as the old one?

3. The dog ate my telescope.

2. I can't get Cathy or Katie to set up the telescope for me.

And the #1 reason why Tom hasn't earned his Lunar pin:

1. At our observings, **Bill** uses my telescope tube for an ashtray, and at home the birds use it as a Port-A-Potty.

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If a man would be alone, let him look at the stars. The rays that come from those heavenly worlds will separate between him and what he touches…But every night come out those envoys of beauty, and light the universe with their admonishing smile.

-**Ralph Waldo Emerson**
Nature (1886)

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