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. Thurs., Oct. 8: Lunar and planetary observing/club meeting (7-10 p.m., The Garden in Griffin); **Fri.-Sat., Oct. 9-10**: JKWMA observings (Site #3, at dark).

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President's Message. Over the past three or four months, I've noticed a very positive development in FRAC: a growing sense of pride in what we've accomplished, and determination to keep on building toward an even brighter future. **Bill** wanted to give me the credit for it in last month's *Observer*, but it goes a lot deeper than that. It's a "What-can-I-do-to-help-out?" attitude that has spread throughout the club.

I joined FRAC in November, 2007, and I've never seen so many members wanting to become involved in our activities. We've asked for your help on several occasions lately, and you've responded every time – not just by showing up, but by pitching in and working in whatever capacity you're needed.

Here's an example: we asked you to come to The Garden on Sun., Sept. 13th for our solar observing. Your response was overwhelming: *eighteen* of you showed up – that was more people than attended our meeting the night before! There was a huge crowd of visitors attending the "Art in the Garden" affair, and we gave them something to remember long after the gates closed.

So thanks, FRAC faithful, for answering the call. It was the best public observing I've ever attended, and one that I won't forget.

-Dwight Harness

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Last Month's Meeting/Activities. Re our JKWMA observing on Sept. 11th: as the '60s folksinger **Judy Collins** put it, "So many things I could have done/But clouds got in my way." **Dwight Harness, Jeremy Milligan, Erik Erikson, Aaron Calhoun** and **yr. editor --** waited until 11 p.m. for the clouds to pass, but they never did. Like party guests who don't know when it's time to leave, the clouds refused to budge, only occasionally opening enough to offer glimpses of what lay beyond them. But Dwight and Erik kept the conversation flowing easily, the way that stargazers have done for thousands of years on cloudy evenings. We managed to see **Vega** long enough for Aaron to find **Ring Nebula (M57)** in his new 8-in. Dob. It was such a challenging find that we're resurrecting our "Katie's Club" award to honor his achievement. (The award was named for **Katie Moore,** who once found **Orion Nebula** at a public observing on a cloudy evening when only one star – **Betelgeuse** – was visible.)

As Dwight pointed out earlier, more people showed up to work at our "Art in the Garden" solar observing on the 13th than came to our free meal on the 12th! Garden attendees included: **Roger & Jane Brackett; Stephen & Natalie Ramsden;**

Smitty, Deborah & Robert Smith; Carlos & Olga Flores; Wayne & Cathy Gardner; Steve Bentley & his guest Patty McMillan; Alan Pryor; Truman Boyle; Felix Luciano; Dwight Harness; and **yr. editor**. The crowd was enormous – probably about 1,200 visitors, since we gave out more than 600 pairs of solar sunglasses. We had twelve solar telescopes set up, showing visitors the **Sun** in white light, H-alpha and Calcium K filters, and we gave away an ocean of posters and other handout materials.

Special thanks go to:

*__Wayne Gardner__, for allowing us to participate in the event;

*__Stephen Ramsden__, for bringing his incredible array of solar 'scopes and serving as FRAC's solar expert at the observing – and, not coincidentally, for donating 600 pairs of solar sunglasses to be given out;

*__Carlos Flores__, for ordering the hundreds of handout materials from NASA;

*__Jane & Roger Brackett__ and **Olga Flores**, for organizing the handouts in a simple but splendidly efficient matter; and

*__Dwight Harness, Truman Boyle, Alan Pryor, Felix Luciano__ and **Steve Bentley**, for bringing their solar telescopes. We needed every one of them.

It was a splendid occasion in every regard: the weather was perfect, and our visitors were well-mannered and eager to see what we had to show them. The 18 FRAC attendees was a participation record for any public observing in the club's 18-year history.

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This 'n That. A Note from Ron Yates. "I didn't want to leave without dropping a note to the club. My stint here has been a short one, but well worth the time spent. I made new friends, and I hope to stay in touch with at least some of you. I was in the hospital last Wednesday with chest pains, likely related to some of the medication I am receiving to deal with my Type 2 diabetes and other issues. I'm okay, just trying to get that blood sugar down. Going to be a rough road, I suspect.

"Anyway, I will miss you all, and will try to come to visit sometime, perhaps if you have another star party soon.

