The Objects That Changed Astronomy

(And How to Observe Them)

-Brad Young, Astronomy Club of Tulsa

Part Four: Sputnik to James Webb Space Telescope

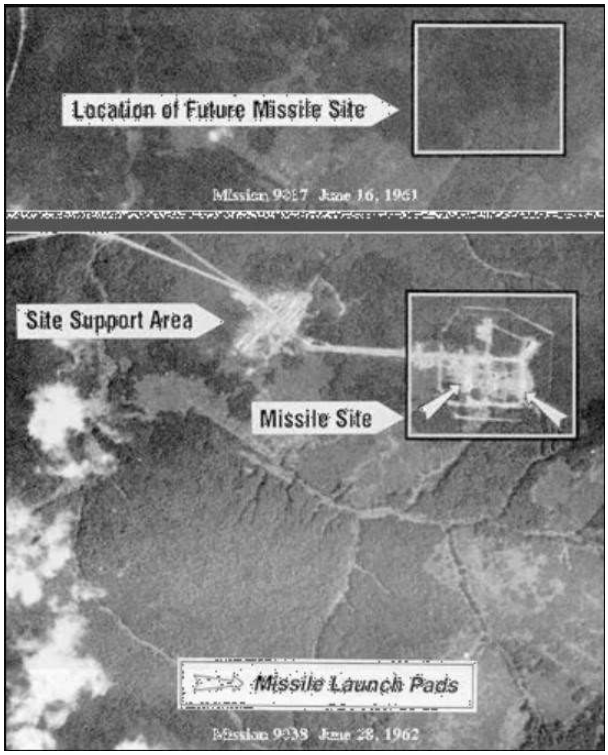
"Listen now for the sound that forevermore separates the old from the new." NBC radio announcer on the night of 4 Oct 1957, introducing the transmissions from Sputnik 1

Mankind's giant leap into space began with a beeping ball less than two feet in diameter that spooked Americans and started one of my favorite parts of this hobby, tracking satellites. But the explosion in space exploration that followed also led to space-based astronomy, and even planetary exploration.

More New Thinking

While astronomy in the visual and radio bands of the electromagnetic spectrum can be done from Earth, the other parts of the spectrum were not available, due to the atmosphere. Even visual observing was hampered by the constant changes in air movement and heat convection. Significant progress has been made in reducing these effects by locating observatories on mountains, and the invention of adaptive optics, but the ultimate solution was to get above the roiling air and into space.

As often happens, military advances due to the Cold War bred civilian advances, beginning with the need to get to space to compete with the other side. Reconnaissance missions to image foreign assets led to better photographic, and later, electronic imaging technology along with working out data transmission and linking to ground stations and "passing" data from different orbits. All these advances transferred easily to planetary probes, imaging satellites, and communications links across vast distances. So, as the space program advanced, so did the science that could be done, using the new vistas opened to us.



"Two U.S. Corona reconnaissance satellite images made a year apart—in mid-1961 (top) and mid-1962 (bottom)—revealing the construction of a new Soviet SS-7 Saddler (R-16) intercontinental ballistic missile site. Located at Yur'ya, Russia, the site was the first Soviet ICBM complex to be identified in Corona images."

Before Men on the Moon

"Flyin' mother nature's silver seed to a new home" Neil Young

Several important missions started before the manned missions culminated (so far) on the Moon. The Explorer missions, at first a cover for early U.S. spy satellites to check rival U.S.S.R., began in 1958 and Explorer 1 was the first successful U.S. launch. Missions later investigated radiation, the magnetosphere, the sun, and observed the sky in wavelengths of light blocked by our atmosphere, such as X-rays, gamma rays, UV, and IR. Explorer missions continue; the recently launched Ionospheric Connection Explorer (ICON) is a satellite designed to investigate changes in the ionosphere of Earth, the dynamic region high in our atmosphere where terrestrial weather from below meets space weather from above.

