



Sign on Highway#17 into Victoria, Aug 2008; by Bruce Lane

## The Return to Solitude

When I took this photo, featuring the mischievous handiwork of a bored municipal worker, I had no thoughts of the time that over ten years later I'd be using it for the topical cover of a newsletter. It was taken from a different time, when zombies were all the rage in pop culture, two years after Max Brook's *World War Z* was published. That was a book about a zombie plague that put civilization on the brink of collapse. That's not what we're facing today and civilization is far from collapsing.

You've been hearing a lot about flattening the curve and social distancing. I'm not going to spend a lot of space in *SkyNews* as an amateur epidemiologist; you'll get more than enough of that on social media. We're not members of the Royal Epidemiology Society of Canada or more properly: the Canadian Society for Epidemiology and Biostatistics (CSEB). As amateur astronomers we should have enough respect for science to listen to the scientific experts and government health authorities. In British Columbia, that means listening to Dr. Bonnie Henry, the Provincial Medical Health Officer. Her voice should carry more weight than any meme, however well intended.

In Canada, we're used to hearing about regional and cultural solitudes. They're usually brandished about publicly, not so much for the sake of preserving the culture or the traditions of the people in those regions, as much as being twisted to further the political aspirations of a few individuals. In reality, Canada is composed of over thirty-seven million solitudes, bound together in a confusing interlacing of shared ideas and identities. It's what creates so much confusion when people are asked to describe what a Canadian is. There are few hobbies that come from a place of solitude more than being an amateur astronomer; one eye to one eyepiece, observing the night sky. That's where we need to be now. The RASC Victoria Centre is a very social group of amateur astronomers, but for a while longer we need to return to our solitudes and our eyepieces.

*Bruce Lane*



Fred Haise (left), Jim Lovell, and Jack Swigert, Apollo 13 launch day breakfast, Apr 11, 1970; scan by Ed Hengeveld, courtesy of NASA

## Editorial Remarks



The beautiful spring weather has arrived on the Coast, but there's not a single event to go to. As an organization we find our sense of belonging to a group is under a threat shared by every other organization. While our social sense of belonging is being chipped away at like never before, people in RASC and the astronomy community are doing what they can provide online connections to the loosely affiliated community of amateur astronomers. A lot of academics are posting lectures; there are some free courses being made available online; and many of those with astronomy gear continue to post their astrophotography. There are also all those books, online tutorials, and blogs you've been meaning to read but never quite had enough time for. It's also never a bad time to do some overdue maintenance on your camera and other astronomy kit. *Victoria Centre SkyNews* will also continue to publish through

the months ahead, as the temperature rises and the nights grow shorter.

In this issue of *SkyNews*, we'll have more recaps from our Centre's activities, an essay about one of the more colourful cosmologists in modern history, a short article on Apollo 13, as well as all the astrophotography and articles you've come to expect from the *Victoria Centre SkyNews*.

*Bruce Lane: SkyNews Editor*

## President's Message for April

The tipping point occurred near the 15th, the Ides of March. Just a few days earlier at the Victoria Centre Monthly Meeting, 50 RASCals enjoyed the entertaining talk by Dr. Tyrone Woods, which involved both super novae and sword fights. While details of the approaching Astronomy Day were presented, there was tension in the air and it was recommended that members monitor HealthLinkBC.ca. By the 17th, Saint Patrick's Day, schools were cancelled, the gates to the DAO were locked, and even the Pubs were closed! In almost an instant, astronomy outreach events, Astro Cafe, Monthly Meetings, Saturday Star Parties, VCO sessions, and the 2020 Vancouver General Assembly were cancelled. What led to this astonishing turnaround? Perhaps it was the eerie images of Italian landmarks, now totally devoid of people. Maybe it was the grim graphs of soaring death totals. Or could it be the announcement that even Tom Hanks was not immune to COVID-19?



Sporting activities like hockey and basketball were among the first casualties. In contrast, the stillness, peace, and wonderment of observing the night sky can be experienced in isolation. One of the joys of the astronomical community, however, is sharing these experiences with others. A "Virtual Astro Cafe" has been set up on <https://victoria.rasc.ca> and it allows you to share your stories, images and links. We have already enjoyed a strong response and we encourage you to forward your contributions to [president@victoria.rasc.ca](mailto:president@victoria.rasc.ca). One of the things missing from this Virtual Astro Cafe, however, is the comments, questions, and banter that make the authentic Astro Cafe a joy. The hosts of Astro Cafe are addressing this shortcoming by holding Astro Cafe Webinars, using software called Zoom. It is scheduled for Mondays at 7:30PM. All you have to do is click on the link provided by the email from the Astro Café host and respond to one or two prompts. It is a surprisingly effective way to achieve a sociable connection at a safe distance. Give it a try!



The mention of Tom Hanks recalls his portrayal of Astronaut, Jim Lovell in the epic movie Apollo 13. The 50th anniversary of the explosion aboard Apollo 13 takes place on April 13th. This is a validation of bad luck for the superstitious! The remarkable success of the earlier Apollo missions fostered a sense of complacency among much of the population. This episode, however, dramatically illustrated the dangers and complexity of these space missions, and riveted the attention of the world until the capsule safely returned. You may not be aware of the Victoria connection of this adventure. Ernie Pfanneschmidt and Frank Younger, of the DAO, were atop Mount Kobau during this mission, and successfully photographed the oxygen cloud that formed in the wake of the explosion. The 16 inch telescope that they used is now residing in the dome connected to the Centre of the Universe. To learn more see pages 6-7 of the Sep 2018 *SkyNews*. Pause and reflect on this historical role when you next peer through the eyepiece of this scope.

