Volume 126 No. 4
April 2017

The Bulletin

Monthly newsletter of the Astronomical Society of South Australia Inc

ASSA 125 years 1892-2017

In this issue:

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- Astronomical discoveries during ASSA's second decade
- Trappist-1 - 7 Earth-sized planets orbit this dim star
- Observing Copeland's Septet in Leo
-

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ASTRONOMICAL SOCIETY of SOUTH AUSTRALIA Inc

GPO Box 199, Adelaide SA 5001

The Society (ASSA) can be contacted by post to the address above, or by e-mail to *info@assa.org.au.* Membership of the Society is open to all, with the only prerequisite being an interest in Astronomy.

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Full Member	$75
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http://www.assa.org.au
or by contacting The Secretary (see contacts page).

Member Submissions
Submissions for inclusion in The Bulletin are welcome from all members; submissions may be held over for later editions.

Wherever possible, text submissions should be sent via e-mail or posted on CD-ROM in almost any word processing format and may still be submitted handwritten or typed. Your name may be withheld only if requested at the time of submitting. Images should be high resolution and uncompressed, e.g. TIFF file formats, although high resolution JPEGs are acceptable. Your full name and object designation must be provided with each image and will be published. Equipment/exposure etc details are welcome but optional.

Advertising & Classifieds
Small adverts and classifieds are free for members (space permitting). Commercial advertising is available at a cost of $50.00 per quarter page per issue.

All enquiries and submissions should be addressed to The Editor and preferably sent by e-mail to:
editor@assa.org.au

For large files (e.g. on CD) or hardcopy items, post to:
Joe Grida
Editor, The Bulletin
PO Box 682,
Mylor SA 5153

Contributions should reach the Editor no later than the 7th of each month, for publication in the following month's issue of The Bulletin

In this issue:

Sister Society relationships with:

Orange County Astronomers
www.ocastronomers.org
Colorado Springs Astronomical Society
www.csastro.org
Central Arkansas Astronomical Society
www.caasastro.org
Arkansas-Oklohoma Astronomical Society
www.aoas.org
Gruppo Astrofili di Piacenza (Italy)
www.astrofilipc.it

Cover photo:
The Large Magellanic Cloud imaged by **David Jenke** from Eudunda SA**.** Taken with QHY8 CCD Camera and Canon 70-200mm f4 lens set to 200mm. Total exposure of 2hrs exp comprising of 12 x 10min subs

Activities

April 2017 - the month at a glance

Happy Birthday, ASSA
Celebrating 125 years in 2017!

General Meeting

Wednesday, 5 April 2017
@ 8:00pm
Kerr Grant Lecture Theatre
2nd Floor, Physics Blg
University of Adelaide
North Terrace, Adelaide

Guest Speaker:
Dr Robert Dahni
Author of Cloud Free Night

Cloud Free Night (***Cloud Forecasts for Australian Astronomers***) is a non-profit online weather forecast information service, for the benefit of the Australian amateur and professional research astronomy community.

It is unique in offering a comparison of the widely available forecasts from the United States GFS global model with higher resolution forecasts from the Australian Bureau of Meteorology ACCESS model.

Let me take you on a journey into the past, present and future of the Cloud Free Night service, highlighting not only the meteorological, astronomical and technical aspects, but the personal contributions in the development of this extraordinary service.

Planning on going observing?

Save yourself unnecessary travel and time. If the weather looks doubtful where you are, check with the following people to see if the event is still on (or see www.assa.org.au after 5pm).

Stockport Observatory (DO 3-13)

Observatory 8528 2284

Lyn Grida 8391 5377

Tony Beresford 8338 1231

Heights Observatory (DO 3-34)

Robert Bronca 8266 7504

Whyalla

Peter Mayfield 0405 410 895

Tooperang

Jeff Lowrey 0429 690 610

Northern Yorke Peninsula

Tony "Hendy" Henderson 0429 352 382

Riverland

Tim Vivian 0407 800 225

April 2017 Calendar

Day		Time	Activity
Wed	5	7:00pm	Beginners' Meeting, Adelaide
Wed	5	8:00pm	General Meeting, Adelaide
Thu	6	7:30pm	Whyalla Members' Meeting
Fri	7	8:00pm	Public Viewing Night, The Heights
Tue	18	7:30pm	ASSA Council Meeting
Sat	22	8:00pm	Members' Viewing Night, Stockport
Fri	28	7:30pm	Astro-imaging Group, Modbury
Fri	28	8:00pm	Public & Members' Viewing, NYP
Sat	29	8:00pm	Members' Viewing Night, Tooperang
Sat	29	4:00pm	New Members' Night, Stockport
Sat	29	8:00pm	Members' Viewing Night, Stockport

Note: Times shown above and throughout this document are:
2 Oct 2016 to 1 Apr 2017 : South Australia Summer Time (UTC+10:30)
2 Apr 2017 to 1 Oct 2017 : South Australia Standard Time (UTC+ 9:30)

Astronomy Education

Wednesday, 5 April 2017 @ 7:00pm
Kerr Grant Lecture Theatre

Planetary Moons & Asteroids

The Solar System is home to over 100 moons and thousands of asteroids.

We will explore some of the major satellites and minor planets and look at the various asteroid belts and populations.

Reports and Notices

Reports on recent ASSA activities, and notices of upcoming events

Guest Speaker Biography

Dr Robert Dahni

Dr Robert Dahni is a retired meteorologist who worked in the Australian Bureau of Meteorology for over 30 years.

His roles included weather forecasting, IT support in research and operations, data management and software development for domestic and international projects.

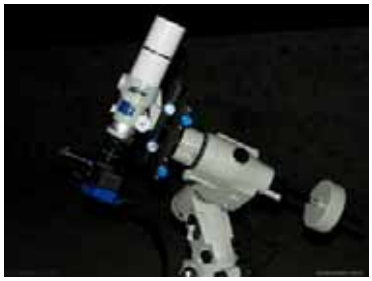
He is skilled in the analysis and visualisation of meteorological data, including the mapping of weather information and development of decision support systems.

In his retirement, he has combined his passion for weather with a re-ignition of his interest in astronomy (now astrophotography) from his youth.

Astro-Imaging Group Meeting

Friday 28 April @ 7:30PM
University Of The Third Age,
22 Golden Grove Rd, Modbury North
Enter via Gold Court to access Car Park 1

There seems to be an endless list of new Astro-Imaging equipment these days, with DIY/Modding gear more active than ever.



This month's Astro-Imaging Group meeting will be a **Show & Tell - Buy & Sell session**, so bring along any imaging gear, or software, that you have recently acquired to present to the group. If you have any old gear that you would like to sell, bring that along too.