As always, yours in friendship. Keep looking up. –Ron"

***Phil Sacco** has qualified for his Basic Outreach pin. It will be his 12th A. L. observing pin; in receiving it, Phil will become FRAC's 35th Outreach pin holder.

Truman Boyle qualified for his Stellar Outreach certificate.

*Is *The Flint River Observer* on the cutting edge of astronomy, or what? In the June '15 issue, **yr. editor** devoted five paragraphs of his article, "This Little Light of Mine," to the mysterious *ashen light* that has been associated with the planet **Venus**.

Not to be outdone, the Sept. '15 issue of *Sky & Telescope* featured "The Ashen Light Redividus" by **William Sheehan & Klaus Brasch** (pp. 52-54), devoting three full pages to this "elusive if not illusive glow on the nightside of the planet."

Just remember, guys & gals: *We beat them to it by three months!*

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Upcoming Meetings/Activities. We'll hold our club meeting on **Thurs., Oct. 8th**, at 7:30 p.m. at The Garden in Griffin. Before and after the meeting, we'll show the **Moon, Saturn, Uranus, Neptune** and deep-sky objects from 7-7:30 and as long as our visitors want to stay after the meeting. Our speaker, **Dr. Richard Schmude** of Gordon State College, will talk about the planet **Mercury**.

On the following evenings, **Fri.-Sat., Oct. 9th-10th**, we'll have our monthly club observings at JKWMA Site #1. We'll still be on daylight savings time until Nov. 1st, but the sky will be dark early by then anyway. It will be a great opportunity for us to tackle the 17 fall deep-sky objects in **Dawn Chappell's** intriguing FRAC 50 Observing Program – and to observe **Uranus** and **Neptune** (along with **Saturn**, of course.)

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The Planets in October. All of the planets will be visible this month. Three of them – **Saturn, Neptune & Uranus** – will be in the night sky, and the others – **Mercury, Venus, Mars & Jupiter** – can be found before sunrise.

Saturn (mag. 0.6) will be in the SW sky during the early evening hours in October, located a fist-width held against the sky from **Antares** in *Scorpius*.

Neptune (mag. 7.8) and Uranus (mag. 5.7) will be up all night, both of them in *Aquarius*. The Oct.

issue of *Astronomy* (p. 42) will show and tell you how to find them.

Mercury (mag. 0 or thereabouts), Venus (mag. -4.6), Mars (mag. 1.8), Jupiter (mag. -1.8) and Uranus will be visible before dawn. On **Oct 28th**, Venus, Mars and Jupiter will form a tight, bright triangle that will fit inside your extended pinky, middle finger and ring fingers held together against the sky.

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Book Review by Bill Warren

THE MARTIAN, by **Andy Weir** (NY: Broadway Books, 2014). 435 pp.

Set in an unspecified date in the future, *The Martian* is the intensely exciting story of **Mark Watney**, a NASA astronaut who is stranded on **Mars** when the crew of his Ares 3 mission is forced to leave early due to a violent dust storm that threatens to overturn their Mars Ascent Vehicle (MAV).

One reviewer's thumbnail description of the book: "*Cast Away* meets *Apollo 13*." Or, as another equally clever reviewer put it, "**Robinson Crusoe** on Mars."

While struggling through the 115-mph dust storm to reach the MAV, Watney is impaled by a piece of a radio antenna and blown away from the others. Only slightly injured but unconscious, he is presumed dead because his spacesuit's bio-monitor and radio have ceased functioning. Unable to find or contact him, his five crewmates have no choice but to leave him behind in order to save themselves.

When Watney regains consciousness, he finds himself half-buried in the sandy martian soil, alone on a planet with no food, water or oxygen except what they brought with them. Blood from his wound has temporarily sealed the hole in his spacesuit, and when he reenters the Hab – short for Martian Habitat, the crew's living quarters – he finds that it has survived the storm with only minor damages. (Except, that is, for the radio antenna, which is literally gone with the wind.) Watney is alone, but he is not completely at the mercy of the harsh martian environment – not yet, anyway.