Although most Victoria Centre events have been cancelled until further notice, there may be an interesting spectacle to anticipate. Victoria RASCal Martin Gisborne recently imaged comet C/2019 Y4 (ATLAS), discovered by the ATLAS (Asteroid Terrestrial-impact Last Alert System) survey on December 28, 2019. Visit Virtual Astro Cafe to view this image. It is currently situated above the plane of the Solar System moving from Ursa Major to Camelopardalis. It will swoop southward and make its closest approach to Earth on May 23rd. Some have speculated that it will brighten significantly on approach. Prediction of any sort is a reckless business but it might provide a welcome distraction from the global pandemic.

As we work our way through this challenging time remember that we are all in this together. So keep at a safe distance, be kind, and when skies are useable ... look up.

*Reg Dunkley*



## Astro Café: Now Online



The weekly social gathering of amateur astronomers on Monday nights, known as Astro Café, is now online. As with many groups, we're trying to find ways to still function as a Centre, without meeting in person. Members are posting their astrophotography, short articles, as well as links to astronomy stories from the Web. Sadly you'll have to make your own coffee and the only cookies are those your browser picks up when you visit our website. You can access the *Virtual Astro Café* at: <https://victoria.rasc.ca/virtual-astro-cafe/>

At the end of March, Astro Café made a foray into Zoom, a web conferencing program, to give attendees having a more personable web experience. Fortunately, no Zoom-bombers from the Flat Earth Society showed up to crash the party.

*Bruce Lane*

## The 50<sup>th</sup> Anniversary of Apollo 13



Fifty years ago, three men rattling around in a tiny spaceship had to negotiate a disaster that could have meant the end of the Apollo program and them. Jim Lovell was in command, Fred Haise was the lunar module pilot, and Jack Swigert was the command module pilot. Ken Mattingly was originally scheduled to be the command module pilot for Apollo 13, but after he was exposed to the measles, Swigert was chosen to replace him. Add to that the fact that Alan Shepherd was originally scheduled to command Apollo 13, but he was returning to service from an inner ear surgery and it was decided to switch his crew with Lovell's Apollo 14 crew, to give Shepherd more time to get ready. Lovell and Haise were now poised to be the 5<sup>th</sup> and 6<sup>th</sup> men to walk on the Moon, while Swigert

orbited them in the command module, waiting for their return. That was the plan.

An oxygen tank explosion doomed their chance to land on the Moon, but had their excessively oscillating engine not mysteriously turned itself off moments earlier it might have also destroyed the entire spacecraft. As it was, they were 322 000 km from home and in a bad way. The number two oxygen tank had previously been damaged when it was installed for the Apollo 10 mission and was swapped out with a new one for that mission. The exterior was inspected, certified, and it was loaded aboard Apollo 13. If someone had done an internal inspection of the tank they would have noticed that the fill tube inside was dislodged from its position. Number two oxygen tank triggered an alarm in the pre-flight check because it wouldn't empty properly and the ground crew went through their procedures to bleed it, by heating it up, but because the gauges only measured temperature up to 26 degrees Celsius, they were unaware of just how ridiculously overheated the damaged tank actually was and they damaged it further. When Mission Control ordered the Swigert to begin the daily chore of stirring the tanks, less than two minutes after he flipped the switches there was an explosion. The number two tank was located on the exterior of the service module and its shelving thankfully shielded the nearby tanks of hydrogen. If tank one had instead exploded the crew of Apollo 13 would have had no chance for survival. As it was, the blast did some damage to oxygen tank one as well.

They were hesitant to use the big rocket on the service module, which would have shortened their journey, because they were worried it was damaged in the explosion. When they finally did cut the service module loose, their decision was proven the right one, because they could see extensive damage to the spacecraft, including to the thruster nozzle. Had they fired up the rocket on the service module, the whole spaceship would have likely been destroyed. The crew of Apollo 13 took the long way home, using the Moon's gravity to sling shot back from where they'd come. Using the rockets on the landing module to make multiple course corrections was risky, since it was only designed to be used once, during the descent. Despite the destruction of one oxygen tank and damage to another, they weren't in any danger of running out of oxygen in the landing module. The problem instead was polluting the cabin of the landing module with CO<sub>2</sub>, when it was being populated for much longer than planned, and for while with three of them on board. The filters for the service module didn't fit the landing module, so duct tape was used to deal with the additional needs of filters in the landing module to keep the astronauts from being poisoned by their own breath. Jim Lovell and Fred Haise were in the Landing Module, while Jack Swigert finished his work aboard the service module.

Water was another critical issue. The astronaut's onboard water supply was created in a process that was powered by the electrical generator, combining the contents of the oxygen and hydrogen tanks. The shortage of power and loss of the system's oxygen tanks put them in a dangerous situation. They were rationed to 170 milliliters of water a day, far less than the needs of their bodies, and tried to eat as many wet rations as possible. Despite everything they did they were going to run out water five hours before landing. The cold that they endured in the cabin only made them require more water, water that they didn't have. When they did return, they were all extremely dehydrated. Fred Haise ended up suffering a urinary tract infection from his ordeal.

