

THE FLINT RIVER OBSERVER

NEWSLETTER OF THE FLINT
RIVER ASTRONOMY CLUB

An Affiliate of the Astronomical League

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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., June 3-4: JKWMA observings (Site #1, at dark); **Thurs., June 9:** FRAC meeting and lunar/planetary observings (7-10 p.m., The Garden).

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President's Message. I don't usually mention events that are two months away, but this is an important exception.

Over the years, FRAC has had about 300 individual members and families; most of them are no longer in the club. In fact, of the eighteen people

who attended the first club meeting in 1997, only five are still in FRAC: co-founders **Larry Higgins**, **Ken Walburn** and **Bill Warren**, and charter members **Steven "Saratoga Smitty" Smith** and **John Wallace**.

Two things occurred to me recently.

First, many of you have never met the men who started FRAC and kept it going when no one outside the club thought it would survive. To borrow from **Sir Isaac Newton's** famous statement, Larry, Ken, Bill, Smitty and John are the giants upon whose shoulders FRAC stands today.

The second thing that occurred to me was, I can't recall ever seeing them together at one time.

Well, all of them will be at the July club meeting. Our program will be "1997: FRAC's First Year," with refreshments afterward. So mark down **Thursday, July 14th** as a special day on your calendar and please try to attend. It will be a night to remember.

-**Dwight Harness**

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Last Month's Meeting/Activities. As anyone who has been in FRAC for longer than 15 minutes knows, our observing mantra has always been, *Do the best you can with what you have*. Case in point: our May JKWMA observings. Overhead, the sky was clear both nights, but down to earth all of the observing sites were knee-deep in weeds. So instead of setting up our 'scopes in the field, we parked beside the driving path at Site #1 and set up on the other side of the path where the weeds weren't high.

Friday evening was highlighted by satellites and fireballs. **Dwight Harness**, **Steve Hollander** and **yr. editor** saw a half-dozen satellites pass overhead during the evening – including two going N-S and S-N at the same time—and Dwight saw three fireballs. As usual, yr. editor was looking in the wrong direction every time and didn't see any of them. (At meteor shower observings, Dwight always tells people, "Forget about facing the radiant or the darkest part of the sky; if you want to see meteors, sit facing Bill.")

Saturday brought more satellites, and two more fireballs (unseen by Bill, of course): they were remnants of the **Eta Aquarids meteor shower**, dropping by to say hello to Dwight, yr. editor, **Aaron Calhoun** and **Erik Erikson**. We observed such treasures as: the shrimp-shaped interacting

galaxies **NGC 4038-4039 (the Ring-Tailed Galaxy, or Antennae)** in *Corvus*; **M101 (Pinwheel Galaxy)** in *Ursa Major*; **NGC 5128 (Centaurus A, or the Hamburger Galaxy)**; and **the Great Cluster (M13)** in *Hercules*. But the evening's observing highlight was **NGC 5139 (Omega Centauri)**. The observing conditions were excellent, and the sky's largest and brightest globular cluster was an easy find in both binoculars and telescopes, floating 10° above the S horizon. In binoculars, it looked very much like the telescopic view of the bright compact globular cluster **M80** in *Scorpius*.

Seven FRACsters – **Dwight Harness, Aaron Calhoun, Cynthia Armstrong, Steve Hollander, Kenneth Olson, Wayne Gardner** and yr. editor – conducted a **Mercury** solar transit observing for a “Friends of The Garden” luncheon on May 8th.

That same day, **Andy Hasluem** and a friend conducted a transit observing outside the Turner/CNN building in downtown Atlanta. About 250 people showed up, and Andy reports that the sky remained clear throughout.

Stephen Ramsden was at an elementary school for the event. But of course he would be: the world's most prolific solar observer and spokesman is always somewhere sharing his love for the **Sun** with schoolchildren or others.

A sparse crowd attended our May meeting on a rainy evening: **Dwight Harness; Tom Moore; Steve Hollander; Cynthia Armstrong** and a guest; yr. editor; and speaker **Carlos Flores**, who gave a powerpoint presentation of his recent trip to the Northeast Astronomy Forum 2016 convention and astronomy products expo. The turnout was disappointing, but Carlos's talk was excellent.

