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Cover: The cover image shows the North and East vertical sundials with the Equation of Time diagrams below them at the Gearings Point Education Display in Hermanus. See p.50.

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News Note: Annual Reports from SAAO and SALT

The "2022 Annual Report" of SALT and the "SAAO Annual Review 2021|2022" have just been published and are available on-line at
https://www.salt.ac.za/2023/04/06/salt-annual-report-2022/ and
https://www.saao.ac.za/2022/06/30/saao-annual-review-2021-2022/
They each have over 100 pages and are so packed with information that they are hard to summarize meaningfully! Apart from the on-line versions, hard copies are currently obtainable at the SAAO library but must be collected.

News from SALT is that SA through the NRF now has a ~52% share of the telescope. Other large shareholders are Rutgers University, the Polish Academy of Sciences, Dartmouth College, the University of Wisconsin-Madison and IUCAA (India). There are several other smaller shareholders in addition.
Major new instruments approaching completion are a fibre-fed near-IR spectrograph (NIRWALS). A "laser frequency comb" (LFC) offering very precise spectral calibration is being added to the High Resolution Spectrograph.
It is hard to single out individual scientific results from the many papers that have been produced in galactic and extragalactic astronomy both by SA and foreign astronomers. The operations, technical and otherwise, required to keep a large telescope operational and up-to-date are very extensive.

The SAAO has now completed 50 years at Sutherland. There are at present in excess of 20 telescopes of various sizes as well as atmospheric and seismic monitors.
Two new installations are the ATLAS Asteroid Terrestrial-impact Last Alert System and PRIME – Prime Focus Infrared Microlensing Experiment. These latter are sponsored by NASA and by a consortium based on the University of Osaka.
Remote operation is now the norm for many of the Sutherland telescopes and the former transit room of the Main Building of the old observatory in Cape Town has been fitted out as the operational centre.

Obituary: Carolina Ödman, 3 July 1974 – 15 November 2022.

Carolina was born on 3 July 1974 in Switzerland. She studied first at the Ecole Polytechnique Federale de Lausanne (EPFL) for an MSc degree in Physics Engineering. She went later to the University of Cambridge to do her Ph.D. in astronomy and was a recipient of the Isaac Newton Scholarship. She afterwards spent four months of 2004 in Cape Town as a tutor at the African Institute for Mathematical Sciences, following which she went back to Europe, having been awarded a Marie Curie Postdoctoral Fellowship. She worked in Rome on Theoretical Cosmology, Bayesian statistics, and programming.

In 2005-2010 she became the International Project Manager at UNAWE, the Universe Awareness project, which she successfully expanded to over 40 countries, ennabling it to become a 'Global Cornerstone Project' of the International Year of Astronomy (IYA2009). For this work she won the 'Science Prize for Online Resources in Education' 2010, from the journal *Science.*

Carolina moved to South Africa in 2010 as an SKA Research Fellow at the SAAO. Here she developed e-tools for research. She spent almost a year as Director of Academic Development at AIMS for the Next Einstein Initiative. In 2018, she became the Associate Director, Development & Outreach, at the Inter-University Institute for Data Intensive Astronomy (IDIA) at UWC, and also an Associate Professor. She was awarded the International Astronomical Union Special Award for Astronomy Outreach, Development and Education, in recognition of her pioneering work.

She was one of the "Inspiring 50 SA" in 2020 – recognised as being one of the most inspiring women in the country, and also in that year won a prize from the International Science Council's Regional Office for Africa. In 2021, she won the Communication Award at the National Science and Technology Forum. She was a founding member of the African Network for Women in Astronomy and a member of its board. She was also active in the African Astronomical Society and in building capacity towards the IAU General Assembly in 2024.

Carolina died of pancreatic cancer in November 2022. She is survived by her husband Kevin Govender and her two children, Xavier and Cyprian.

