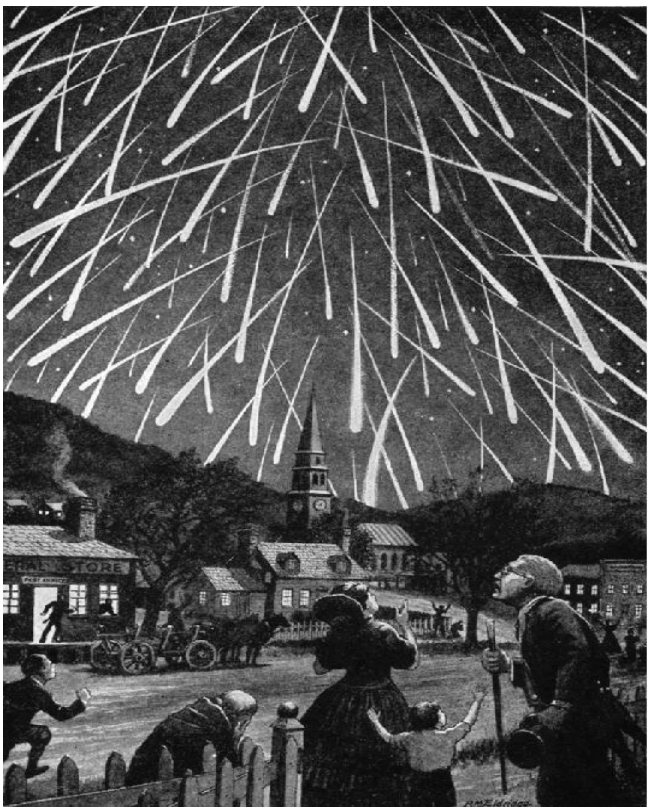
Autumn Showers
Fall 2013

The email was addressed to "The Complaint Department", and the first line summed it all up, "I want my money back." This is how I'm greeted by an old friend, and a regular Newsletter reader? I've known her since Junior High (oooh baby, *that* was a long time ago!) and she decided that she'd had enough – the Perseid Meteor Shower on August 12 was "awful", "I saw NONE!", she lamented. I did my best to console her, but she would have none of it; she wept, she screamed, she railed at me, and yeah…I'm exaggerating…she was just pulling my chain. Still, she was legitimately miffed at the small number of "***pretty shooting stars***" that showed up during what is often cited as the best meteor shower of the year. So, this newsletter is about one of the most notoriously misunderstood celestial events there is…the ***Meteor Shower***. So strap in and hold on!

Now, to be certain, I've written about meteor showers in past newsletters, but never in a comprehensive way. I have always talked about one or the other shower that is coming up, and what we can expect, where to look, etc. This time, I'll address the ***subject of meteors and meteor showers*** in detail. Before the end of the newsletter, as a special bonus, I'll give you a list of the best annual displays to keep for your very own…*you can even have it laminated!*