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This 'n That. Murphy's Law. During the Mercury transit observing at The Garden, **Aaron Calhoun** announced that the International Space Station would cross the **Sun's** face in about fifteen minutes. Since the odds of having those two bodies transiting the Sun at the same time are somewhere between slim and nonexistent, we were excited at the prospect of seeing a double solar transit. Mercury transits are rare, but they last for hours; I.S.S. transits aren't exactly rare -- but they aren't common, either, and they are over in less than a second.

Enter **Mr. Murphy**.

Ask yourself: *What could possibly go wrong?*

You guessed it: Fifteen minutes after Aaron's announcement you couldn't have squeezed one more cloud into the sky near the Sun.

Here's what it looked like, courtesy of NASA's “Astronomy Picture of the Day” of May 13th:



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Upcoming Meetings/Activities. We'll hold our club observings at JKWMA Site #1 on **Fri.-Sat., June 3rd-4th**. **New Moon** is on the 4th.

Our club meeting and public lunar/planetary observings will be held at The Garden in Griffin from 7-10 p.m. on **Thurs., June 9th**. The meeting will begin at 7:30 p.m., with observing before and after the meeting. The program will be “Seeing and Navigating the Sky” from the *The Night Sky* dvd.

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Sailors I've Met Through Astronomy reflections by Steven “Saratoga Smitty” Smith

I was a Machinist Mate in the Navy. We operated the main engines that turned the propellers of the ship I was on, the *U. S. S. Saratoga*.

On a Facebook group for us Machinist Mates, I ran across a guy named **Joe Poniowski**. I asked him if he knew about the “Bull” in astronomy that bears his name and resembles the constellation *Taurus*, only smaller. He didn't know about it, so I filled him in. (*See below. –Ed.*)

It's strange, but through astronomy I've met other sailors, including the captain of a ship. I also met the present-day **Earl of Rosse** when he visited the Atlanta Astronomy Club.

In 1884, **Charles Parsons**, the youngest son of Ireland's third Earl of Rosse, designed and built the first practical steam turbine engine for shipboard use. It ran circles around the steam piston engine-

powered ships then in use. Well, that's what the Navy trained me to do: operate a huge 70,000 h.p. steam turbine engine.

It amazes me, the kinship I feel every time I encounter folks like these through astronomy.

(Editor's Note: Once regarded as a constellation, the "Bull of Poniatowski" is a miniature version of the V-shaped asterism called the Hyades that forms the face of Taurus, the Bull. It is located in northeastern Ophiuchus, and was named Taurus Poniatovii in honor of the Polish king Stanislaus Poniatowski, who reigned from 1764-1795. It is no longer a constellation.

William Parsons, the third Earl of Rosse, was a very important figure in 17th century astronomy. He built "the "Leviathan of Parsonstown," a huge reflecting telescope that weighed four tons and was 58 ft. in length, with a 6-ft. mirror. It took three years to build, and for 72 years the "Leviathan" was the largest telescope in the world. With it, Lord Rosse became the first person to see the spiral shape of the "nebulae" that are now known to be galaxies. His detailed drawings of those "nebulae" still exist; they are kept at the present Lord Rosse's estate in Birr, Ireland.

William Parsons made all of the tools and machinery he used to build his telescope, including the furnace in which the metal (speculum) mirror was cast and the steam engine with which he carefully shaped and polished it.)

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Questions Over the Years **article by Bill Warren**

Here are three questions I've been asked by FRAC members over the years. I've written about the first one before, so I tried to make it fresh this time around.

As for the other two... Well, I didn't know much about them when I was starting out, but I do now. So will you.

Question #1: *Have any humans ever been killed by a comet or asteroid impact?*

Answer: Probably. No one knows for sure. There have never been any verified human fatalities, although a few years ago a dog was struck and killed by a small meteorite.

*An obscure manuscript published in Italy in 1677 mentioned an unnamed friar in Milan who

allegedly was killed by a rock that fell from the sky. No details were given, so most scientists discount it.