Attempting to overcome his initial panic, Watney sews up his wound, checks the Hab's vital functions and makes the necessary repairs to the Hab and his spacesuit. Then he goes back outside, digs away the sand around the two rover vehicles and finds that, although they are functional, their radios are terminally damaged. He has no way to communicate with the crew or NASA. He realizes that his only hope of ever reaching Earth again is to find a way to survive for four years until the crew of Ares 4, the next Mars mission, arrives at **Schiaparelli Crater**, 2,000 miles away.

Four years is an impossibly long time to survive on food provisions designed for six crew members for 56 days – and 2,000 mi. is a very long trip for a martian rover that was designed for a month of short excursions. But Mark Watney is an extraordinarily resourceful person (as any martian astronaut would have to be, of course).

Oxygen and water are relatively minor concerns – initially, at least. The Hab uses an oxygenator to draw oxygen from the CO_2 he exhales; it has a water reclaimer, too, and he is able to produce additional water by burning tetrazine. He also has an abundant store of batteries and solar cells to supply energy for the Hab and the rovers.

As for food – he figures that, by eating just ¾ of a portion at each meal, he can stretch his 300 days of food to 400 days. And since he is a botanist, he is able to create a small potato farm in the Hab, using soil and potatoes brought from Earth for scientific experiments. He writes in his log, "Of course, I don't have any plan for surviving for four years on one year of food. But one thing at a time here. I'm well fed and have a purpose: fix the radio."

He never fixes that radio, by the way – but other problems arise, and other doors of opportunity open for him to apply his vast technical knowledge, handyman skills and creative thinking. All of them are risky and life-threatening, and almost nothing goes as planned; he's constantly on the verge of losing what little control he has over his shaky situation. But the problems he faces, his solutions to them and his ever-present humor will keep you reading long after you should have put the book down and gone to bed.

I won't tell you whether (or how long) he survives, but I will tell you this: Watney doesn't encounter any martians. *He* is "The Martian" referred to in the title. And NASA discovers early on that Watney is still alive when enhanced satellite images of the landing site show evidence of his presence and activities outside the Hab after the storm. Although unable to communicate with him, they begin searching for a way to rescue him before he runs out of food.

If, like me, your grasp of NASA technology and terminology is minimal, it won't affect your appreciation of the story if you just skim through those parts like you understand what he's talking about. If you can do that – well, Mark Watney is an incredibly likeable character, and you'll find yourself agonizing with his failures, cheering his successes, and enjoying the remarkable story he's telling. It is, as a third reviewer put it, "relentlessly entertaining and inventive." I would simply add that, as a lifetime nail-biter, I chewed my nails down to my elbows reading it.

You can buy a used paperback from amazon.com for $5.50 + $3.99 shipping and handling. We'll give away a copy of the book as a doorprize at our Christmas party.

A movie version of *The Martian* starring **Matt Damon** in the title role will open in theaters on Oct. 2nd. If it is even half as good as the book, it will be a don't-miss movie.

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Star Light, Star Bright

article by Bill Warren

Part One

*Occasionally someone asks me what it means when I write something like "**Saturn** (mag. 0.6)" or "**Venus** (mag. -4.6) in my monthly sky updates. "Mag." is short for magnitude, and the numbers indicate the relative* apparent brightness *of those planets. In other words, they refer to how bright those objects appear to us, not how bright they really are. The numbers change from one month to the next because the planets' orbits take them nearer or farther away from us and/or the **Sun** every month.*

This article is about apparent brightness and how it's measured.

Ever since humans replaced dinosaurs at the top of the food chain, men have studied the sky, trying to make sense of what they saw up there. There were clouds, of course, and the **Sun** in the daytime and the **Moon** at night. Everything else except the occasional comet or aurora was a tiny point of light in the night sky.

Regarding the latter, there were only three ways of studying the stars: by the patterns formed by the bright stars; by their color; and by their brightness. (The planets were different, of course: they moved across the sky faster than the stars.)

Patterns. Because the identifiable star patterns – constellations -- came and went with predictable regularity, they were reliable indicators of the changing seasons. Realization that one cycle of the four seasons constitutes one year was an important step in the development of a universal system for measuring time.

Color. Since there were basically only four naked-eye star colors – bluish-white (e.g., **Rigel**), white (**Sirius**), yellow (**Arcturus**), and orange (**Antares**) – color was pretty much a dead-end street in terms of studying the stars thousands of years ago.