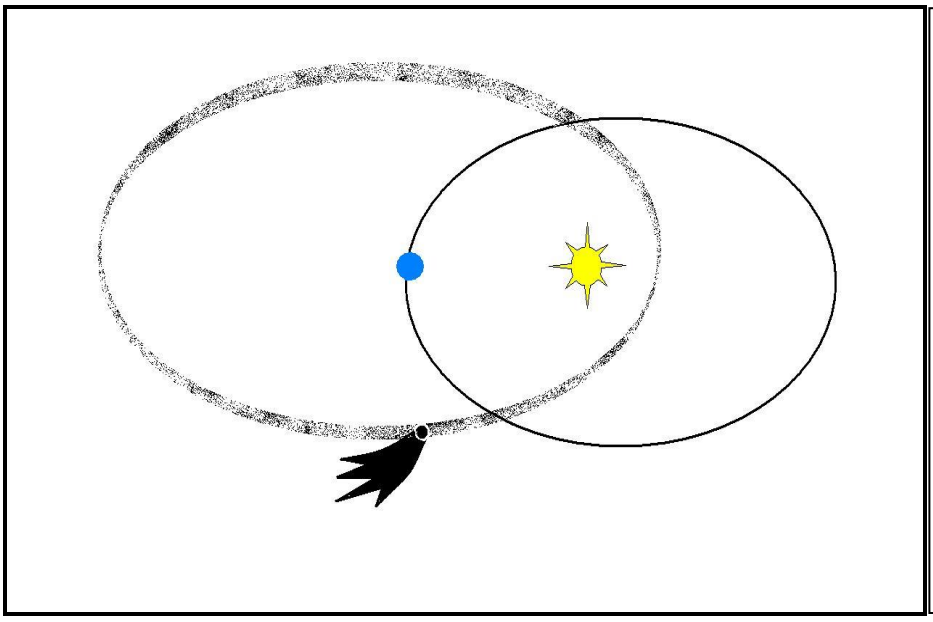


This illustration, by R. M. Eldridge, is said to represent the spectacular Leonid Meteor Storm of November 1833. It is an excellent depiction of what nearly everyone believes a "meteor shower" is *supposed* to look like. In fact, what this image truly shows are the many misconceptions often attributed to these regularly occurring celestial events.
The event depicted here was thought by many to herald "the end of times", and was even witnessed by Abraham Lincoln. According to one of Lincoln's contemporaries, the famous American writer Walt Whitman, it was during some of the darkest days of the Civil War that Lincoln drew on this experience from his youth. "Gentlemen," the President is said to have pointed out, "the World did not come to an end then, nor will the Union now."

I'd like to begin by pointing out what most of you already know. However, in the interest of being comprehensive, here it is…a meteor is not a "shooting star". This misconception still leads to confusion, and I am often asked about it during my ***visitor programs at Kitt Peak***. Even the closest "stars" (other than the Sun) are ***trillions of miles away***. Meteors become visible when they hit the Earth's atmosphere less than 100 miles above the ground. Most of them are no larger than a grain of sand, and hundreds of them hit our planet every day. So, where do these bits of dust, rock, metal, and ice come from? Well, actually, they come from just about everywhere! They can be left over pieces from the birth of the solar system, they can come from volcanic blasts or impacts on other planets and moons, and in the case of a meteor "***shower"*** they can come from comets or asteroids.