*Until 1703, few people believed that extraterrestrial rocks fell to Earth. On June 30th of that year, however, hundreds of townspeople in L'Aigle, France witnessed a shower of rocks falling from a clear sky overhead. No one was hit, and the townspeople gathered up as many of the rocks as they could find. Subsequent investigation of the event by French scientists left no doubt that the rocks had come from somewhere beyond Earth. As **Sherlock Holmes** noted, *When you have eliminated all other possibilities, whatever remains, however unlikely, must be the truth.*

*On Nov. 30, 1954 a Sylacauga, AL woman named **Ann Hodges** was severely bruised but not otherwise injured when a grapefruit-sized meteorite crashed through her living room roof, bounced off a radio and struck her left hip. (Want to see what it looks like to get hit by a meteorite? Google "Ann Hodges meteorite".) That meteorite eventually sold for \$100,000.

*In 1992, a tiny meteorite, its force dissipated by a large tree in its path, struck a young boy in Uganda but did not injure him.

*On Feb. 15, 2013, more than 1,500 residents of Chelyabinsk, Russia were injured by glass fragments when a 100-yd.-wide asteroid exploded high above the city. Its concussive blast shattered windows in the area, but no one was struck by meteorite fragments, and no one died.

*Probably the most likely candidate for human fatalities was the famous "Tunguska Event" of 1908.

Just after dawn on June 30, 1908, a 220-million-lb. space rock – probably an asteroid – exploded at an altitude of more than five miles above a remote region in Siberia near the Stony Tunguska River. The blast, which was 185 times more powerful than the atomic bomb that leveled Hiroshima in 1945, was felt 500 mi. away. It flattened 80 million trees over an 830 sq. mi. area. Several reindeer herders in the area lost their entire herds, but there were no reports of human loss of life. It's safe to assume, though, that a blast that was powerful enough to scorch one survivor's clothing and throw another man off his front porch *40 miles from ground zero* would have killed anyone much closer to the blast site than that.

There are several reasons why no one knows if any human deaths resulted from that explosion. Only a few thousand people lived in the vast and

largely unexplored Tungus region of Siberia. There were no roads connecting the few trading posts with the outside world; aside from hunting, inhabitants used the river to travel from one place to another. The area was so isolated, and the terrain so difficult to navigate on foot, that it wasn't until 19 years later that, after two earlier failed attempts, a scientific expedition was able to reach ground zero. They knew they had reached it when, after weeks of slogging their way through unforgiving marshes, peat bogs and destroyed forests, laboriously hauling their equipment and supplies by hand and battling hordes of mosquitoes all the way, they found limbless, burned trees standing upright like blackened telephone poles. Those trees were directly below where the blast had occurred. For 25 miles in every direction, uprooted pine trees were lying with their roots pointing toward the epicenter.



Tunguska in 1927, 19 years after the explosion. The photo was taken a few miles from the epicenter. Note the sparsity of new growth.

When scientists from Moscow finally reached the site in 1927, few residents in the area would talk to them about the explosion. They believed it was caused by their god, Ogdy, and by talking to outsiders about it they might anger Ogdy into doing it again. One of the few men willing to talk to the scientists said, "The fire came by, and there was a very loud bang. The whole northern sky was filled with fire. There was a rumbling noise like rocks falling or distant cannons, and the earth shook beneath my feet." (It wasn't rocks falling, though: to this day, no one has ever recovered any meteorites from the Tunguska asteroid.)

Question #2: *Why do red giant stars like Betelgeuse go supernova, and what happens to them after that?*

Answer: Stars of more than 9-10 solar masses grow into red giants in old age because nuclear fusion at their cores does not stop when they run out of hydrogen atoms to fuse into helium. The process continues as helium converts into other, progressively heavier elements such as lithium, beryllium, carbon, neon, oxygen, silicon, and eventually iron. Every step in the process re-ignites the star's core and expands its outer layers, until the star reaches red giant proportions of hundreds of millions of miles in diameter. (It is red because it is old and does not burn with the intensity of a hot young blue star.)

The nuclear fusion process within the red giant stops with iron, but gravity, like the Energizer bunny, keeps on going. Iron does not release energy, it absorbs it. So the iron core contracts even faster than before, increasing its density and temperature. When the temperature reaches 5 billion Kelvins – and folks, that's literally as hot as Hades! – the star goes supernova, releasing in a split second nearly four times as much energy as our **Sun** has produced in its entire 4.5-billion-year existence. You don't want to be anywhere nearby when a star goes supernova! (Betelgeuse, the nearest red giant star, is 640 light-years away, so we're out of the danger zone.)