The other big problem to overcome was navigation. The guidance and navigation systems on the service module weren't usable anymore. They lost two fuel cells in the initial explosion and the last one was steadily losing power. They had to conserve the power to maintain the life support just enough to keep themselves alive, but they were far from comfortable. The Apollo missions had a backup navigation system that originated from the 1700s: the sextant. The *primary guidance, navigation, and control system* (PGNCS) was a modernized version, with the sextant and telescope on the outside of the spaceship, while the astronauts controlled it from inside the cabin. The only problem was that the astronauts wouldn't be able to use the guidance system that it was connected to, because it didn't have enough power. There were many stars that astronauts could use to navigate by, but the debris cloud from the explosion clung to their ship making it almost impossible to see any stars at all. They ended up using the Sun. On the way back home they used the dark/light terminator visible on the Earth, in relation to the Sun, to plot their descent, because there wasn't another viable option. They were fortunate to have someone on board who had used the space sextant before. During Apollo 8, Jim Lovell had a bit of a button mashing moment and accidentally erased his navigational data. To make things worse, it happened when the capsule was in its descent phase. NASA informed them that their trajectory was too shallow and they didn't have time to recalculate, so Lovell used the sextant to make their course correction. Of course that time, the sextant's guidance computer was available.





Just like people had been mesmerized about the Apollo 11 mission, the world pressed close to their radios and television sets for news of the three Apollo astronauts facing death in space. The work by the astronauts and the ground staff to return the crew safely back to the Earth successfully met one of the greatest challenges ever faced in space. They were also incredibly fortunate that the landing module's heat shield was undamaged during the explosion or while the debris cloud was surrounding them. Both the Apollo 13 crew and Mission Control Operations Team were awarded the Medal of Freedom. Jim Lovell was aboard two Gemini missions and two Apollo missions, but never got the chance to walk on the Moon. Fred Haise's only chance to walk on the Moon was aboard Apollo 13. He later became a test pilot for the space shuttle program. Jack Swigert was one of the only Apollo astronauts to request duty as a command module pilot, meaning he would never get the chance to walk on the Moon. Apollo 13 was his only mission in the program. Ken Mattingly, who Swigert replaced when the original pilot was exposed to the measles, was the command module pilot for Apollo 16. Mattingly would go on to command two space shuttle missions during the 1980s.

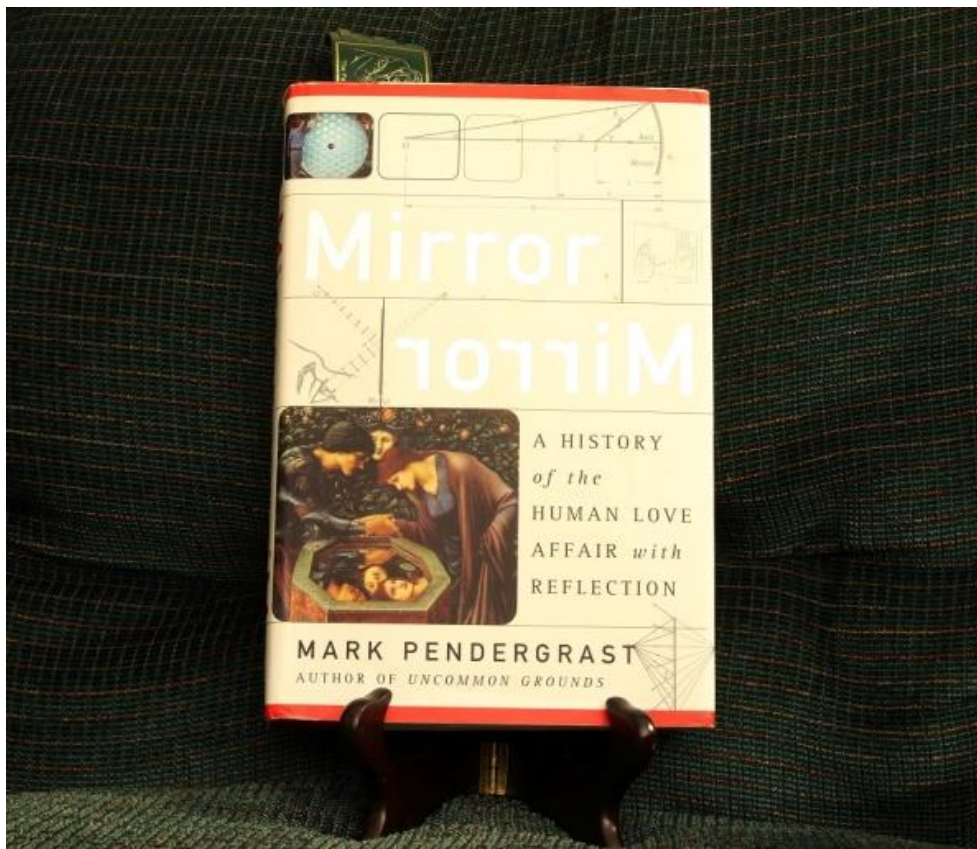
*Bruce Lane*



Mission Control celebrates safe return of Apollo 13 crew. Gene Kranz (right) smokes a cigar, while Deke Slayton (in front of mission patch) shakes hands, Apr 17, 1970; scan by Kipp Teague, courtesy of NASA

## From the Library

The RASC Victoria Centre Library is housed in the Astronomy Department's faculty lounge, located on the 4<sup>th</sup> floor of the Elliott Building, at the University of Victoria. It contains over 500 titles, curated by Diane Bell, our RASC Victoria Librarian. Our library covers many aspects of astronomy: observing, astrophotography, telescope construction, space exploration, astrophysics, and much more. Normally, the library is opened up during the social gatherings in the faculty lounge, after our monthly meetings, with coffee, juice, and cookies provided by our Centre. Sadly, that won't be happening until our monthly meetings resume. I've been doing book reviews of the contents of our Centre's library, but for the time being, I'll be doing reviews of the astronomy books from my personal library; at least ones that can be purchased online or better yet from your local bookstore.