Please bring any images that you would like to share with the group on a USB memory stick. Any questions, contact the Group Coordinator, Jeff Lusher: **imaging@assa.org.au**

New Members' Night @ Stockport Observatory

April 29, 2017

If you have joined ASSA for the first time or perhaps you have been a member for a while and have never been to Stockport, then here is your chance.

A night for new members is to be held at Stockport Observatory on the 2nd of April, which is a regular members' night, so that you can meet the more experienced observers as well as other new members.

The night will commence at 4:00pm with a tour of the facility followed by a mini telescope clinic, so bring along your scopes and we will help with questions you may have regarding setting up and using them.

At the BBQ that follows, you will have the opportunity to mingle with your fellow members and get the chance to see some of the equipment others have brought along before it gets too dark.

Later, you will get the chance to view the heavens through the Society's telescopes or any of the other scopes that will be available on the night.

So if you are new to ASSA and want to experience Stockport for the first time, then come along to a night dedicated to you and get to know your society and the people who make it what it is.

It is important to let me know if you intend to come to this event, so we can cater for the BBQ. Send an email to beginners@assa.org.au or ring (08) 8523 0211 a/h.

Colin Hill

History of Astronomy

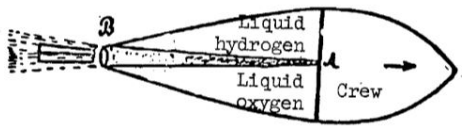
Andrew Collings reviews some of the astronomical discoveries since ASSA was formed.

This instalment covers the ASSA's second decade - **1902-1911:** With new and improving techniques and instruments there had been an explosion in the amount of data collected. But with these advances astronomy was starting to move from astrometry to astrophysics and into the realms of *"How?"*, *"Why?"* and even, *"What the Heck!?"*

"Nature and Nature's laws lay hid in night:
God said, Let Newton be! — and all was light."
– Alexander Pope, 'Epitaph on Sir Isaac Newton'

"It did not last: the devil, shouting "Ho.
Let Einstein be," restored the status quo."
– J C Squire, 'In Continuation of Pope on Newton'

1903: Konstantin Tsiolkovsky publishes *'Exploration of the Universe with Reaction Machines'*. In this paper he uses his previously developed rocket equation and calculates the most efficient trajectory and velocity required to reach earth orbit. He also suggests liquid oxygen and liquid hydrogen be used to fuel the rocket. First flight at Kitty Hawk, North Carolina by Wilbur and Orville Wright. We are on our way to the stars.



Sketch of K. E. Tsiolkovskiy's reaction machine.

1902-1911 Tsiolkovsky's rocket.jpg : source COLLECTED WORKS OF K. E. TSIOLKOVSKIY VOLUME II - REACTIVE FLYING, MACHINES (NASA TT F-237)

1904: The Mount Wilson solar observatory is founded near Los Angeles by George Hale. The 40 inch refractor at Yerkes Observatory is moved here and a $300,000 grant from the Carnegie Foundation is secured to complete and install the 60 inch reflector blank that has been in storage since 1897. The grinding of this 19cm thick 860kg mirror blank begins in 1905 and takes 2 years. Transportation to the observatory at 1742m altitude is a massive task, but worth the effort as this 60 inch telescope is to become one of the most successful and productive.

While studying proper motions of stars Jacobus Kapteyn discovers there is a pattern and their movement is not just random as was thought. In retrospect this was the first indication of the rotation of the Milky Way.

The first detection of interstellar gas was made by Johannes Hartmann during his investigation of the orbit of Delta Orionis (a multiple star system). Absorption line spectroscopy showed the 'K' Line for calcium was extremely weak and did not suffer the periodic shift due to the orbit. Hartmann posits this was due to gas between us and the star.

1905: Forest Ray Moulton and Thomas Chrowder Chamberlin propose their 'planetesimal' hypothesis for the formation of the solar system. In conjunction with the mechanism behind solar prominences a near collision with another star causes material to be repeatedly pulled from the sun and star. This material condenses into many small bodies ('planetesimals') that congregate over time to form the planets and their moons. They publish this hypothesis the following year and the idea holds sway for over 3 decades.

Working from different directions Enjar Hertzsprung and Henry Norris Russell independently observe that on average fainter stars are redder than bright stars.
The Special Theory of Relativity is introduced in Albert Einstein's paper *'Electrodynamics of Moving Bodies'* and the world gets a little weird. Space and time are bound, a speed limit is imposed throughout the universe and simultaneous events need not happen at the same time. Also, thanks to time dilation, length contraction and mass variation, if you run *really* fast you'll age more slowly and get thinner but unfortunately your mass will increase.. so it's up to you if you go for that run tomorrow.

1906: Hertzsprung shows that there is a relationship between colour and absolute magnitude for 90% of stars observed.
The 60 inch telescope at Mount Wilson observatory is not yet complete, yet Hale is at it again. With $45,000 of vital funding from John D. Hooker he commissions the Saint-Gobain factory to cast the blank for an even larger mirror. First light for what will be the 100 inch Hooker Telescope is still over a decade away.

Max Wolf discovers the first Jupiter trojan asteroid, 588 Achilles. (There are now over 6,100 of these asteroids known.) Jupiter Trojans share the orbit of Jupiter and are congregated in 2 regions about stable Lagrangian points 60 degree ahead of and behind the planet.

Lowell publishes *'Mars and it's Canals'* suggesting that the canals were built to move water from the poles to drier regions. This view gains popular rather than scientific support.

History of Astronomy

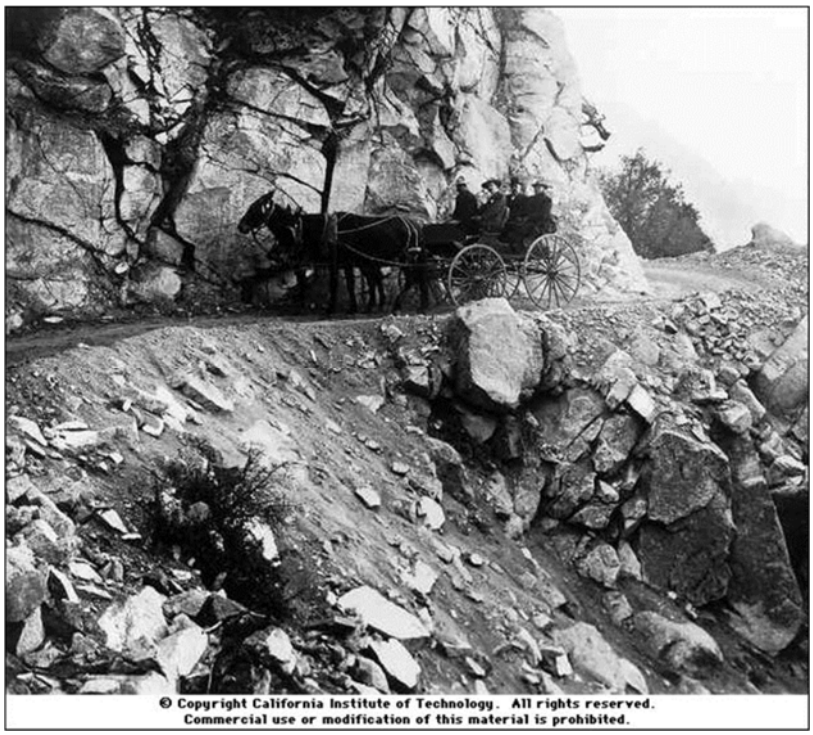
Andrew Collings reviews some of the astronomical discoveries since ASSA was formed.