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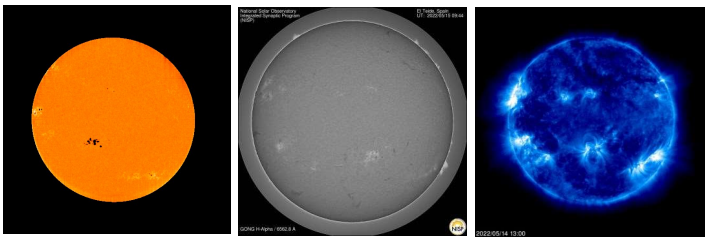
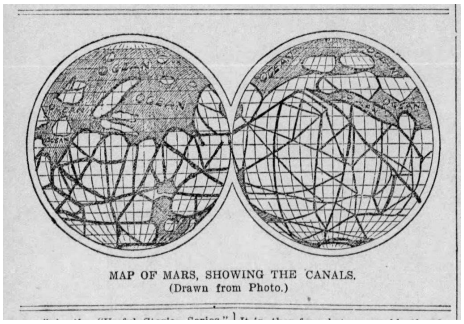
The Orbiting Astronomical Observatory (OAO) missions also began early, in 1966. 3 of the 4 launches were successful and are also still on orbit. Their focus again was on parts of the spectrum we can't see well from Earth, so it would be difficult to recreate the discoveries they made. But understanding better how the sun works, how space weather works, and what radiation threatens space travel and resources has led to planetary exploration and our modern space infrastructure. Consider this the next time you use GPS, satellite data services, or observe the sun. When you see solar activity in white light (left), or, as some amateurs and ground-based observatories do, in H-alpha (center, from GONG project), SOHO and other missions can add to the picture by observing in other wavelengths (right, extreme UV).

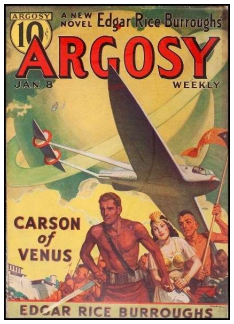


Planetary Exploration

"That's one small step for a man, one giant leap for mankind." Neil Armstrong (the transmission squelched, and most did not hear "a man").

However, the epoch defining advance for humans was setting foot on the Moon. This and unmanned missions to the planets, other moons, asteroids, comets, and beyond the solar system is what defines the Space Age. Now, when you explore the Moon, you can see where man's footsteps first fell there by observing where the Apollo Missions landed. When you observe any solar system object, you are enriched by knowledge gained from missions that flew by a planet (Mariner 2 was first, at Venus), crashed (Deep Impact into Comet Tempel 1), or are a Mars helicopter (Ingenuity).





One of the fundamental driving forces of exploring other worlds is the search for other life. Man has wondered about this since at least the Greek philosopher Epicurus. The story of Lowell's "canals" on Mars is well known. And consider that in 1918, Svante Arrhenius, a Nobel chemistry laureate, concluded "We must therefore conclude that everything on Venus is dripping wet" from spectroscopic studies, and therefore "only low forms of life are therefore represented, mostly no doubt belonging to the vegetable kingdom." JPL (Jet Propulsion Lab) researchers stated as late as 1963 "if Venus were covered by water, it was suggested that it might be inhabited by Venusian equivalents of Earth's Cambrian period of 500 million years ago, and the same steamy atmosphere could be a possibility." Many people held hope before Venus and Mars probes were launched that life would exist on either of these close planets (and still do).

Whether you believe life ever existed, or could be supported, by other planets or moons (such as Titan), solar system observation at any level, from eclipses, meteor showers, comets, storms, and rings is always a fascinating sight. Although we still see the planets through our fickle atmosphere, we can observe them knowing more thanks to missions like Pioneer, Voyager, Cassini and New Horizons.

Now, instead of fearing comets, we study them up close, even collecting samples from comets and asteroids, such as the Osiris-REX mission to the asteroid 101955 Bennu. *Note: I have this patch for helping (just a little) to use images returned by the spacecraft to map the landing site for the sampler.*

Modern Space Based Observatories

"Can you take me higher, to a place where blind men see?" "Higher" by Mark Tremonti / Scott Stapp

The use of spacecraft for lofting instruments above the atmosphere has led to the greatest discoveries yet in astronomy. It would be difficult to select the best, but a few are easy to include. The Hubble Space Telescope (HST) set the bar, at least with the public, for modern SBO's. It's first "hit", arguably the

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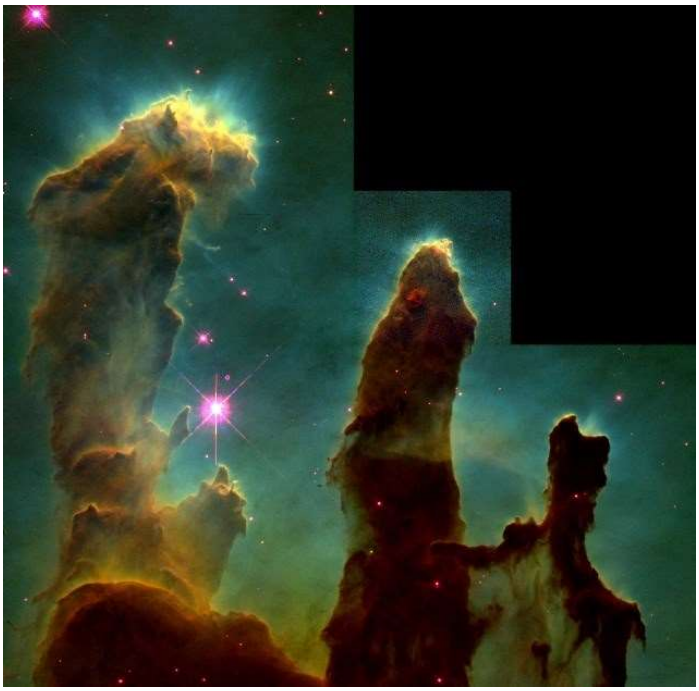
most famous astrophoto ever, is 1995's "Pillars of Creation":