This month we're taking a closer look at *Mirror Mirror: A History of the Human Love Affair with Reflection*, by Mark Pendergrast. *Mirror Mirror* comes at the subject of mirrors from two different views: culturally and scientifically. You're treated with references of mirrors in literature, along with its use in the history of vanity, and development of glassmaking technology. This book also discusses the way mirrors were adapted to scientific optics, with much of that emphasis on astronomy, taking us from the Dutch invention of the refractor all the way to radio and x-ray telescopes. It's a rollercoaster of a book, taking on us a simultaneous tour of the human imagination and scientific exploration. We're introduced to the likes of Leon Foucault, George Ritchey, and Russel Porter, with their sizeable contributions to meet the increasing demands for better optics. *Mirror Mirror* is well worth reading, whether you have an interest in optics or the history of astronomy and it's available from your local bookstore.

*Bruce Lane*





M45 Pleiades, March 18th, 2020; by Dan Posey

## Hill and Dale (Observing on the Island)

While the scheduled weekly observation sessions at the Victoria Centre Observatory are taking a hiatus for the immediate future, there have been quite a few good nights of stargazing available in March and many members are taking advantage their opportunities. For those willing to get up in the early morning, they've been treated by number of planetary occultations. For astrophotographers with their own gear and the will to use it, the shutdown of Centre activities hasn't slowed them down.

The RASC Victoria Council had given the green light to have the 16" Ritchey-Chretien telescope packed up and shipped back to the vendor, to fix its current problems. Unfortunately, all access to Observatory Hill has been temporarily suspended by order of the National Research Council, pursuant to *Article 15* of the *Licence to Use Land for Recreational Purpose Agreement*, including access by the Technical Committee to the Victoria Centre Observatory.

*Bruce Lane*

## Aperture Fever: Space Madness



On a quiet night at the Palomar Observatory, while operating the most expensive scientific instrument on the planet that took decades to construct, a senior astronomer orders the night assistant telescope operator to fire a rifle through the observatory roof's opening. Has an astronomer overreacted after seeing an insect through the eyepiece? Is the 2<sup>nd</sup> Amendment to the Constitution being contested at Palomar? Is this a fevered attempt to break up some clouds, after one too many nights of bad weather? No. It's just Fritz Zwicky doing a science experiment.

Some of the most difficult objects for a telescope to track and image are those passing by, fast and close to the Earth, such as asteroids or comets. Zwicky designed an experiment to see if the mighty 200" Hale Telescope was capable of tracking and imaging a bullet that was breaking the sound barrier, fired from inside the observatory. There doesn't appear to be a lot of data for this experiment and it didn't result in any scientific papers being published. It's possible that repeatedly firing a rifle inside the observatory caused a bit of a commotion on Mount Palomar, with some staff scrambling to see what was happening, while others were locking

themselves in the nearest cupboard. The experiment did result in Zwicky being temporarily banned from Mount Palomar, despite being one of the greatest minds of his time. It's possible the telescope administrators were scared of escalation, since it was rumoured that he had suggested using artillery to fire air burst shells, in an attempt to combat the infamous turbulence in the night sky at Palomar.

The life of Fritz Zwicky spanned the time of some of the greatest discoveries and ideas in astronomy, in which he had no small part. When Fritz was born in 1898, he came into the world where the consensus was that we lived in an Island Universe. Three decades earlier, James Maxwell had already laid siege to the Newtonian Universe, with the publication of *A Dynamical Theory of the Electromagnetic Field* and proving that the speed of light was constant. 1898 was the year that Eros was discovered; a century after the first asteroid was found (then thought of as small planets). That year, George Darwin – doomed as a scientist to always be overshadowed by his father's publishing of *Origin of Species* - made his own waves with the hypothesis that the Moon and the Earth had at one time been part of one planetary body. In the theatres, a Georges Méliès' science fiction/fantasy film called *A Trip to the Moon* was playing.

Fritz Zwicky came from a life of privilege and wealth. His Swiss father was a leading industrialist in Bulgaria and at the age of six, Fritz was sent to live with his grandparents in the family's ancestral home in Switzerland. He was expected to follow in his father's footsteps and was enrolled to study engineering, but mathematics and physics were more to his liking. It still took considerable convincing before his father allowed him to change the path he was put on. He obtained his first degree in mathematics at the Swiss Federal Polytechnic in 1920; a year after Edwin Hubble arrived to begin his career at the Mount Wilson Observatory. When Fritz completed his PhD in 1922, with his thesis about relation between quantum mechanics and ionic crystals, he had already met some of the greatest minds in his field, including Albert Einstein and Wolfgang Pauli (a pioneer in quantum physics).

Fritz Zwicky was employed as an assistant scientist at Swiss Federal Polytechnic and would have most likely spent the rest of his life either there or teaching in Europe had not fate intervened. The Rockefeller Foundation had a strong interest in Physics and in particular the subject of quantum science. A substantial effort was made to recruit experts in quantum science in Europe and bring them to America. In 1925, Zwicky was given a fellowship by the Rockefeller Foundation. He asked for a posting somewhere where there were mountains, so he could participate in the same outdoorsman activities he had enjoyed in the Swiss Alps, and was sent to Caltech. An experienced mountain climber and skier, Fritz Zwicky was a bit underwhelmed by the nearby San Gabriel Mountains, referring to them as foothills. Zwicky's job at the California Institute of Technology was to assist Robert Millikan, a Nobel laureate for his work on electricity, now doing research on how quantum mechanics related to atoms and metals. Zwicky published some papers on the subject, but it wasn't what caught his interest. The San Gabriel Mountains might have failed to impress him but the work being done at the Mount Wilson Observatory did. Fritz once had a *Sheldon Cooper* moment, telling his Nobel laureate boss that he had read all of his papers and couldn't find a single original idea. Zwicky stated that he himself only had a great new idea once every two years, in whatever field he was working in. Nobody would ever accuse Fritz Zwicky of being humble. He challenged Millikan to pick a field for him and his boss suggested that he try astrophysics. Once more, Fritz changed his focus and this time he found his true calling. Once his work wrapped up with his two year fellowship, he began studying cosmic rays. He was made an associate professor of physics at Caltech in 1929. The conservative, old guard of astronomers at Caltech and Mount Wilson would soon wish that Robert Millikan had challenged him to take up art history or botany.