1908: George Ellery Hale determines that sunspots are strongly magnetised. This is the first discovery of magnetic fields outside of Earth.

The 60 inch telescope is completed at Mount Wilson and becomes the largest operational telescope in the world.
This marks a change in observing, where the largest and best telescopes are now reflectors.
A whole pile of trees gets knocked down in Tunguska, Siberia. Was it the largest meteor impact in recorded history, or was it Nikola Tesla? Conspiracy theories abound.

Lowell publishes his third and final book concerning Mars, *'Mars as the Abode of Life'*.

Annie S. D. Maunder publishes *'The Heavens and their Story'* with her husband Walter as co-author (Walter credits her in the preface as the primary author.) The book contains her photographs of the moon and the Milky Way.



Above: *1902-1911 Mount Wilson - Hale and Co.jpg (the passengers are Hale, George Ritchey, and John D. Hooker, : early 1900's, source http://www.stsci.edu/~inr/observ/obs5.htm*

Henrietta Swan Leavitt discovers Cepheid variables. A correlation between absolute magnitude and period of variability allows them to be used to calculate distance. Due to their high luminosity Cepheid variables can be seen in very distant galaxies where other methods of calculating distance may fail.

1909: In his autobiography Mark Twain writes, *"I came in with Halley's comet in 1835. It is coming again next year, and I expect to go out with it. It will be the greatest disappointment of my life if I don't go out with Halley's comet. The Almighty has said, no doubt: 'Now here are these two unaccountable freaks; they came in together, they must go out together.'"* Mr Twain wasn't disappointed, on April 21, 1910, the day after Halley's comet reaches perihelion he died of a heart attack.

Above: *1902-1911 Halley's_Comet_-_May_29_1910.jpg source: Published in the New York Times on July 3, 1910*

1910: As Halley's comet makes its approach Yerkes Observatory finds evidence of the poisonous gas cyanogen in its tail. As Earth will pass through the comet's tail Camille Flammarion claims the *"gas would impregnate the atmosphere and possibly snuff out all life on the planet"*. While this is not a widely held view amongst astronomers there is still a brisk trade in gas masks and 'comet pills.' On May the 19th earth spends 6 hours in the tail of Halley's Comet, no-one dies and Pope Pius X tweets *"Entire Shown Overblown"* or at least he would have if he had twitter. Staunch to the end Flammarion claims 4 people had olfactory experiences.

1911: Probably not one of the people who bought comet pills, Ejnar Hertzsprung publishes for the first time a diagram plotting absolute magnitude of stars against their colour (and hence effective temperature). This scatter plots shows the relationship between temperature and luminosity of a star is not random but instead forms several distinct groups.

Vale Vera Rubin

We remember a great astronomer

Vera Rubin, "Mother of Dark Matter," Dies

By: Shannon Hall | Sky & Telescope | December 27, 2016

Xmas brought sad news to astronomers across the world after they learned that Vera Rubin, whose pioneering work led to the confirmation of dark matter, passed away.

Astronomer Vera Rubin, known for her revolutionary work confirming the existence of dark matter, died on December 25, 2016. She was 88.

Rubin's love for celestial motions began at a young age. In 1938, when she was just 10 years old, her family moved from Philadelphia to Washington, D.C., where she inherited a north-facing bedroom window. There, she would watch the night sky revolve, entranced by the sense of Earth's motion. Four years later, she built her own telescope with her father and started attending amateur astronomers' meetings.

But that isn't to say this pioneering female scientist walked an easy path. Although her parents were supportive, Rubin received little encouragement from others to pursue her passion in astronomy. Her high school physics teacher told her to stay away from science in college. And a college admissions officer suggested she become an astronomical artist instead.

Determined nonetheless, Rubin followed in the footsteps of Maria Mitchell — the first professional female astronomer — by attending Vassar College in Poughkeepsie, New York. On a summer break she met Bob Rubin, then a graduate student at Cornell. They married after her graduation from Vassar.

Rubin completed her master's at Cornell (her dream was to attend Princeton, but the university didn't accept women into its graduate astrophysics program at the time) while her husband finished his PhD. The couple then moved to Maryland for Bob Rubin's new job at the Applied Physics Lab. Thanks to a chance office arrangement, noted physicist George Gamow learned of Rubin's master's work on galaxies and asked to talk with her. It was a stroke of luck that ultimately led her to complete her PhD work at Georgetown University under him. Her 1954 thesis broke new ground on the spatial distribution of galaxies.
She subsequently joined the Georgetown faculty but her work remained uneventful. She focused on raising four children, who would later become scientists themselves. "It took me a long time to believe I was a real astronomer," she told *Science* in 2002.

The turning point came when Rubin was invited to collaborate with Margaret and Geoffrey Burbidge at the University of California at San Diego. She and her husband spent a year working with the husband-and-wife team, who encouraged her ideas and ultimately gave her a new sense of professional accomplishment.

She returned to Maryland a changed woman, with an eagerness so strong she walked into Carnegie's Department of Terrestrial Magnetism and demanded a job. In the following years she took multiple observing trips with collaborator Kent Ford to Kitt Peak in Arizona and Cerro Tololo in Chile. In 1965, she even became the first woman legally permitted to use the Palomar Observatory in southern California. Below left, she is pictured at Lowell Observatory in 1965.

The new work allowed Rubin to return to her initial curiosity of stellar motions within galaxies. With new advances in technology, she was able to study the rotation of the outer reaches of galaxies much as she used to watch the rotation of the stars outside her bedroom window. Her observations of stars orbiting on the outskirts of galaxies helped spark a remarkable discovery: the vast majority of matter is invisible.

Galaxies Are Overflowing with Dark Matter

In 1933, Swiss astronomer Fritz Zwicky observed the Coma Cluster, a galaxy cluster roughly 50 million light-years across

that's filled with thousands of galaxies. He found that these galaxies move so rapidly through the cluster that it ought to fly apart. There simply wasn't enough visible matter to hold the galaxy cluster together with its constituents zipping through it that fast. Yet the cluster was stable.

Zwicky decided there must be a hidden ingredient, which he called *dunkle Materie*, or "dark matter," that held the cluster together.