Based on an appreciation by Niruj Mohan Ramanujam (SARAO)

Recent Southern African Fireball Observations Events # 425-437

Tim Cooper, Director, Comet, Asteroid and Meteor Section

This article continues the sequential numbering of reported fireball sightings from southern Africa. By definition, a fireball is any meteor event with brightness equal to or greater than visual magnitude (m_v) –4. The following events were reported to the author and details are reproduced as given by the observer [any comments by the author are given in brackets]. Where the report originated from the American Meteor Society Fireball page, the corresponding AMS event number is given. AMS reports are courtesy of Robert Lunsford (Secretary General of the IMO). All times were converted to UT unless stated, and all coordinates are for epoch J2000.0. Descent angles, if given, are in degrees, with directly upwards = 0°, horizontally left to right = 90°, directly downwards = 180° and horizontally right to left = 270°.

Event 425 – 2022 December 3 – Rosetta, Mooi River, KwaZulu Natal
Observed by Flynn Goodlad at 17h30, m_v = -10, bright yellow white fireball, duration 1-2 seconds, started as a thin trail that grew quickly and then broke up into five fragments just before disappearing. Path from az/alt 82°, 56° to 77°, 49°, that is RA/Decl. 02h45, -20° to 03h06, -14°. Path length 8°. The Moon was then 82% illuminated, magnitude -11.9, altitude 51° in azimuth 23°, just to the left of the fireball, which was not quite as bright as the Moon.

Event 426 – 2023 January 10 – Gordons Bay, Western Cape
Observed by Tony D'Errico at 19h52, duration 3-4 seconds, magnitude -9, bright green fireball 'visible slightly longer than average meteor, with glowing sparkling train' which persisted for about 2 seconds. Path from az/alt 263°, 34° to 221°, 23°, that is RA/Decl. 00h11, -24° to 22h02, -53°. AMS Event 201-2023

Event 427 – 2023 January 10 – Suiderstrand and Cape Town, Western Cape
Observed by Natalie Nieuwenhuizen and Jiří Syrový from Agulhas National Park at 20h45, duration 2-3 seconds. m_v –13, brighter than the full moon which was visible just above the horizon, colours yellow and white. Path from az/alt 30°, 27° to 9°, 17°, that is RA/Decl. 07h20, +22° to 06h08, +37°. Natalie said 'it was very big and bright, first appearing as a ball that got brighter, and then it had a tail like a comet. It seemed to disappear before it reached the horizon'. No fragmentation and no sounds heard. Observed by Le Roux Neethling who has the time as 20h50, duration 1-2 seconds, magnitude –13, colours seen were white, blue and yellow. Path from az/alt 75°, 40° to 75°, 33°, that is RA/Decl. 08h46, -11° to 09h04, –7°. AMS Event 169-2023.

Event 428 – 2023 January 20 – Hout Bay, Western Cape
Observed by Shai Harman at 19h15, m_v = –6, duration 1-2 seconds, colour white. Path from az/alt 52°, 11° to 32°, 6°, that is RA/Decl. 08h20, +24° to 07h20, +40°, or right to left below the bright stars Castor and Pollux. No terminal flash, no fragmentation, and no sounds reported. The fireball may have been an alpha Crucid meteor. AMS Event 430-2023.

Event 429 – 2023 February 5 – Betty's Bay, Western Cape
Captured by Guy Snelling on a security camera at about 03h50. Very approximately the start and end points of the path are az/alt 252°, 16° to 246°, 15°, that is RA/Decl. 08h00, –23° to 07h40, –28°, and the event was sporadic.

Event 430 – 2023 February 13 – Langebaan, Western Cape
Observed by Greg Miller at 20h30, m_v = –4, duration 7-8 seconds, yellow-white colour, trail appeared to sparkle 'like a firework rocket', main object appeared to fragment into two or three pieces just before fading out. Path from az/alt 154°, 21° to 57°, 28°, that is RA/Decl. 21h42, –64° to 17h30, +8°, path length 87°. The fireball was sporadic. AMS Event 1020-2023.