In 1931, Zwicky began working closely to study novae with German astronomer, Walter Baade. Fritz came to the conclusion that there was a link between cosmic rays and novae. The two of them hit a wall in their study of novae, until a year later when James Chadwick discovered the neutron. After this revelation, Zwicky and Baade hypothesized the existence of neutron stars and they invented the term *supernova* to describe the death of massive stars. It was a huge jump leap forward in explaining the end of a star's life cycle and many astronomers were outraged that their meticulously ordered Universe was being upended by these two upstarts. Baade and Zwicky had just shown up the entire astronomy community, and they were both just getting started. The two of them decided they needed a new astronomical instrument to continue their work, but what they wanted wouldn't be a reflector or refractor. Fritz Zwicky secured funding and permission from George Hale for a new telescope to be built at Palomar, while the primary 200" telescope was still under construction. Under the pretext that the main telescope would be well served by having a smaller telescope to scout out targets for it, he asked for a catadioptric telescope. George Ritchey had been turned down from doing the same thing at Mount Wilson, but while Ritchey was a skilled astrophotographer and telescope designer, Zwicky and Baade were doing ground breaking work in the science of astronomy. Hale appreciated the genius of fellow scientists and even more so when they increased the prestige of the observatories he had spent his life building. Baade wrote a letter of introduction to a friend of Bernard Schmidt, who had just built the first Schmidt observatory telescope in Hamburg, Germany. Zwicky travelled in person to Germany, to get Schmidt's help to design a catadioptric telescope of his own namesake. The project at Palomar was overseen by John Anderson, who was already overseeing a substantial portion of the work on the 200" telescope, and to everyone's amazement and a lot of work by Zwicky, the 18" (457mm) Schmidt telescope was operational a year after work started. Following the tradition of Caltech astronomers, Zwicky soon asked for an even bigger Schmidt telescope to be built. Work began on the 48" (1219mm) telescope in 1939 and it was completed in 1948, taking a little longer due to the interruption caused by the war. Zwicky would use these telescopes to discover 129 supernovae in other galaxies, more than any other astronomer until long after his death, when technology made that possible for those who came after him.



While studying the Coma Cluster (Abel 1656), a cluster of over 1000 known galaxies, he couldn't reconcile the observable mass with the gravitational effects that he was observing. In 1933, he concluded that these galaxies must be denser than what he was observing or in the words of Zwicky *"If this would be confirmed we would get the surprising result that dark matter is present in much greater amount than luminous matter."* It marked the beginning of the quest for dark matter. Telling the astronomers that most of the matter of the Universe wasn't something that they could observe through their telescopes was another shot across the bow of the astronomy establishment. What started out as another dismissed idea of Zwicky's would eventually become so widely accepted by mainstream astrophysicists and astronomers that they regularly forget that it is still only a hypothesis. While Edwin Hubble, along with most astronomers of his time, believed that galaxies were evenly distributed throughout the Universe, Zwicky was resolute in his belief that almost all galaxies were part of galactic clusters; although he later resisted the idea of his clusters existing in super clusters. Even while Hubble was currently wearing the mantle of a revolutionary, after the destruction of the Island Universe Theory, he was starting to become aware that a much more radical revolutionary had just entered the battleground of cosmology. Other astronomers were also taking note that a trespasser had come to their sacred observatory, seeking to tear down their carefully ordered Universe.



In 1937, Fritz Zwicky became the first person to come up with the idea of using galaxy clusters to do gravitational lensing, to observe objects behind them by their light being bent by space-time. Einstein had come up with the idea of gravitational lensing with stars in 1912, but only got around to publishing his idea in 1936. The first use of gravitational lensing was done on a galactic scale, to observe a double quasar in 1979. Not all of Fritz Zwicky's ideas were gold. He never believed that the Universe was expanding. Zwicky thought that the red shifting being observed was something he called *tired light*. Tired light happened when some unknown phenomenon made photons lose energy as they traveled through

space. One can only imagine how Hubble reacted to this hypothesis. Part of the problem that Zwicky had with the expansion of the Universe came from incorrect measurements made by Hubble and the fact that the accepted age of the Universe at that time didn't match up well with the formation of galactic clusters. These two issues would be mostly corrected by the later work of other astronomers, especially by Walter Baade, who would point out many of Hubble's mistakes and become his bitter rival. Tired light may not have held up to the observations of professional astronomers, but it remains an idea still being examined on the fringe of astrophysics. Who knows? The way things have turned out in the unsuccessful search for dark matter and the failure to agree on a single model for expansion, in a few decades we could end up with dark matter being filed away to the fringes and tired light taking the place of expansion.