The issue remained relatively quiet for the next three decades. It was Rubin, Ford, and their colleagues who gathered further evidence that individual galaxies also did not rotate as expected. Because most galaxies have a luminous central bulge composed of densely packed stars, and faint outskirts composed of far fewer stars, astronomers had largely assumed that most of a galaxy's mass was concentrated in the centre. The natural conclusion then is that galaxies should rotate much as our solar system does, where the inner planets orbit the Sun faster than the outer planets.

But the team's work showed that wasn't the case. In their 1978 *Astrophysical Journal* letter, the astronomers looked at the galactic rotation curves — graphs showing the orbital speeds of stars versus their distance from the galactic centre — of 10 galaxies (seven are shown at right). If the visible matter was the only character in this story, then these curves would dip down at large distances, much like it does for the solar system.

Instead, all the rotation curves are relatively flat. The stars far from the centers of galaxies, in the sparsely populated fringes, rotate just as rapidly as the stars closer in. The team's calculations showed that galaxies must contain about 10 times as much dark matter as light matter.

Rubin is notorious for having once said: "In a spiral galaxy, the ratio of dark-to-light matter is about a factor of 10. That's probably a good number for the ratio of our ignorance-to-knowledge. We're out of kindergarten, but only in about third grade."

Over the next decade, Rubin continued to study hundreds of galaxies, amassing even more evidence for dark matter. Although the nature of that matter remains a mystery today, it has become one of the biggest buzzwords in astronomy. Observers continue to study it, much in the same way Rubin once did, and theorists are desperate to explain it.

Rubin's Legacy

Rubin's love for science swept over her family: all of her children grew up to become scientists. Judith Young was an astronomer at the University of Massachusetts, Amherst, until her untimely death due to cancer in 2014; David Rubin is a geologist with the U.S. Geological Survey; Karl Rubin is a mathematician at University of California, Irvine; and Allan Rubin is a geologist at Princeton University.

Her husband, a mathematician and physicist, was also one of her greatest supporters; he passed in 2008.
Rubin's achievements earned her election (as the second female astronomer) to the National Academy of Sciences in 1981.

In 1996 she became the first woman to receive the Royal Astronomical Society's Gold Medal since Caroline Hershel in 1828. She repeatedly called for more women to join the sciences, providing encouragement and fighting problems that persist today. Sadly, she never received the Nobel Prize that many feel she deserved.

While many have praised Rubin for her remarkable discoveries, advancement for women in science, and successful juggling of career and family, she stands tallest as a role model in her unabashed love of astronomy. Her child-like curiosity and wonder present throughout her entire life will encourage many for years to come.

Astro News

Interesting news stories sourced around the world

Seven Earth Sized Planets Orbit Dim Star

by: Camille M. Carlisle | Sky & Telescope magazine| February 22, 2017

Astronomers have found seven Earth-sized planets around a cool red dwarf, all of which have the potential for liquid surface water.

The star TRAPPIST-1 is an unassuming, *M*8 red dwarf star. It lies 39 light-years away in the constellation Aquarius. With a diameter only one-tenth that of our star, the dwarf puts out less than a thousandth as much light as the Sun.

Last year, Michaël Gillon (University of Liège, Belgium) and colleagues announced that a trio of small exoplanets orbits this pipsqueak star (although the third world was of dubious reality). Now, after an intensive follow-up campaign, the team has discovered that there are actually *seven* planets, not three. All are likely rocky. Three lie in TRAPPIST-1's putative habitable zone — the region where, given an Earth-like composition, liquid water could be stable on the surface. But all, with enough hand-waving, might have a chance at liquid water.

From Three to Seven

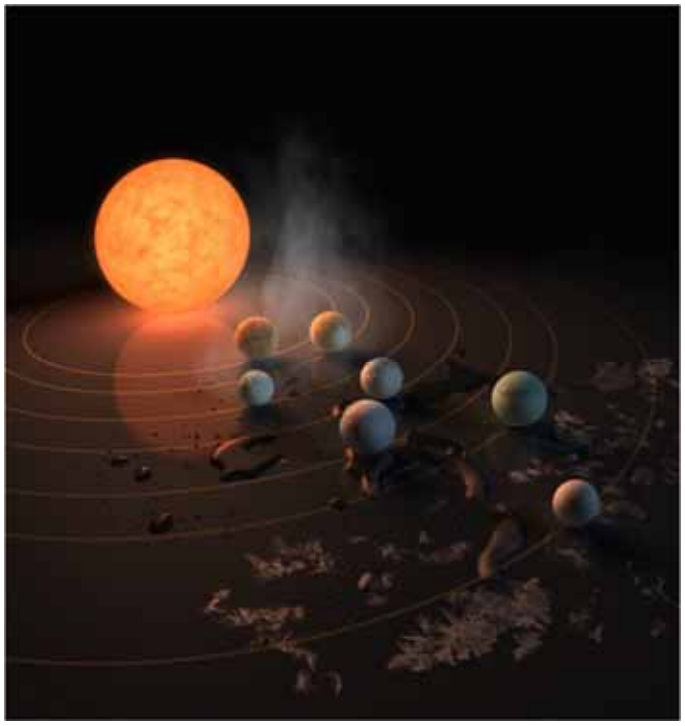
The astronomers detected the exoplanets using the transit technique, which catches the tiny dip in starlight when a planet passes in front of its host star from our perspective. The discovery roller-coaster began when the team found that what it had thought was a combined transit of planets #2 and #3 was in fact the crossing of *three* planets.

The observers next assailed TRAPPIST-1 with an impressive flurry of ground-based observations. But the big breakthrough came with the Spitzer Space Telescope, which observed the star for 20 days. These data caught 34 clear transits. The team was then able to combine their ground- and space-based observations and slice and dice them to determine that the signals likely came from seven different planets.

Only six of those are firm detections, however. Number 7, or planet h, is iffy in its specs: The team only detected a single transit for it, and astronomers prefer to see three transits before calling something a candidate planet. Expect astronomers to haggle over this one in months ahead.

Mini Solar System?

Let's assume for now that all seven exoplanets are real. All their orbits would easily fit inside Mercury's circuit around the Sun. Their years range from 1.5 to 12 Earth days long, with the period of outermost h being anywhere between 14 to 35 days. The smallest two worlds are about three-fourths as wide as Earth, the largest 10% wider. The biggest orbit is less than 20% as large as Mercury's. One of the wonderful things about this system is that the exoplanets' orbits are *resonant* with one another.



Above: *Abstract Concept of TRAPPIST-1 System. Credit: NASA/JPL-Caltech*

This means that their orbital periods are rough integer multiples of one another — for example, in the same span of time that the innermost planet whips around the star eight times, the second planet takes five laps, the third three, and the fourth two. This setup gravitationally links the planets together and can lead to tiny shifts in their positions. Based on these shifts, the team could calculate the planets' gravitational influences on one another, and hence their approximate masses and densities. All are consistent with being rocky, the team concludes in the February 23rd *Nature*.