Event 431 – 2023 February 21 – Hartebeespoort, Gauteng

Fig 1. Event 431 captured by Paul Ludick on GMN Camera ZA004 on 21 February 2023. To the right of the fireball is a fainter meteor, to the lower left is a satellite trail.

Captured by Paul Ludick on GMN Camera ZA004 at 02h01m51s. Path from az/alt 172.2°, 49.9° to 189.8°, 32.8°, that is RA/Decl. 14h42m, –65.0° to 10h43m, –78.8°. Path plotted on Atlas Brno chart 11, starts just below alpha Centauri and bright double flash to the left (east).

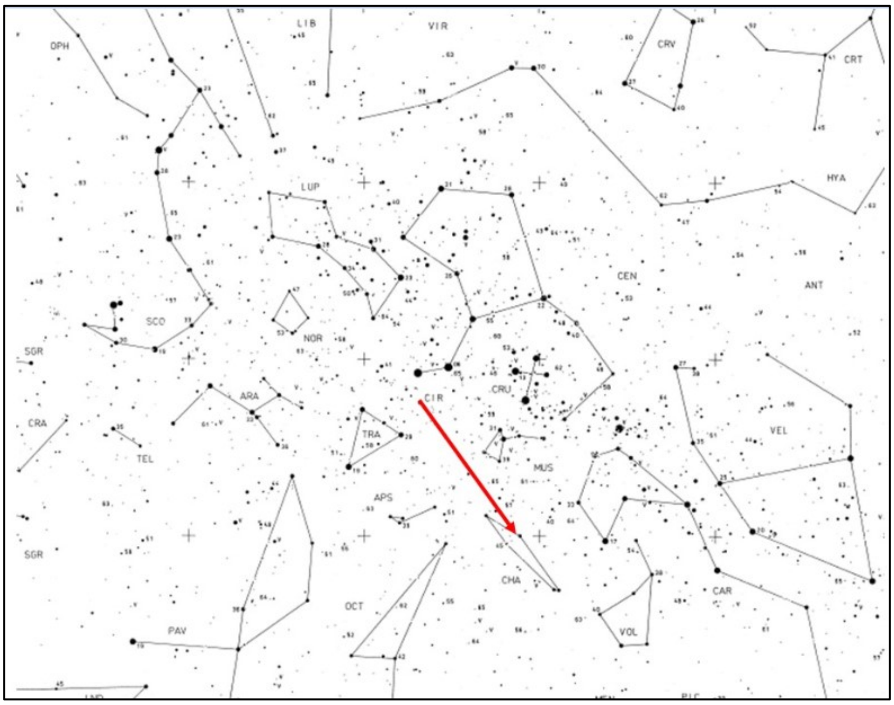


Fig. 2 Plot of Event 431 on part of Atlas Brno Chart 11. The fireball descended left to right below Centaurus and Crux Australis.

Event 432 – 2023 March 2 – Newcastle, KwaZulu Natal
Observed by Shevlin Balgobind at 18h31, $m_v = -4$, duration 3-4 seconds, bright white, path from az/alt 349°, 45° to 346°, 45°, that is RA/Decl. 06h37, +16° to 06h23, +15°. The path was slightly above left of the Moon, which was then 81% illuminated, magnitude –11.8, altitude 36° in azimuth 6°. Shevlin said the object 'made a sound like a match when lit, but much louder'. The fireball was probably an Anthelion meteor. AMS Event 1404-2023.

Event 433 – 2023 March 6 – Harare, Zimbabwe
Observed by Michaela Baker at 18h30, estimated as bright as the Moon, which was then near-full and magnitude –12, duration 1-2 seconds, white head, orange-red tail, split into two fragments before burning out. Path from az/alt 153°, 50° to 156°, 38°, RA/Decl. 09h18, -51° to 10h17, -61°. The event was sporadic.