Things between Walter Baade and Fritz Zwicky went from amicable to antagonistic over the years. It was a shame, considering the body of their work together from just a few years could have been the beginning of something much greater. It didn't help when Baade took credit for discovering a pair of dwarf galaxies, later proven in a letter to Hubble to have been discovered by Zwicky. The Swiss Astrophysicist was already a little wary that as a rising star in the astronomy community, Baade would get the lion's share of the credit for their three shared papers. Just like Edwin Hubble and many

other astronomers, Zwicky constantly feared his ideas would be stolen by the astronomers at Mount Wilson. The relationship became irreconcilable with the rise of Adolf Hitler in Germany, in part due to the fact that Baade was pressured to sign an oath of allegiance to the chancellor and leader of the Nazi Party. Walter did manage to carefully avoid ever becoming a member of the Nazi Party, something most German scientists overseas routinely did to keep his family and friends safe back at home.

With the cessation of activity at both Mount Wilson and Palomar, after the bombing of Pearl Harbour, Fritz Zwicky's mind was enlisted into the war effort. Despite not having an American citizenship, he was quickly given a temporary exemption to work on sensitive defence projects. Zwicky was among the Caltech scientists working for the Aerojet Engineering Corporation since its founding in 1936, but there really wasn't much interest in rockets until the war started. In 1943, Aerojet supplied 3000 rockets to the US Air Corps, designed to outfit planes for jet assisted take off, and the Swiss astrophysicist was put in charge of Aerojet's research department. He championed the idea of using autogyros for rapid troop deployment, decades before helicopters would play an important role in the conflicts in both Korea and Vietnam, but Allied command wasn't interested. Scientists were for developing new inventions for them to make use of, not revolutionizing tactics. After the war, Zwicky was taken to tour a number of secret project facilities in both Germany and

Japan. The Swiss astrophysicist was also selected to be one of the first three people to interview the leading enemy rocket expert, Nazi Party member, and SS Major: Wernher von Braun (*Ed. That's an interview transcript I would really like to read*).

For his role in World War II, Fritz Zwicky was presented with the Medal of Freedom by President Truman, the first time a foreign citizen ever received the award. He kept inventing new uses for jets after the war, such as the first underwater jet engine, designed to power a torpedo. The Swiss astrophysicist designed a jet powered tunneling device, called the Terrajet, that was never built, but would later inspire the tunneling machine used by the Boring Company, owned by Elon Musk. He also continued to do research on rocket fuel that would later benefit the space program. Zwicky became a person of interest during Joseph McCarthy's witch hunt in search of communists lurking in America. This despite his very vocal opposition to the Soviet Union, for as long as there had been a Soviet Union, and having developed a system for the US military to detect Soviet missile launches. Paranoid minds in Washington were worried about the dangerous secrets locked away in the mind of Fritz Zwicky and what would happen if they fell into the wrong hands. He lost his special status in the defence industry, after again rejecting a request to apply for American citizenship, and was forced to leave Aerojet over the matter. Zwicky regarded naturalized citizenship as a second rate status and preferred to retain his own Swiss citizenship. Twelve days after Sputnik made its dramatic debut in 1957, Fritz made his own orbital launch, courtesy of the US Army. The Swiss astrophysicist used a captured V2 rocket to launch a number of small aluminum balls into space, using shaped charges that were detonated 87km over New Mexico, to give them a boost. Tracking cameras indicated that at least one of the balls, referred to as *Artificial Planet Zero*, had the velocity and trajectory to escape Earth's gravity. The American government still insists that their first successful orbital mission was the launch of the Explorer I satellite, a year later. I personally prefer the Zwicky launch, because it's so much more of a *space cowboy* response to Sputnik. If you ever find yourself at the National Space Hall of Fame in New Mexico, there's a plaque dedicated to Zwicky's rocket launch, in response to the Soviets.

Allan Sandage and Tom Matthews were the first to study the mysterious quasi-stellar radio sources that were being detected by radio telescopes since 1959. The only thing that astronomers could agree on was that they were points of light, similar to a star. That and almost everyone disliked the catchy name of *quasar* that a NASA physicist had coined. In 1962, a pair of radio astronomers in Australia were able to use the occultation of Quasar 3C 273 by the Moon to find its location in the night sky. Using this new information, Dutch astronomer Maarten Schmidt observed and imaged the source of Quasar 3C 273: a little blue "star" in Virgo. When he examined the spectrum and measured the red shift, Schmidt was astonished by the results. This was an object 4 trillion times brighter than our own Sun and billions of light years away. Maarten Schmidt rushed to publish his ground breaking findings in *Nature* magazine. Another astronomer, Jesse Greenstein, pounced on the discovery to write a paper of his own on the subject of his observations of Quasar 3C 48, citing Matthews as a co-author. The failure to cite Allan Sandage resulted in Greenstein's portrait being displayed for a

while on Sandage's office door, in Pasadena. Later, Greenstein's picture was still hanging on the door to the office, but it was vandalized. Not citing people properly for their work was a touchy subject among astronomers, as was claim jumping onto other people's studies. This became relevant, when Allan Sandage made a colossal mistake of his own. Sandage made the connection between the faint bluish Haro-Luyton stars and quasars. He rushed to publish his findings, without having it peer reviewed, and gave a lecture on the subject at Caltech, while the paper was still at the printers. Fritz Zwicky was present for the lecture and was not very happy. The Swiss astrophysicist had already published some of these observations himself, which Sandage claimed to have never read, despite being on the same specific subject Sandage had been studying for years. Feeling ashamed, Sandage left for Europe before his paper was even published and stayed there, until he felt it was safe to return to the American astronomy community in Pasadena. For years afterwards, one of the astronomer's night assistants at Palomar would leave an open book, by Fritz Zwicky, in the observatory's reading room at night and every morning it was returned to the book shelf.