Brightness was a different story, however. Even a casual glance at the night sky showed that some stars were brighter than others, so the subject of star brightness was considered worthy of pursuit.

Hipparchus and the Magnitude Scale. Sometime around 130 b.c., the Greek astronomer **Hipparchus of Rhodes** devised a system for comparing stars: a brightness scale.

(The word *magnitude* is derived from the Latin prefix *magnus*, which refers to "great size" or "bigness," not brightness. The brightness of celestial objects was thought to be a function of their size: it didn't occur to ancient astronomers that brightness could result from a celestial object being nearer to us than others. They assumed – because they had no reason not to – that everything in the sky except clouds and auroras was more or less the same distance from us. The Sun and Moon were brighter than the stars because they were larger, not because they were closer to us.)

Hipparchus assigned a magnitude value of **1** to the twenty brightest stars in the night sky. Fainter stars were listed as mag. **2, 3, 4, 5** or **6,** respectively, with 6th-mag. stars being the faintest ones visible to the naked eye. So his scale ran backward from what might appear to be the logical way of arranging magnitudes: the brighter the star, the lower its magnitude, down to mag. 1.

Differences in star brightnesses were shown in ancient star atlases like **Ptolemy's** *Almagest* by using large circles to represent 1st-magnitude stars and progressively smaller circles to indicate the other magnitudes. An extended and modified version of that system is still in use in today's star atlases.

Brilliant as Hipparchus's magnitude system was, it contained three unavoidable, built-in flaws. First, his magnitude estimates were completely subjective. (His most obvious error was in classifying Sirius – by far the brightest star and fourth-brightest object in the sky behind the Sun, Moon, and **Venus** – as a mag. 2 star.) Second, limiting the scale to naked-eye stars meant that the system was closed to the possibility of stars fainter than naked-eye. And third, the use of just six magnitudes meant that a lot of stars were lumped together as mag. 1 stars, etc., when it was obvious that they weren't equally bright. It took the invention of the telescope, with its ability to probe deeper into space and provide precise measurements of stars, to point out the need for a better system.

Enter **Norman Pogson** (1823-1891).

Pogson's Ratio. In 1856 Pogson, an English astronomer, proposed a new way of measuring star magnitudes. It became the standard by which apparent star brightnesses are measured today.

In Pogson's system, star magnitudes lie along an expanding logarithmic scale in which every magnitude represents an increase (or decrease) of 2.5 – actually, 2.512 – times the brightness of another star that is exactly one magnitude brighter (or fainter). So a mag. 1 star is 2.5 times brighter than a mag. 2 star, 6.25 times brighter than a mag. 3 star (2.5 x 2.5), etc., and 100 times brighter than a mag. 6 star. The fact that 2.512 is almost exactly the 5^{th} root of 100 is known as *Pogson's ratio*.

Pogson didn't stop there, though. Since telescopes capture the distant light of faint stars and other objects that lie beyond the range of naked-eye visibility, his magnitude scale extends to any celestial object that can be detected, no matter how faint it is. (For example, **Pluto** shines weakly at mag. +14, and the Hubble Space Telescope can detect objects as faint as mag. +31.5)

At the other end of the scale, Pogson reversed the process by setting magnitude **0** as the standard against which star brightnesses are measured. And because **Vega** was selected to represent mag. 0, the three brightest stars in the night sky – Arcturus, **Canopus** and Sirius – actually have negative brightnesses. (The same rules apply on either side of 0: each magnitude of brightness is 2.512 times brighter or fainter than the one above or below it.)

Finally, improved ability to measure stars made it possible to determine their brightness to within $1/100^{th}$ of a magnitude. So Vega is mag. +0.03, Arcturus is mag. -0.05; Canopus is mag. -0.62; and Sirius is mag. -1.46. (In case you wondered, the Full Moon shines at mag. -12.64, and at a blistering mag. -26.74 the Sun appears more than a billion times brighter than Sirius.)

On the other side of mag. 0, Rigel is mag. +0.14 and **Polaris (the North Star)** is mag. +1.98, to cite two examples. (If the plus sign does not appear, it's assumed to be there.) So even if you know nothing else about those stars, you'll recognize that Sirius is brighter than Vega, and Vega is brighter than Rigel (which in turn is brighter than Polaris). And Polaris is brighter than, say, a mag. 2.5 or 3 star.