Such resonant orbits arise when worlds migrate from their original locations, Gillon explains. Astronomers think that when lightweight planets form far out in a star's planet-forming gaseous disk, gas drag and such will make them advance inward. During this inbound migration, the worlds catch one another in resonant orbits, such that they can form a kind of "chain of planets," he says. In this case, the migration landed the exoplanets in what the team calls the "temperate zone" — orbits with enough incoming starlight that, with the right conditions, the planets might at least sometimes have liquid surface water. It's a looser definition than that for "habitable zone."

The planets are also all likely tidally locked with their star, meaning they always point the same hemisphere at it, as the Moon does to Earth. So close to the star, the planets could experience huge tidal pulls, stretching and squeezing their interiors and spurring heating and even volcanism, similar to what we see on Jupiter's Galilean moons.

TRAPPIST-1 is quiet for an *M* dwarf — notably less active than Proxima Centauri, which also has a habitable-zone planet (although it's likely a desert world). But unfortunately, astronomers don't know how old the star is. It's also unclear whether the planets' orbits are stable: the researchers haven't determined the seventh planet's orbit, nor do they know if there are other worlds in the system mucking things up. This kind of star, called an *ultra-cool dwarf*, is very common; roughly 15% of stars in the nearby galaxy fall into this category, Guillon estimates.

Are These Worlds Habitable?

The next goal is to look at the exoplanets' atmospheres. If any of the worlds host life, then it might leave chemical fingerprints in the atmospheres. There's no single compound that's a smoking gun — for example, oxygen can come from life or from water molecules broken up by starlight into their constituent hydrogen and oxygen atoms. But certain combinations of chemical compounds (such as methane, carbon dioxide, and molecular oxygen) would be highly suggestive.

The team is developing a program to use the Hubble Space Telescope to look at the starlight passing through the planets' (maybe extant) atmospheres as they transit, to detect any compounds that might have absorbed light. Follow-up will come with the James Webb Space Telescope, which will be more apt for this project because it focuses on infrared wavelengths, and TRAPPIST-1 puts out most of its light in infrared.

Study coauthor Amaury Triaud (Institute of Astronomy, UK) favours planet f as the most promising for life. With a girth of 1.05 Earth radii and about 60% Earth's density, TRAPPIST-1f might be rich in water and/or ice. It receives about as much energy from its star as Mars does from the Sun, and with a good atmosphere it could be habitable. (Mars is technically in the Sun's habitable zone.)

During a press conference Triaud painted this picture of what we might see, were we to stand on one of these worlds: "The amount of light reaching your eye would be something like 1/200 as much as you receive from the Sun on Earth — similar to what you experience at the end of sunset. However, it'd still be quite warm, because there's still about the same amount of energy reaching you from the star as Earth receives from the Sun — it's just that most of that comes in infrared, which you can't see but your skin can feel".

The star would be a salmon-like color. On TRAPPIST-1f, he estimated, the star would be three times wider in the sky than the Sun is to us.

"The spectacle would be beautiful," he said.

Above: *Artist's concept of what the sky might look like from one of the seven known terrestrial planets in the TRAPPIST-1 system. ESO / M. Kornmesser*

Solar System Highlights

The major planets during April 2017

by John Newell

The **Sun** will rise at 7:30am and set at 7:08pm on the first. On Sunday the 2nd ACDT ends and the clocks go back an hour to ACST, you might find these abbreviations as confusing as I do. On the 30th sunrise is at 6:54am and sunset is at 5:30pm.

The first quarter of the **Moon** is on the 4th, it will be full on the 11th at 3:39pm, last quarter on the 19th and new on the 26th at 9:47pm. Perigee on the 27th.

Mercury is at Greatest Elongation of 19 degrees East on the first setting at 7:44pm, will be at inferior conjunction on the 20th and on the 30th it will rise with Uranus at 5:43am.

Venus rises at 6:52am on the first and rises at 3:49am on the 30th.

Mars sets at 8:39pm on the first, passes the Pleiades on the 21st, sets with the Moon on the 28th and sets at 6:51pm on the 30th.

Ceres magnitude 8.6, sets at 9pm on the first, passes Mars on the 11th, crosses from Aries into Taurus on the 12th, sets with the Moon and Mars and the Pleiades on the 28th and sets at 6:41pm on the 30th.

Diary of phenomena

April 2017

d	h(UT)	
1	9	Aldebaran 0.4°S of Moon
1	9	Mercury greatest elong E(19°)
3	18	FIRST QUARTER
6	5	Saturn stationary
7	4	Regulus 0.7°N of Moon
7	21	Jupiter at opposition
10	22	Jupiter 2.1°S of Moon
11	6	FULL MOON
14	5	Uranus at conjunction
15	10	Moon at apogee
16	18	Saturn 3.2°S of Moon
17	13	Moon furthest South (-19.1°)
19	9	LAST QUARTER
20	5	Mercury inferior conjunction
20	20	Pluto stationary
22	19	Neptune 0.2°N of Moon
23	21	Venus 4.9°N of Moon
25	20	Mercury 4.3°N of Moon
26	12	NEW MOON
27	16	Moon at perigee
28	9	Mars 5.6°N of Moon
28	17	Aldebaran 0.5°S of Moon
28	22	Mercury 0.2°S of Uranus
30	13	Moon furthest North (19.2°)

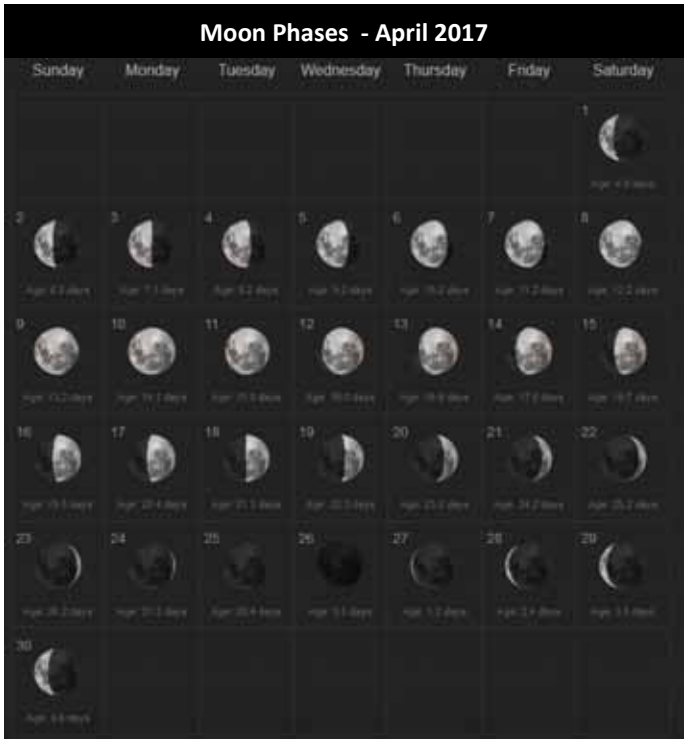
Jupiter in Virgo, rises at 7:33pm on the first, reaches opposition on the 8th, sets with the full Moon at 6:20am on the 11th and then sets at 4:55am on the 30th. See the image below, taken by Damian Peach on February 25, 2017.