As for the other part of the question: If the red giant's collapsed core is less than about 2-1/4 solar masses, its gravitational collapse will end when all of its remaining protons and electrons have been crushed into neutrons. The compressed core will be a *neutron star* about 12 mi. in diameter. Four neutron stars would fit comfortably inside the metropolitan Atlanta area.

Because they are so tiny, neutron stars rotate extremely rapidly. In Feb., 2016, the neutron star **XTE J1739-285** in the constellation *Ophiuchus* was found to be spinning 1,122 times per second! (By comparison, the Sun rotates on its axis once every 25 days.)

Neutron stars emit radiation from their magnetic poles. That radiation can be detected by x-ray, infrared and visual means. When a neutron star's magnetic poles and axis of rotation are aligned, the radiation emission is constant.

In some cases, however, a neutron star's magnetic poles are not aligned with its axis, producing an effect like a lighthouse beam sweeping the sky in periodic bursts, although much more rapidly than that. Such stars are known as *pulsars* because their radiation appears to "pulse" in

our direction as they rotate. The pulsar at the center of **Crab Nebula (M1)** flashes on and off about 33 times per second.

*(An interesting side note: While studying radio wave sources in the sky in 1967, researchers **Anthony Hewish** and **Jocelyn Bell** discovered rhythmic radio pulses emanating from a certain point in the sky every 1.33 seconds. That source was a pulsar, although pulsars were unknown at the time. Hewish and Bell thought they were receiving an alien transmission.*

Speaking of which...A few years ago, SETI [Search for Extraterrestrial Intelligence] researchers in Australia were convinced that they were receiving alien transmissions when, around noon every day, they received strong radio signals from an unidentified source. Their excitement evaporated when they discovered that workers were using the microwave oven in the basement to heat their lunches.)

One more thing about the ultimate fate of red giants that have gone supernova: If the neutron star is more than 2-1/4 solar masses, gravity will crush it until it becomes a black hole.

Question #3: I recently read about a star – I forget which one – whose distance from Earth was given in parsecs, not light-years. What is a parsec? How is it different from a light-year? And why is it used?

Answer: A parsec is a unit of length that astronomers use to measure the distance to objects that lie beyond the solar system. It is an abbreviation of the terms *parallax* and *arc-second*. The term *parsec* apparently was coined by a British astronomer, **Herbert Hall Turner**, in 1913, although some sources cite another Englishman, **Sir Frank Dyson**.

Technically, one parsec is the distance to an imaginary star whose apparent movement, or parallax, measures one arc-second when viewed from one side of Earth's orbit and then the other side. One parsec equals 3.26 light-years, but all stars except the **Sun** are farther away than that. The nearest star, **Proxima Centauri**, is 1.3 parsecs away; that translates into 4.24 light-years.

Astronomers use parsecs in referring to or measuring stellar distances because it simplifies the geometry involved. But to understand the process, you need to know more about parallax and arc-seconds. (We'll skip the geometry.)

Parallax. Parallax is the apparent change in an object's position when viewed from two different angles. For example, hold your fist at arm's length in front of you with your thumb up. Close one eye. Then, without moving your fist, close that eye and open the other one. Your thumb will appear to have moved a couple of inches. If you blink repeatedly between one eye and the other, your thumb will appear to jump back and forth against the background.

Has your thumb moved? No. The only thing that has changed is your viewing angle, or line of sight. The distance that your thumb appears to move is parallax, and the angle created by that apparent movement is, not surprisingly, known as *parallax angle*.

If you measure the parallax angle created by your thumb's apparent movement and the distance between your pupils, you can figure out how far away your thumb is. And while that measurement is unimportant, the same principle can be applied on a larger scale to distant stars and galaxies as seen from both sides of Earth's orbit.

Arc-seconds. An arc-second is a measure of distance, not time. One degree equals 60 arc-minutes, and one arc-minute equals 60 arc-seconds. There are 360° in the celestial sphere, so an arc-second is a very small part of the sky. (To give you an idea of how tiny it is, the two components of the famous double star **Zeta Ursae Majoris** – we know them as **Mizar** and **Alcor** – are 14.4 arc-seconds [written: 14.4"] apart. They are so close that, in many ancient cultures, the ability to see them as two separate stars was a test of one's visual sharpness.) But the apparent movement of stars and galaxies is extremely small, too.