To recap: the brighter a star or other celestial object appears to us, the lower its magnitude will be, down to mag. 0. Beyond that point, the numbers rise, prefixed by a minus sign.

Part Two

Question: *Okay, we understand the term* **apparent magnitude***: it's how bright stars and other celestial objects look to us from Earth. Is there any other kind of brightness?*

Answer: How bright celestial objects appear to us depends on two factors: their size, and how far away they are. But those measures, taken together, can be deceptive. For example, consider two bright stars, the Sun and **Betelgeuse**.

The Sun is, of course, very large and very bright in our view – so bright that its intense glow blocks our view of all other stars in the daytime.

Betelgeuse, on the other hand, is a red giant, 800 times as large as the Sun. If Betelgeuse were located at the center of the solar system, at 700 million mi. in dia. it would extend past **Jupiter** and from there halfway out to **Saturn**. Yet Betelgeuse is only the 9^{th} brightest star in the night sky. Why? Because it lies 640 light years from us – more than 50,000 times farther away than the Sun. So the Sun appears much larger and brighter in the sky, although Betelgeuse is actually 7,500 times brighter than the Sun.

But that brings up two questions: *How do we know that Betelgeuse is brighter than the Sun? And how do we know how bright any star really is?*

Absolute magnitude is used to express the actual brightness of stars, regardless of how bright they appear to us or how near or far away they are.

In order to determine absolute magnitudes, astronomers measure how bright objects beyond the solar system would be if all of them were the same distance from Earth. That standard distance is 10 parsecs, but we'll use a more familiar equivalent measurement, i.e., 3.26 light years.

One light year equals roughly 5.8 trillion miles. Betelgeuse is a variable star located 640 light years – 3,800,000,000,000,000 miles – from us. (That's why astronomers use terms like light years and parsecs: so they won't have to fill up pages with zeros.)

At a distance of 3.8 quadrillion miles, the apparent magnitude of Betelgeuse varies between mags. +0.2 and +1.2. But if it were 3.26 light years away instead of 640 l.y., it would be by far the brightest star in the night sky, shining at mag. -5.85. It would be six times brighter than Venus, and bright enough to cast a shadow at night.

So the actual (absolute) brightness of Betelgeuse is mag. -5.85.

The Sun is 400,000 times brighter than the Full Moon. But it is only 93 million miles away -- 0.00012th of a light year from us. If it were 3.26 light years distant, it would no longer be a 1/2^{o}-wide circle of blistering heat in our view, it would be just another star in the endless night sky, visible to the naked eye but shining faintly at mag. +4.83, its actual brightness.

And that, in a nutshell, is the difference between the apparent and actual brightness of stars. The same principle applies to all stars and celestial objects that lie beyond the solar system, not just the Sun and Betelgeuse. But it doesn't apply to the planets, asteroids and comets, etc.: they are too small to be seen from a distance of 3.26 light years away. And since they don't generate and release massive amounts of energy at their cores the way that stars do, they don't have an absolute magnitude. The only reason we see the planets at all is sunlight reflecting off their surfaces.

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Above Right: A portion of **IC 1318**, an emission nebula in *Cygnus*. (Photo by **Alan Pryor**.) **IC 1318** is an enormous – 3^{o} – area of nebulosity centered around 2nd-mag. **Sadr (Gamma Cygni),** the star at the center of the **Northern Cross**. Known variously as **Butterfly Nebula, Gamma Cygni Nebula** and **the Sadr region**, the nebula is divided into three parts, IC 1318A, B and C. Alan's incredible photo shows the Butterfly's left wing (1318B), which is larger than the right wing, a small portion of which appears in the upper right corner.

Sadr, also unseen in the photo, lies about 2^{o} below the dark, spiked rectangle at upper left center.

The open cluster near the lower left corner is **NGC 6910, the Rocking Chair Cluster**. The two brightest stars and others nearby form the seat of this **Y**-shaped little open cluster.

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Above: DWB 145 in *Cygnus*. (Photo by **Felix Luciano**.) In 1968, three astronomers – **H. R. Dickel, Heinrich Wendker** and **J. H. Bieritz** – cataloged the HII regions of ionized hydrogen in **Cygnus X**, an emission nebula. Felix's photo shows #145 on their list. It looks like waves in a cosmic ocean.

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