Saturn in Sagittarius, rises at 11:20pm on the first, rises with the Moon at 9:22pm on the 16th and rises at 8:26pm on the 31st.

Uranus magnitude 6.3 in Pisces, sets with Mercury at 7:40pm on the first, is at conjunction with the Sun on the 14th, rises at 6am just before the Moon and Mercury on the 26th and rises at 5:45am on the 30th.

Neptune magnitude 7.8 in Aquarius, rises at 5:17am on the first, rises with the Moon on the 23rd and rises at 2:26am on the 30th.

Pluto magnitude 14.2 in Sagittarius, rises at 1am on the first, rises with the Moon on the 19th and rises at 10:07pm on the 30th.



Southern Hemisphere Comets

by Michael Mattiazzo

A roundup of bright & telescopic comets visible for southern hemisphere observers

This April will be a busy period for the comet observer, with 4 objects expected to be brighter than mag 10.

41P Tuttle-Giacobini-Kresak

Closest to Earth on 2017 April 1 at 0.142AU. Closest to Sun on 2017 Apr 12 at 1.045AU. Maximum magnitude 5 in April 2017 but prone to outbursts! Orbital period: 5.41 years

As discussed last month, in 2017 the short period comet 41P Tuttle-Giacobini-Kresak will be having an exceptional apparition, at least for northerners. The comet remains within 0.20AU from Earth between March 5 and May 3, a period of nearly 2 months.

41P TGK has a history of frequent outbursts, particularly in 1973 when the comet brightened some 10 orders of magnitude! (14 to 4) on May 27.

The comet is expected to reach magnitude 5 ordinarily during April 2017. A similar event at closest approach could briefly bring the comet within easy naked eye visibility.

Unfortunately for southern hemisphere observers, the comet will be at high northern declination during early April, thus restricted to viewers north of 20°S latitude.

From April 20, the comet rises a couple of degrees above the northern horizon at 4am local time, situated on the border of Hercules and Draco. It may appear magnitude 5.5 at this time. Visibility slowly improves as the comet treks south-eastwards through Hercules.

Conveniently, the Moon disappears from sight around the morning of April 23. The coma diameter is expected to be very large, >1/2 degree across, so expect to see a large diffuse object, with little tail, requiring a dark country sky to observe.

On the morning of May 1, the comet transits at about 3:30am local time and attains an altitude of 14 degrees, about 5 degrees west of Vega. It will have faded slightly to magnitude 6.

C/2015 V2 Johnson

Closest to Earth on 2017 June 5 at 0.81AU. Closest to Sun on 2017 June 12 at 1.63AU. Maximum magnitude 6-7 in June 2017. Orbital period: N/A (parabolic.)

Is a dynamically new comet entering the solar system. It is closest to the Earth at 0.81AU on June 5, prior to its perihelion arrival on June 12 at 1.63AU.

It will be well situated for viewing in southern hemisphere evening skies after June as it treks southwards overhead. You can catch an early glimpse of the comet at the start of April 2017.

It will be located low in the northern morning sky, near the vicinity of Tau Herculii, shining at magnitude 8. It transits at 330am local time, 7 degrees above the northern horizon.

Moonlight interferes from April 9. By April 23, it transits about 2am local time, whilst 41P joins in on the view. Comet Johnson may then shine at magnitude 7.5.

It's morphology will be very different to 41P, much more condensed, with a bright dust tail through telescopes or photographically.

C/2015 ER61 PANSTARRS

Closest to Earth on 2017 April 19 at 1.18AU. Closest to Sun on 2017 May 9 at 1.042AU. Maximum magnitude 6-7 in May 2017. Orbital period: 7,763 years

Discovered as an asteroid but later shown to display cometary activity, this comet arrives at perihelion on 2017 May 9, when it will be 1.04AU from the Sun. It is not very well placed from Earth's perspective, closest at 1.17AU on April 20, however the comet is intrinsically bright (absolute magnitude about 6.5) This is a returning long period object, so has the potential to become brighter than expected, peaking at magnitude 6 or 7 during May 2017, and well situated for southerners in the morning sky.

At the start of April 2017, the magnitude 8.0 comet will be situated in Capricornus, about a degree north of Rho Cap, high in the East before dawn. It continues its easterly trek at over a degree per day, and enters Aquarius on the morning of the 6th. Moonlight interferes from the morning of April 10.

The comet returns to Capricornus on the 13th, then back into Aquarius on the 19th. By the morning of April 24th, moonlight no longer interferes, and the now magnitude 7.5 comet can be found a couple of degrees to the north of Rho Aqr. It enters Pisces on the morning of May 1.

2P Encke

Closest to Sun on 2017 March 10 at 0.33AU. Closest to Earth on 2017 March 12 at 0.65AU. Maximum magnitude 3 in March 2017. Orbital period: 3.3 years

"Old faithfull" was discovered by Mechain in 1786. This is one of the shortest period comets, with a period of 3.3 years, and the most observed (63rd apparition to date) At the start of April, the comet has faded to magnitude 8 and is situated 3 degrees to the north of the Helix Nebula NGC 7293 in Aquarius, in the morning sky.

It will be 20 degrees high at the start of astronomical twilight. The comet rapidly fades after this and will appear magnitude 11 by mid month.