This is a very magnified view of part of Messier 16, the Eagle Nebula. The top of the dark columns are incubators of new stars. This object can be seen in a moderate sized telescope or imaged easily, and, although you probably won't get *this* view, it is still a stunning object, well worth a look.

Another early hit (pun intended) for HST was it's capture of the effects of Comet Shoemaker-Levy 9's impact on Jupiter in July 1994. Although the impact was visible from Earth with a telescope, HST images helped us understand and track the effect. *Author's note: there's a regular contributor to the W.A.S.P. who can describe this event much better than I.*

I have fond memories of stopping people on the sidewalk where I lived across the street from Chapman Stadium in Tulsa and showing them this sight. We can't always predict comets (or impacts), but we can follow on the latest discoveries with scope or CCD when possible. The COBS (Comet Observation database) is a great place to report visual or imaging sightings of comets and see what current comets are up to with brightness, size, tail, etc.

Symbiosis

"As our circle of knowledge expands, so does the circumference of darkness surrounding it." A. Einstein

The idea of following on discoveries is the true value of SBO's and manned missions – building on what we can see here and returning material and data back to Earth for research. Moon rocks, meteorites, samples, pictures, and instrument data are what have driven the last 60 years of unparalleled growth in our understanding of astronomy, and its popularity. But, as Einstein noted, the more you know, the bigger the circle is of what you don't know. This is why we keep searching, and why astronomy will always be a fulfilling hobby: we still have so much to learn.

But we can help the process by involving ourselves in outreach, education, and citizen science. Symbiotic projects abound for those who have the time to devote to working with the data collected by SBO's. One way is to help track the darkness of the sky and supplement space-based studies is with such naked eye activities as Globe at Night. Zooniverse has many astronomy related programs that support ongoing SBO projects, most of which require no equipment at all. For imagers, Hubble Legacy Images can be downloaded and processed to check for "hidden treasure". Other projects such as the Osiris-REX mission mentioned above have searchable image sets that can help support probes and landers.

If you do have remote access or equipment of your own, you can assist with such things as HST or Transiting Exoplanet Survey Satellite (TESS) observations of strange variable stars or even exoplanet discoveries. Recently, HST observed a YSO (young stellar object), VZ Chameleontis, and asked amateurs to image it also, in different wavelengths if possible. Using a remote scope, I was able to contribute the magnitude reports shown with crosses (Next Page).

This data will be used to help explain how these objects, both protostars and pre-main sequence stars, form and mature, based on their light curves and other data.