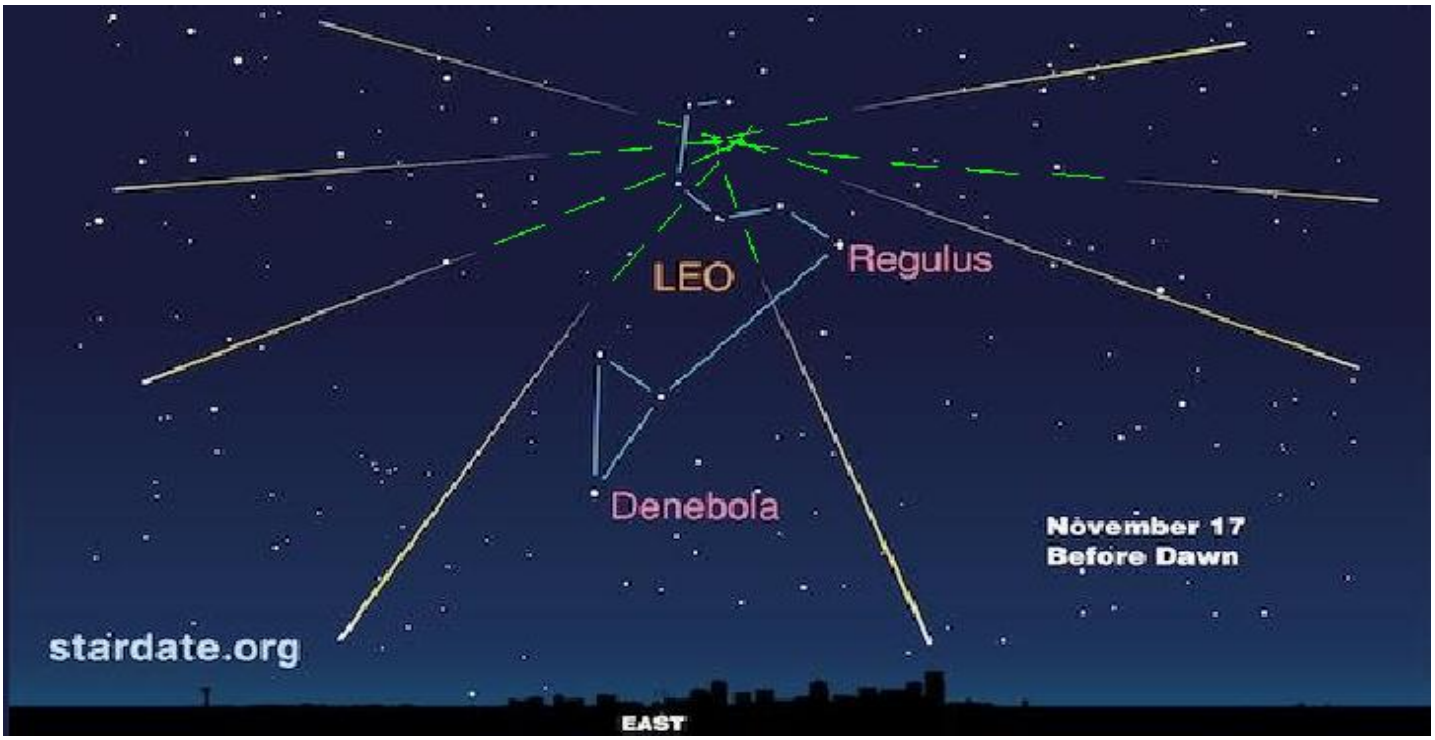
While these random bits of cosmic flotsam are just out there floating around in space, they are called ***meteoroids***. Once a meteoroid encounters the Earth, some interesting physical changes take place. Most people think that friction causes the particle to heat up and glow, but the most recent explanation is a bit more complicated. You just knew that had to be the case, right? As a meteoroid hits the air at about 100,000 miles per hour, something called ***ram pressure*** begins. The air in front of the particle just can't get out of the way, and that causes the air to compress. As a gas compresses, it heats up – it's why a tire gets warm as air is pumped into it. With the air just in front of our incoming meteoroid heating up to about 3000 degrees, the rest of the particle is soon vaporized. Unless the particle is much larger, it has no chance of hitting the ground. The heated glowing trail in the sky is now called a ***meteor***. Only if the meteor is large enough to survive its encounter with our atmosphere and actually impacts the Earth, is it re-categorized again…it then becomes a ***meteorite***. Random particles can hit the Earth from just about anywhere and be seen moving in almost any direction; these are called "sporadic meteors". On any moonless night, the ***expected rate*** for ***"sporadics"*** is anywhere from about 2 to 5 per hour.

So now we know how a single meteor happens, but when a whole bunch of them are no longer random, they become a "shower". In the nineteenth century we began to understand that meteor showers were associated primarily with comets. Comets themselves were not understood as periodic visitors until the eighteenth century, so it isn't surprising that their progeny, meteor showers, might be misunderstood as well. As a comet nears the Sun, heat breaks down some of their mass into gases and particles. This material continues along the comet's orbit like Hansel and Gretel's trail of bread crumbs. When Earth passes thru this cometary debris, thousands of "comet pieces" hit the atmosphere over a period of days. In fact, for a few hours at ***"the peak"***, hundreds of thousands of meteors may flash across the sky – this is called a ***meteor storm***, and it is very special, and rare.



This illustration shows how a comet can leave a trail of particles along its orbit. If the Earth passes through the comet's path at a regular period, then many of the small particles may become meteors, and a meteor shower is born. A comet does not disintegrate at a constant rate, however, so some showers may be more active than others.