Latest information, images and charts (including night mode versions) can be found on my website at:

http://members.westnet.com.au/mmatti/sc.htm

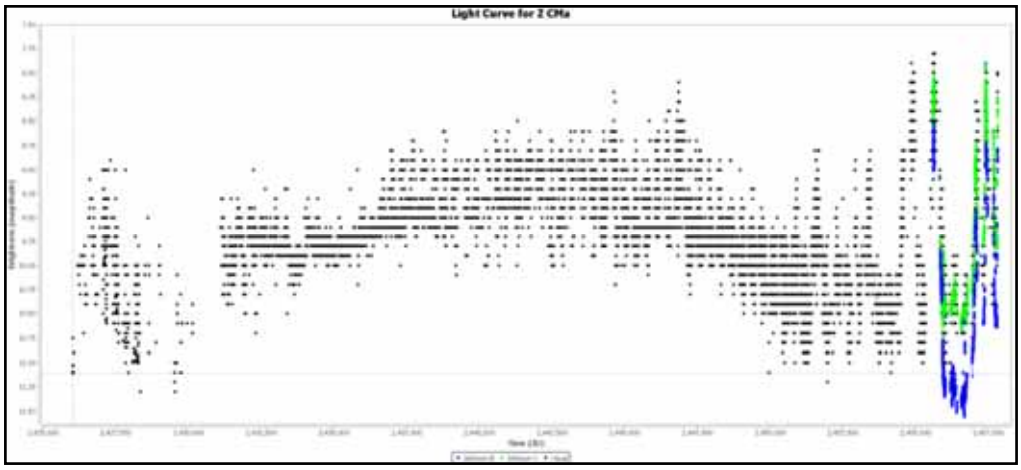
Variable Vagaries

by David Benn

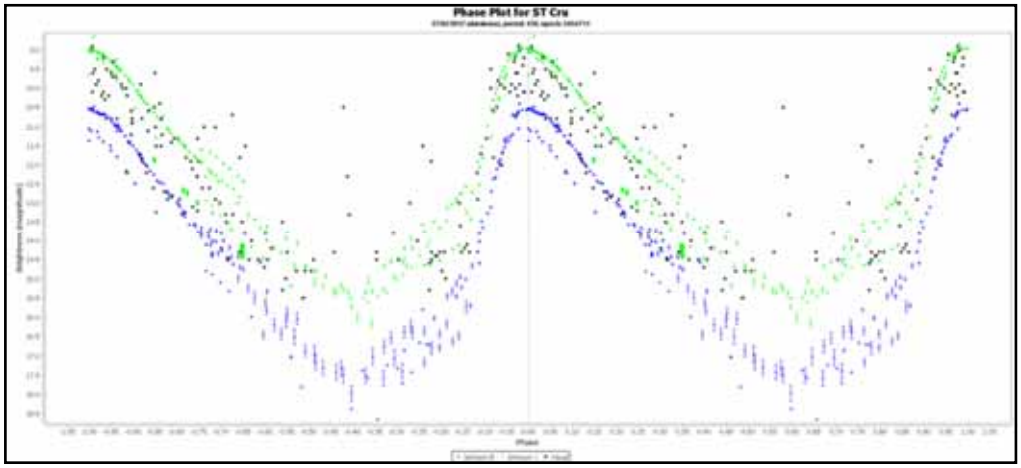
This regular column will cover happenings in the ever-changing world of variable stars.

(This month's column has been contributed by Robert Jenkins)

While I have a regular observing programme of stars that I am researching, the AAVSO regularly sends out requests for observations on stars that are becoming more active. Over the last month three stars I have previously worked on have done just that.

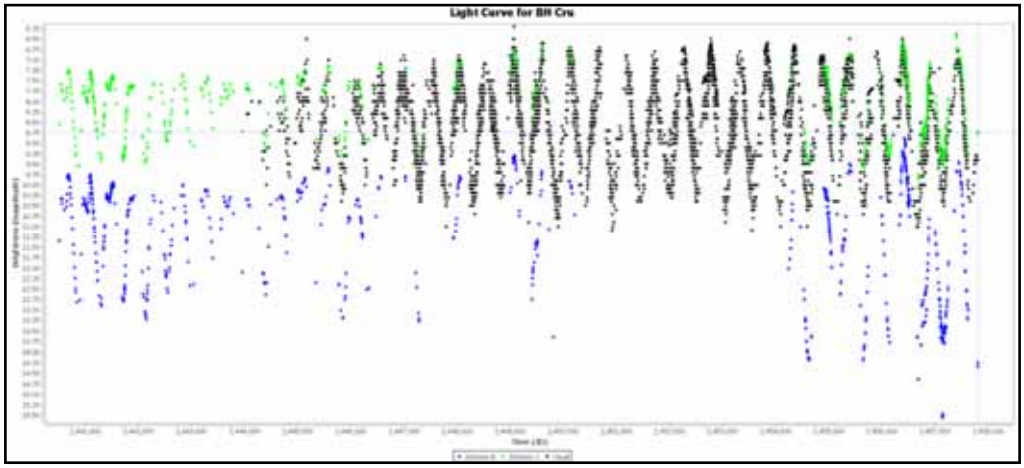


The stars are eruptive variable Z Canis Major, and Miras ST Crux and BH Crux.



Since February 1930, when observations were first recorded in the AAVSO, Z CMa has slowly trended up in mag around a variation of 1.5 mag. In 1987, the brightness trend dipped but still in the 1.5 mag range. Since 2007, the system has gone into overdrive with variability increasing to 3.2 mag and trending up again.

The Z CMa binary system is only 300,000 years old with two main components separated by an estimated 100 AU.

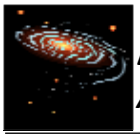


One star is 1300 times as luminous as the Sun, has 3 times its mass and 13 times its diameter and a surface temperature of 10,000 K. The second has been calculated to be 12 times as massive as the Sun with 1690 times its diameter, and shining with 2400 times its luminosity.

A lot less is known about ST Cru except it appears to be an M6 class Mira variable with surface temperature of approx. 3,000K. Its variability is spectacular, brightening by 7.3 mags in 6.5 months in 2005/6. The latest outburst has taken 10 months to brighten by 5.6 mag. and in February 2017 appears to be still brightening. This Mira has a regular period of approx. 439 days.

Unlike the other two that have or are close to peak brightness, the spectacularly red carbon star and Mira variable with a surface temperature less than 2,500K, BH Crucis, (also known as Welch's Red Variable) is just on the way up, increasing by ½ mag in the last few months. The period of this long period Mira has varied from 421days on discovery to 540 days in the last decade to an estimated 521 days now. With only around 6 months to wait for maximum, it confirms my concentration on eclipsing binaries with periods of around a day but still interesting to watch.

Z CMa and ST Cru are worth some immediate attention while BH Cru should not be ignored over the next few months.



Alone in the dark

A guide to observing faint fuzzies in our night sky ***by Joe Grida***

Observing Copeland's Septet (Hickson 57) in Leo

Now that galaxy season has well and truly arrived, we can certainly become gluttons with so much choice. The galaxy fields of Leo, Virgo, Hydra, and Coma Berenices can keep a galaxy hunter busy for many months; and that's just looking at the bright galaxies. So, here's a challenge for you.

Certainly, use the bright Messiers and some NGC's as the entrée and main course, but when it's time for dessert, set the GoTo computer to RA (centre): 11h 37.9m DEC: +22° 00.0'. It will take you to a group of galaxies known as Copeland's Septet in Leo.

Ralph Copeland, was an assistant of Lawrence Parsons at Birr Castle on Lord Rosse's 72" telescope. During 2 nights in the spring of 1874, whilst observing with the large reflector (the largest telescope of its time), he discovered seven galaxies within a field of just 7 arc minutes.