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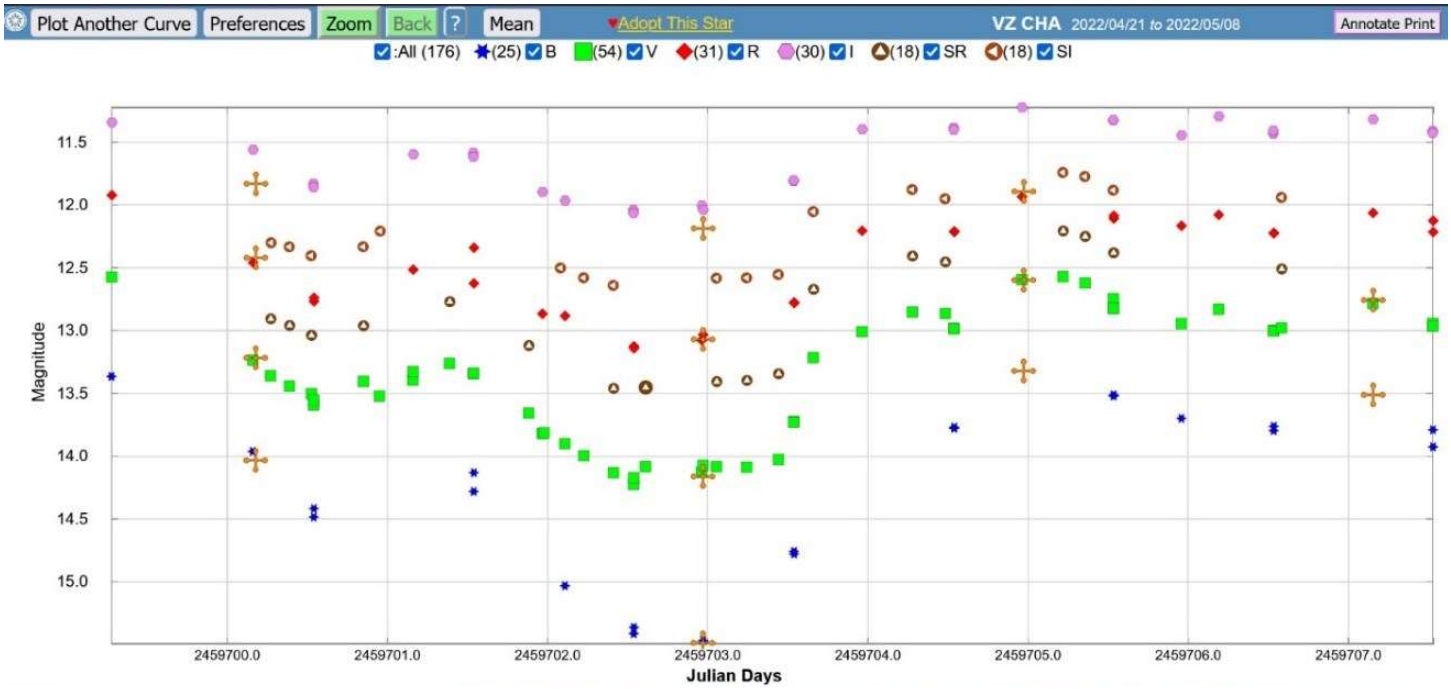

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Observing Satellites

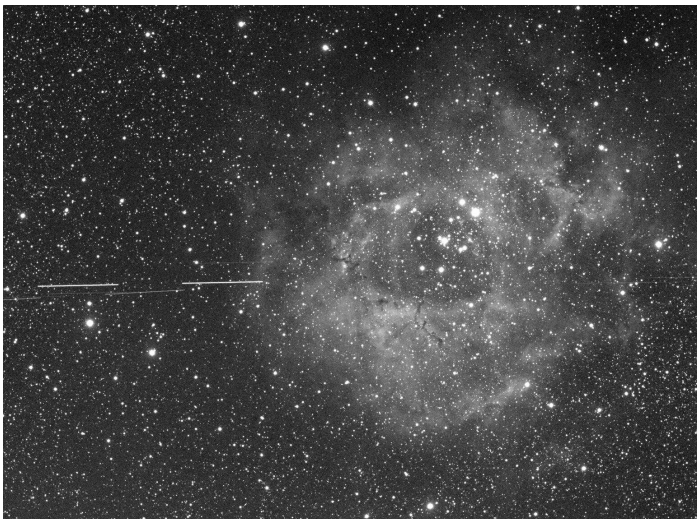

Image by Author

As mentioned above, a direct result of the launching of satellites and other space vehicles is that we can observe them, also. Many of the oldest spacecraft are still up there. The OAO payloads and their rockets are bright enough to see with your naked eyes, hundreds can be seen with binoculars, and even Vanguard 1, launched in 1958 (and oldest still in orbit), can be seen with a telescope on occasion. Though some people are irritated by their presence (e.g., Starlinks), they can be an interesting part of our hobby and show firsthand the Space Age and its impact on our civilization. Where would astronomy be without Hubble Space Telescope, ISS, and all the science missions on orbit?

Epilogue

Astronomy has evolved as a science throughout history, with new methods, instruments, and especially, new ways of thinking using scientific, critical methods. There have been many objects discovered or observed in new ways throughout mankind's quest to understand his home that you can observe for yourself. Using your eyes alone, or with instruments and tools, you too can experience the wonder of our universe by revisiting these objects for yourself. Who knows? You might even discover something new or different yourself. So, get out and observe!