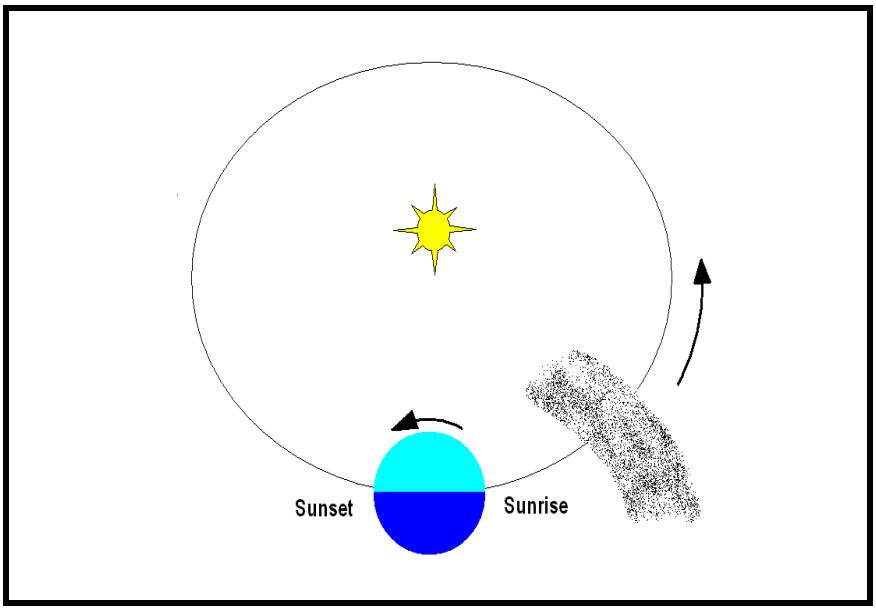
There is another characteristic that differentiates a shower from sporadic meteors. Remember, a shower is not made up of "random" particles; these all come from a single source and are moving along a designated path. What this means to the bleary-eyed, late-night observer on the ground is that all the meteors in a shower seem to emanate from a particular point in the sky. This is in fact the property that gives each shower its unique name (like "The Perseids"). If you used a star chart, and tracked each of the meteors you see, you could extend all of their paths back to a particular point in the sky. The constellation that contains this ***"radiant"*** provides the name of the shower. The radiant is not a "true point of origin"; the meteors appear to come from that point, due to our ***perspective*** – like train tracks converging in the distance.



The chart above demonstrates how the "Leonid Meteor Shower" gets its name. By tracing the path of each meteor back to an "optical point of origin" (dashed green lines have been added from the starting point of each meteor), you can see that they all intersect in the "mane of Leo the Lion". Sporadic meteors are easy to spot in this way as well – they seem to originate from a different spot in the sky.

We come finally to a characteristic of meteors (showers and sporadics alike) that causes grief to any observer who isn't totally committed (insert your own "commitment/committed" joke here). People ask me all of the time, "Why is meteor viewing best between the hours of 1am and 5am in the morning? Why can't they be more convenient, like from 8pm until 10pm?"

The answer to these questions again comes from the Earth's motion. We need to look at both the Earth's ***rotation around its axis***, and the planet's ***revolution around the Sun***. Here's a diagram:



Think of Earth as a car going down the freeway in a rainstorm. More raindrops hit the windshield than hit the back window. Notice that on Earth, "after sunset" is like the back window. "Before sunrise" it is more like the front windshield; Earth is plowing into the meteors after midnight, so many more "streakers" are visible in the "wee" hours of the morning.

At last, we can put all of this together to find out why observers are often “disappointed” with any particular meteor shower. As for my friend last week, I’ll use the recent Perseids as an example.

Perseids are widely believed to have one of the ***highest rates***, often listed at 100 meteors per hour. However, year to year there is ***variation***, and this year was a bit of a downer. So, let's take 20% off for a "down year". That leaves a rate of 80. Next, where you view from makes a huge difference. ***City lights*** will knock down the number of faint meteors you see. If you only lose 25% of the fainter ones, your effective rate is now down to 60 meteors per hour.

Different showers have different characteristics, and while the Perseids may have the “mostest” meteors, they are not the slowest moving; they are often very ***short and fast***. So, we can lose another 25% just because they’re Perseids! The 60 is now down to about 45 per hour. Also, if you think about it, not everyone has the fastest ***reaction times***, or the ***best vision***. These factors can bring us down by up to one-third, so we’re now down to 30 meteors per hour.

Then we have to consider the time factor illustrated earlier. If you’re not watching ***after midnight***, you can easily lose another third. So, if you actually HAVE A LIFE, and weren’t watching between 1am and 5am, the rate of 30 is now down to about 20 per hour! But here is something that many people miss. The ***peak date*** for the Perseids is the ***night of August 12th or pre-dawn August 13th***, and often the peak lasts just a few hours. If you were out before or after that time, you probably lost another half. Your 20 just dropped to about 10 good bright Perseids per hour.