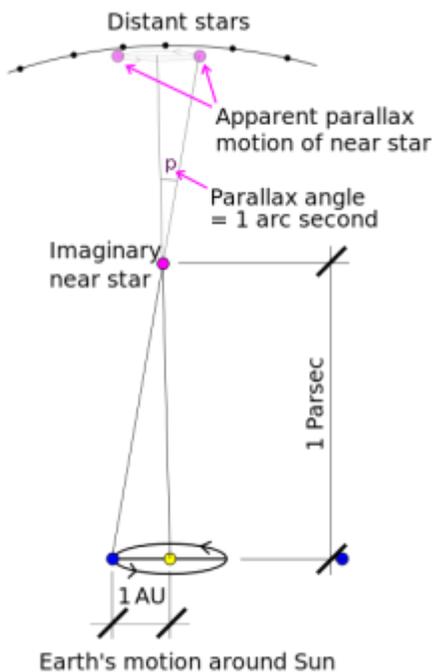
Of course, stars and galaxies are actually moving in space, too. Due to their vast distances from us, though, it takes years to detect that movement (which is referred to as *proper motion*, to distinguish it from parallax). Movements toward or away from us are determined by spectroscopic analysis. But those are subjects for another time.

Early astronomers were aware of the concept of parallax, but they didn't apply it to the sky around them. The invention of the telescope offered proof of **Copernicus's** heliocentric theory, however, and parallax took on new importance.

Measuring Parallax. As everyone knows, it takes one year for Earth to complete one orbit of the Sun. In the 1830s, astronomers noticed that, whenever they observed a nearby (i.e., bright) star

and then observed it again six months later from the other side of Earth's orbit, it appeared to have moved slightly against the background of more distant, fainter stars. It wasn't the star that had moved, of course, but Earth's location in its solar orbit. Astronomers soon realized that a star's apparent movement, or parallax, could be measured in arc-seconds to determine how far away the star was. The parallax angle, combined with the size of Earth's orbit – 186 million miles – lets astronomers calculate the distance to the star in parsecs by a process called *triangulation*, as shown in the diagram.

The German astronomer **Friedrich Bessel** was the first to measure stellar parallax. In 1838, he announced that the star **61 Cygni** had a parallax angle of 0.314 arc-seconds, which indicated that 61 Cygni was 10.4 light-years away. (Current measurements have shown that the star is actually 11.36 light-years away, so Bessel's parallax measurement was wrong. But no one knew it at the time, and he was wrong by less than 10%.)



Since nearby objects have a larger apparent movement than more distant objects, parallax measurements once had limited value. Astronomers traditionally used parallax to measure the distance to nearby stars (e.g., stars in the **Large** and **Small Magellanic Clouds** or any bright star in the **Milky Way**); however, using space telescopes such as *Hipparcos* has allowed them to apply parallax to more distant objects.

Back to Parsecs. Using parsecs as a yardstick for measuring stellar distances makes it quick and easy for astronomers to calculate nearby stellar distances. For objects that are farther away, they use multiples of parsecs: for distant stars in the Milky Way, they express distances in *kiloparsecs*; for distant galaxies, *megaparsecs*; and for the most distant observable galaxies and quasars, *gigaparsecs*.

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Above: M87, a giant elliptical galaxy in *Virgo*. Photo by **Alan Pryor**. Not only is **M87** four times larger than the **Milky Way**, but its core is 300 times more densely concentrated with stars than other elliptical galaxies. M87 lies 16.4 megaparsecs – that's 54 million light-years – away. It's located near the center of the **Virgo Supergalaxy Cluster**.

Extending from the galaxy at a ten o'clock angle in Alan's photo is a small, faint blue jet of hot gases emanating from the vicinity of a black hole at M87's core. Weighing in at 6.6 billion solar masses, it's the largest black hole known. The gases are charged particles that have been flung out from near the black hole's event horizon, where vast amounts of material have accumulated and are interacting furiously. That material eventually becomes part of either the black hole or the gas jet.

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