Resources:

https://en.meming.world/wiki/Modern_Problems_Require_Modern_Solutions
https://kids.britannica.com/students/assembly/view/73048
http://www.csun.edu/sfo/dailyim.cgi
https://umbra.nascom.nasa.gov/images/
https://gong2.nso.edu/products/tableView/table.php?configFile=configs/hAlpha.cfg
https://www.space.com/apollo-landing-sites-moon-observer-guide
Wikipedia
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https://nwspprs.com/marsim1
https://www.sciencenews.org/article/hope-life-venus-survives-centuries-against-all-odds
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NASA, Jeff Hester, and Paul Scowen (Arizona State University) - http://hubblesite.org/newscenter/newsdesk/archive, retrieved May 15, 2022
Hubble Space Telescope Comet Team and NASA - https://hubblesite.org/contents/media/images/1994/34/179-Image.html, Public Domain, https://commons.wikimedia.org/w/index.php?curid=972901, retrieved May 15, 2022
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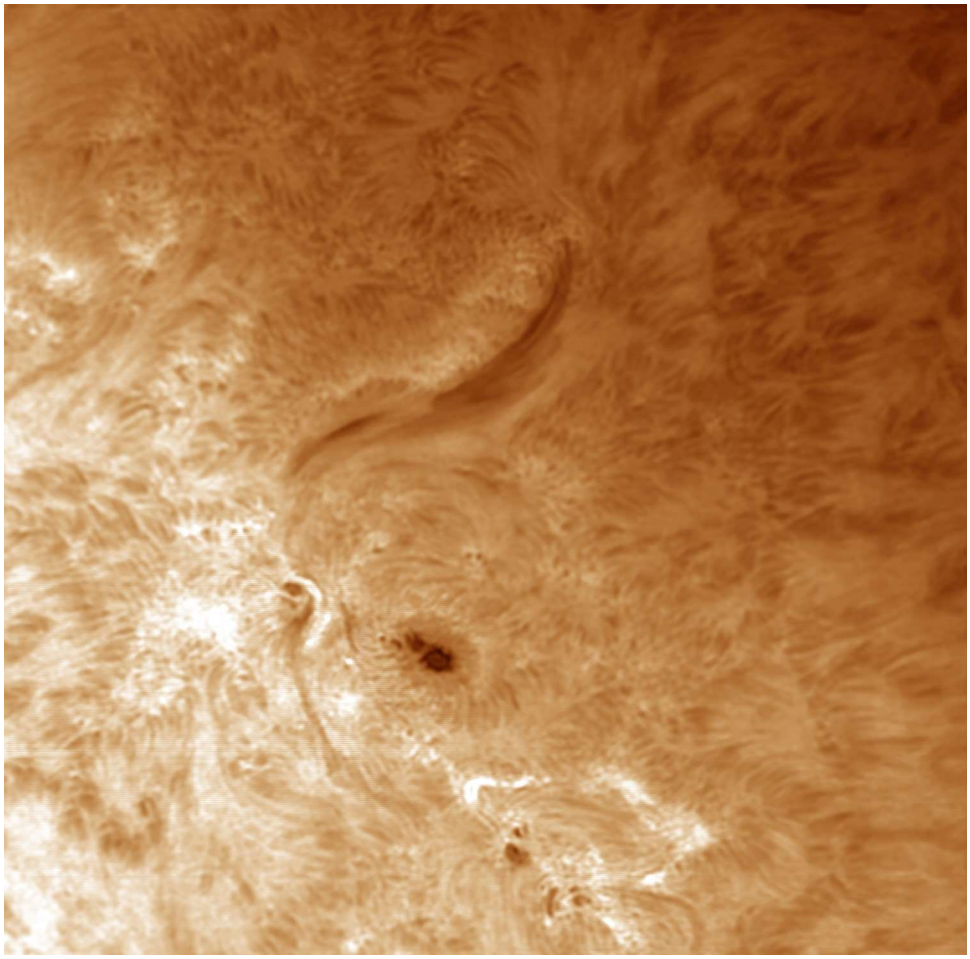

Image by Bob Berta

June 14th photo on of Ha solar activity

Bob states, "This was a different setup than I normally use. Instead of my smaller 80mm refractor I used my 6" (152mm) f8 Officina Stellare APO refractor which is my normal night time imaging scope. The Ha filter was my DayStar Quark Chromosphere with IR/UV filter and a f5.95 focal reducer. To avoid excess IR/UV to the camera I used a 5" aperture mask. The Quark has a built in 4.4x Barlow so this works out to about a 3080 mm focal length. The camera is a simple Player One Neptune 6 MP mono camera with 2.4 micron pixel size, so capable of high resolution but a small FOV. Since the exposures are very short....just a fraction of a second for each video frame, a cooled camera is not required.

I shot a video 2000 frames long captured with Sharp Cap software, Processed with Autostakkert, which aligns and stacks every video frame then determines which are sharpest and best contrast, selecting about 25% of the best then throws out the rest. Final colorizing and tweaking is done with Photo Shop or similar programs."