Another thing that we have to consider is ***the Moon***. Almost everything in visual astronomy is impacted by the Moon, and meteor showers are no exception. If you are watching meteors when the moon is in the sky, you will easily lose another quarter of them – and maybe more if it’s actually near full moon. Ooops, 10 just became 8.

Finally, (now, ain't this FUN??)...
While the human eye has nearly a 180 degree ***field of view***, you are more effective in about half of that. Using a field of view of about 90 degrees, means that you can really watch about 25% of the sky at one time. Perseids can start in any part of the sky – they don’t cooperate by beginning only at the ***radiant point***! This means you see about a quarter of all the meteors in the sky, just because of the normal human eyeball. If you were a FISH, you might be able to see more 'cuz you would have FISH-EYES, but, alas, you are human. Of the 8 per hour we’re now down to TWO!!

So, there you have it. No wonder we get disappointed with meteor showers! Now, to be fair, there is a little bit of “tongue-in-cheek” with the above scenario, but these are all actual factors to consider if you want to maximize your meteor observing experience. I myself was able to spot about 40 meteors during 3 hours at 2am on August 12 (yep, I really DON’T have a life). If you do the math, I actually came pretty close to the 80 per hour I would have expected. Don't feel bad - the Orionids and the Leonids are coming in October and November, and they’ll give us all a shot at redemption. Then again, these are meteor showers we’re talking about. They are born of comets, and as I said in the last newsletter, they're like cats - they will do just what they please…just when they please to do it!

So, before finishing up with a couple solar system updates and a personal note, here’s an overview of some of the better annual meteor showers. The rates shown are “averages” for the shower - sometimes they’re better, and sometimes…well, maybe not. Remember, you can always help yourself by watching after midnight, check the moon’s phase, and get out of the city! One more quick thing, here is a great website to check moon phases, Sun and Moon rise and set times, etc:
http://www.sunrisesunset.com/predefined.asp
So, on to the chart:

Chuck's Best Annual Meteor Showers

NAME	PEAK DATE	PEAK RATE	COMMENTS
Quadrantids	Jan. 2-4	40/Hr	Radiant is in constellation Bootes
Lyrids	Apr. 21-22	20/Hr	Radiant near star Vega
Eta Aquarids	May 5-6	20/Hr	The farther south you are, the better
Delta Aquarids	July 28-30	20/Hr	Concurrent shower: Capricornids Some nice fireballs possible
Perseids	Aug. 12-13	80/Hr	A consistent performer
Orionids	Oct. 21-22	20-40/Hr	Fireballs a definite possibility
Leonids	Nov. 17-18	40-60/Hr	Many long dust trails Known to produce Meteor Storms
Geminids	Dec. 13-14	60-100/Hr	Large, bright, slow-moving fireballs A consistently excellent shower

Now I'll finish with just a couple solar system updates. First, ***Saturn*** and ***Venus*** are racing toward a ***conjunction*** on September 20 when they'll be within about 4 degrees of each other low in the western sky. At the close of September, Saturn passes Venus, and sets by 7pm; Venus sets a short time later. You have about a month and a half to see these two planets before they exit the night.

Next up, a very current update on what was billed as ***"the next comet of the century"***; and the operative word here is "WAS". After nearly three months hidden in the glare of the Sun, ***Comet ISON*** has made a faint re-appearance in pre-dawn skies. Magnitude estimates put it well behind what was expected - or at least, hoped for. We may yet get a very nice comet by autumn's end in November, but it really is time to start tamping down the exuberance. Yes, comets are often unpredictable, but I would rather be surprised by a pretty nice ISON, than disappointed by another ***PANSTARRS***. In any case, by the time the Winter Newsletter comes out we'll already know the outcome.

A final note to my newsletter readers: as you may recall, my ***"Fall 2012 Newsletter - A Martian Chronicle"***, addressed the passing of Ray Bradbury. I was requested (by one of my readers, in fact) to submit an expanded version of the article for inclusion in a collection of essays and stories about Ray Bradbury from a variety of perspectives. The book, ***"Orbiting Ray Bradbury's Mars"*** is now being published by ***McFarland***. Be sure to get it while you can! Information about the book is already included in McFarland's ***online catalogue*** found here:

http://www.mcfarlandpub.com/book-2.php?id=978-0-7864-7576-6

Enjoy the Autumn Skies!

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