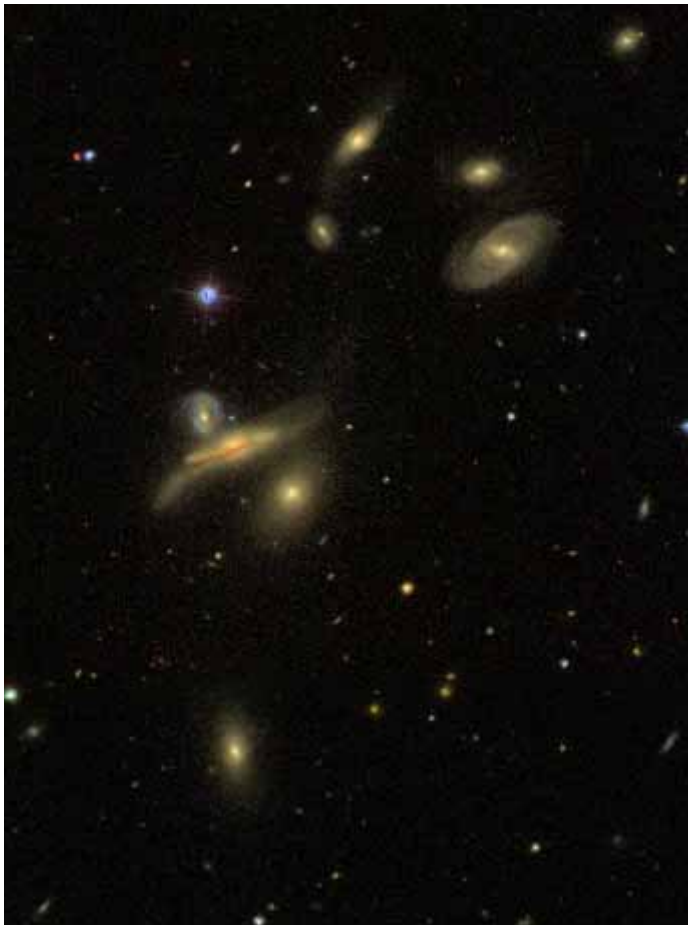
This challenging group consists of 7 NGC galaxies (3745, 3746, 3748, 3750, 3751, 3753, 3754) contained within a 5' circle and requires a 10"-12.5" scope for a decent view. Unfortunately, Copeland confused the field with a nearby area containing two faint galaxies (NGC 3743 and 3758) and reduced the positions using the wrong reference stars.

In compiling the NGC in 1888, Dreyer used these incorrect positions and this later resulted in the RNGC classifying the entire group as nonexistent! More recent catalogues and atlases list Copeland's Septet at the correct position. In 1982, Canadian astronomer, Paul Hickson, published a list of compact galaxy groups, and the group was listed as #57.

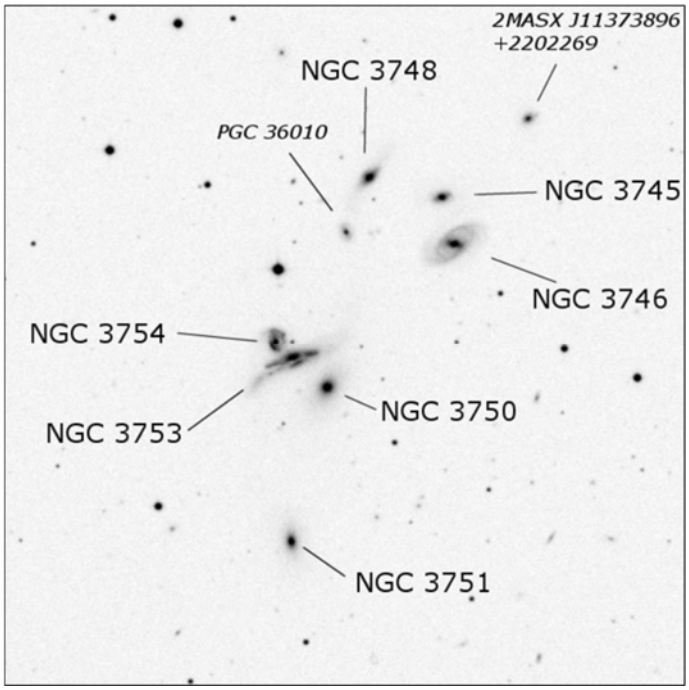
I've read reports of some of the brighter members of this group having been glimpsed with telescopes as small as 8"; but to treat it seriously, you should really use a 14" telescope or bigger and needless to say, dark skies. I observed the group from the dark skies of the Flinders Ranges last year, using my 16" Dobsonian. The brightest galaxy, NGC 3753 shines at a dim 13.6 mag, so this group is not for the faint-hearted!

Please let me know how you fare. Happy observing.

HICKSON	NAME	SIZE (Mins)	MAG (V)	SB
57a	NGC 3753	1.7X0.5	13.6	13.2
57b	NGC 3746	1.1X0.5	14.2	13.5
57c	NGC 3750	0.8X0.7	13.9	13.1
57d	NGC 3754	0.4X0.3	14.3	12.0
57e	NGC 3748	0.7X0.4	14.8	13.2
57f	NGC 3751	0.8X0.5	13.9	12.7
57g	NGC 3745	0.4X0.2	15.2	12.4



Above: image of Copeland's Septet from the Sloan Digital Sky Survey, Release 9. The field of view is approx. 10 arc minutes high. Use the chart below to identify the individual components.



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Here's how to contact various members of Council, Regional Co-ordinators and SIG's

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Whyalla

The group meets on the first Thursday of the month.

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Email: whyalla@assa.org.au

Northern Yorke Peninsula

The NYP'pers hold combined members' and public viewing nights monthly.

Coordinator: Tony Henderson
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Email: nyp@assa.org.au

Riverland

The Riverland group hold combined members' and public viewing nights monthly.

Co-ordinator: Tim Vivian
Ph: 0417 800 225
Email: riverland@assa.org.au

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Variable Stars	David Benn	0407 261163
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National Police Check Coordinator	Paul Rogers *ozymandias@senet.com.au*	08 8263 7666
ASSA 125th Birthday Celebrations	*assa125@assa.org.au*	

Members' Gallery

Highlighting members' astrophotos

Above: The Monkey Head Nebula, NGC 2174, in Monoceros by **Justin Tilbrook**. Skywatcher 8" f/4 astrograph, Baader coma corrector & Skywatcher HEQ Pro 5 mount, Orion mini guider. Unmodded Canon 1100D DSLR camera. 30 x 120 sec ISO 6400. Median stack in DSS, processed Photoshop CS2.

Below: NGC3532 - Wishing Well Cluster in Carina inmaged by **Colin Hill**. Orion ED80 refractor with a QHY8L CCD Camera. Exposure: 8 x 10 min