From 1961-68, Fritz Zwicky worked with a number of other astronomers to create the comprehensive *Catalogue of Galaxies and of Clusters of Galaxies*, with details about 29 418 galaxies and 9134 galaxy clusters. He wrote 300 articles or papers, 10 books, and held dozens of patents for his inventions. He was made an honorary professor, professor emeritus, by Caltech just before retiring as a professor.

Fritz Zwicky credited his problem solving ability by using a general morphological analysis system he had invented. This system made use of a morphological box matrix, seeking every probability, and often coming up with some very unusual solutions. He used this problem solving system to tackle everything from cosmology to air pollution in Los Angeles (his answer to the latter was to charge a toll for single passenger vehicles coming into the city). This form of *guided intuition*, allowed him to take a non-linear approach to deep thinking. What set Zwicky's system apart from some earlier problem solving systems of this type was that his wasn't tailored to be applied to one specific discipline. It could be used on anything. He gave his first speech about his problem solving system in 1948 and published a book on the subject in 1969 called *Discovery, Invention, Research through the morphological approach*.

Fritz Zwicky was a big idea scientist in an era where big idea scientists were laying the groundwork for modern astronomy and generally being resented for it. He was often referred to as arrogant and abrasive, with the additional habit of stubbornly defending his ideas to the bitter end. The problem was likely more to do with being an astrophysicist muscling in on the territory of professional astronomers and throwing his substantial intellect around; something especially upsetting to the professional astronomers who were themselves often described as being arrogant and abrasive, and stubbornly holding on to their scientific beliefs to the bitter end. His enemies in the scientific community continued their belittling attacks on his character and spreading rumours about him long after his death. This has not been well regarded by his surviving family, resulting in a number of law suits. Given his contributions to science it's shocking to see how few accolades and recognition he has been given by his peers, a testament to the pettiness that can take a hold of scientific institutions that should instead be more concerned about seeking the truth of things. As soon as Fritz Zwicky retired from his position at Caltech, the more conservative and petty of these astronomers, in charge of the Palomar observatory, drafted a suspiciously timed and very specific rule that effectively banned Zwicky from ever using the 200" Hale Telescope again.

Fritz Zwicky had a lot of respect for Milton Humason and credited him with helping the physicists find their way around Palomar, at a time when they were mostly regarded as trespassers by the resident astronomer community. He sympathized with Humason, in that he understood what it was to accomplish so much and receive so little credit for it. After Milton Humason died in 1972, Zwicky wrote a letter to his widow to say just how much he had been appreciated, both personally and for his contributions to science. That same year, Zwicky received the Gold Medal from the Royal Astronomical Society for his life's work. Fritz Zwicky was still working on and publishing scientific papers right up until the year he died in 1974.

*Bruce Lane*





Jim Lovell reads newspaper about Apollo 13, April 17th, 1970; scan by Kipp Teague, courtesy of NASA

## Astronomical Term of the Month: Chromatic Aberration

Aberrations occur with astronomy optics because a point of light going in one end of the optical system doesn't all end up going in a straight line to another point at the other end. Light can get dispersed from one end of an optical system to the other. In the case of a chromatic aberration it's caused by a wavelength(s) of light being unevenly refracted through the telescope, causing one or more colours to appear to be bleeding, when viewing brighter solar system targets. It might even appear like director JJ Abrams decided you needed just a little more lens flare in your observing or imaging experience.

Lateral chromatic aberration will most commonly happen when using a shorter focal length refractor. Longer focal length refractors are designed for planetary work and are long enough so that this isn't an issue. You also need to understand that the wider the primary lens of the refractor the longer the focal length needs to be to avoid chromatic aberration from having too fast a focal ratio for their aperture. It's one reason, besides expense, why you don't tend to see people with huge refractors that are longer than their car. At a certain point doing this becomes wildly impractical and extremely non-portable. Because this is an issue, why would anyone use a short focal length refractor? They have a wider field of view, which can be desirable for doing astrophotography of star fields, where lower magnification makes focusing easier and a lower focal ratio saves precious camera stops. There are also a lot of cheaper models of these available, so for many people it's the only way they can afford to buy a refractor telescope. If you're willing to back off from your maximum useful

magnification you can also limit the effects of this type of aberration. Another way that refractor telescope designers avoid chromatic aberration is by using double or triple primary lenses. These types of telescope are generally much more expensive than regular achromatic refractors. The doublet lens set is designed to eliminate most issues a telescope might have with chromatic aberrations and a triplet lens set will outright eliminate the issue for you. These refractors with multiple lenses are often referred to as being apochromatic. ED glass (extra-low dispersion glass) also helps limit the effects of chromatic aberrations in optics. There are even special optical coatings used to give the best resolution possible, when using your refractors, so you should be careful when cleaning them.

Because Barlows have more than one glass element, their act of division on the telescope's focal length does not usually make it more prone to chromatic aberration. The exception might be if you used a particularly cheap or poorly made Barlow. Field flattener-reducers can introduce chromatic aberrations, depending on their quality and how well it is matched for the telescope you're using it with. In any case, if it's well matched for use with your refractor it's likely that any chromatic aberration will show up more visually and less when imaging, especially if you're doing astrophotography of a rich star field. Of course, the other way to deal with chromatic aberrations is to just use a reflector telescope, but they have their own optical aberrations to contend with.

Bruce Lane

## In Closing



In a month commemorating the 50th anniversary of the Apollo 13 mission and the 59th anniversary of Yuri Gagarin's historic spaceflight, you could be forgiven for being a bit distracted. *Cancel Culture* has taken on a new meaning thanks to Covid-19, known by many as the coronavirus, despite how many different strains of coronavirus there are. It's a particularly tough pill to swallow for event organizers and volunteers, who spend a lot of time and effort preparing the various activities for our astronomy club. The enthusiasm those members have is what we'll need a lot of when all this seclusion comes to an end. I remember seeing some of the organizers, for our 2014 RASC General Assembly in Victoria, run ragged to the point of burning out. That's why I know that this is going

to be particularly hard on the organizers of the General Assembly that was scheduled for this June in Vancouver, now that it too has been canceled. A week ago was when the Vancouver Island Science Fair was supposed to have been held, something several members participate in as organizers and judges, and more importantly that many children in the region have long prepared for. Astronomy Day, with events both at the Royal BC Museum and the Plaskett Observatory, has been cancelled. Having your plans cancelled is something that likely nobody has more experience with than an amateur astronomer; especially one living on the West Coast. How many times have we waited in anticipation for good weather to view an event in the night sky, only to be frustrated by the clouds? How many comets, lunar eclipses, and other observing events have we lost the opportunity to see due to poor weather? It's something you have to make peace with as an amateur astronomer. Now it seems like you can go out and observe the night sky whenever you want, but just not with the other kids.

For many of us, all these closures mean the opportunity to really focus on learning something new or more deeply, if we can just stop watching cat videos for a few hours. For those of you now dealing with stir crazy children, no longer at daycare or school, while also checking on elderly relatives, it's likely turned working from home into a daily endurance event. It's often pointed out that a lot of humanity's great works were made while their creators were in quarantine. Isaac Newton invented calculus and laid the groundwork for his theory of gravity; Shakespeare wrote *King Lear*; and Giovanni Boccaccio wrote *the Decameron* (about a group of friends telling each other stories while quarantined from the plague in Florence). Naturally, the Stoic in me asks: what about the vast majority of people who were just hunkered down without a

thought more than survival or frittering away their time watching the equivalent of cat videos? It's certainly the more likely result from having a lot of spare time. We're very privileged in the wide assortments of entertainment and distractions available to us, more so now than at any other time in history. Hopefully, sometime between binge-watching an entire TV series and becoming further ensnared by social media, you'll take the opportunity to pick up a few books, read some academic papers, or take an online course. And if it's a clear night, it probably wouldn't hurt to take a telescope or binoculars outside to have a look at the night sky.

*Bruce Lane: SkyNews Editor*

## Photography Credits

Cover: "Caution Zombies Ahead", taken on Highway#17 into Victoria, Aug 2008; by Bruce Lane

Page 2: Fred Haise (left), Jim Lovell, and Jack Swigert having launch day breakfast, Apr 11, 1970; scan by Ed Hengeveld, courtesy of NASA

Page 3: Crop of Bruce Lane (SkyNews Editor) at 2013 RASCal Star Party in Metchosin, by Chris Gainor

Page 3: Crop of Reg Dunkley (RASC Victoria President) at 2018 AGM, by Joe Carr

Page 4: Group of astronauts and flight controllers crowd around the consoles at Mission Control, Apr 13, 1970; scan by Kipp Teague, courtesy of NASA

Page 5: Photograph and Design of Astro Cafe Mug, by Joe Carr

Page 5: Guenter Wendt, seated at the Command Module hatch, signals to the Apollo 13 crew, Apr 11, 1970; scan by Kipp Teague, courtesy of NASA

Page 6: Damaged Service Module, viewed after separation, Apr 17, 1970; scan by Kipp Teague, courtesy of NASA

Page 7: Mission Control celebrates safe return of Apollo 13 crew. Gene Kranz (right) smokes a cigar, while Deke Slayton (in front of mission patch) shakes hands, Apr 17, 1970; scan by Kipp Teague, courtesy of NASA

Page 8: Posed Book, "Mirror Mirror", taken at editor's home on Apr 13, 2020, by Bruce Lane

Page 9: M45 Pleiades, nearly one hour of 30 second exposures, with Sony 200-600mm lens at 600mm/f6.3 and my unmodified A7III at ISO 3200, taken Mar 18, 2020; by Dan Posey

Page 10: Orion Nebula, imaged from downtown Victoria, Canon 6D camera with Hutech HEUIB II filter on Williams Optics 105mm scope with Orion AVX mount, Exposure - 83 7.7sec exposures at ISO 3200 with 8 flats and 49 dark frames for calibration, processed in ImagesPlus and Photoshop, Mar 17, 2020; by John McDonald

Page 12: Mars, Jupiter, Moon, Saturn, and a ship, early in the morning of Mar 18, 2020; by Randy Enkin

Page 15: Jim Lovell reads newspaper about Apollo 13, Apr 17, 1970; scan by Kipp Teague, courtesy of NASA

Page 16: "Hawk" and "Misty" sunning in the rose garden, Apr 12, 2020, by Bruce Lane

Page 18: Al Shepherd and Ed Mitchell (Apollo 14) training at Kapoho, Hawaii, Apr 2-4, 1970; scan by JL Pickering, courtesy of NASA

## Call for Article and Photo Submissions for May Issue

SkyNews is looking for submissions of astronomy photos and articles for the May issue of our Victoria Centre's magazine. Send your submissions to [editor@victoria.rasc.ca](mailto:editor@victoria.rasc.ca)



## RASC Victoria Centre Council 2020

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Al Shepard and Ed Mitchell (Apollo 14) training at Kapoho, Hawaii, Apr 2-4, 1970