Event 434 – 2023 March 18 – Hartebeespoort, Gauteng
Captured by Paul Ludick on GMN Camera ZA005 at 01h35m16s. Path from az/alt 291.7°, 15.3° to 281.4°, 9.8°, that is RA/Decl. 10h41, +12.1° to 10h01, +5.8°. A screengrab from the video is shown in Figure 3 and the path plotted on Atlas Brno Chart 8 is shown in Figure 4. The path shows a good coincidence with the radiant of the beta Comae Berenicids. Data from both the GMN and CAMS camera networks indicate activity from the shower from 13 March continuing into early April but with no clear maximum.

Fig. 3 Event 434 captured by Paul Ludick on GMN Camera ZA005 on 18 March 2023. The bright star Regulus is below the fireball, Denebola is centre right of the image, upper right are stars in Virgo.

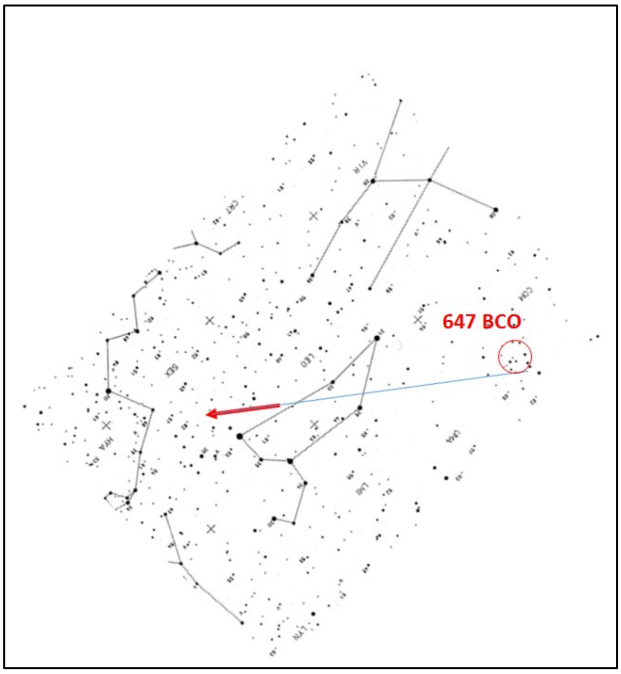


Fig 4. Plot of Event 434 on part of Atlas Brno Chart 8 through Leo. There is a reasonable alignment with the radiant of the beta Comae Berenicids, IAU shower number 647, code BCO, and the red circle delineates the area from which several meteors appeared to emanate from CAMS (Cameras for All-sky Meteor Surveillance) data on the same night.

Event 435 – 2023 April 3 – various locations, Western Cape

Observed by Chris Swart at about 16h53, still twilight, bright white fireball, brighter than Venus, which was then magnitude –3.5 after correcting for atmospheric extinction, altitude 15° in azimuth 306°. Duration 3-5 seconds, path very approximately from a north-westerly direction towards south and around 45-60° above the horizon descending right to left. The fireball fragmented towards the end of passage, about 4 or 5 fragments breaking off and burning out immediately, the largest fragment persisting for a little over 1 second before suddenly disappearing.

Francois Groenewald from Franskraal was looking south facing the ocean, and noticed the fireball 'briefly out of the corner of [his] eye', duration 1-2 seconds, start not seen but descending right to left and ending about azimuth 170°. Francois said it was still light, no stars were visible and the sky was clear. The fireball was seen as a white light.

Marlize Vosser from Pearly Beach, while sitting outside just after sunset, saw a bright object with a tail, descending vertically in azimuth 205°, duration 2 seconds

Krishin Poonsamy saw the fireball from near to Kalk Bay and noted the time as 17h00, bright white fireball, about as bright as the Moon, which was then 94% illuminated, magnitude -12, altitude 15° in azimuth 66°. Duration 1-2 seconds, path from az/alt 185°, 47° to 160°, 36°, that is RA/Decl. 06h05, –76° to 12h13, –74°. The fireball ended in a momentary terminal flash. The fireball was probably sporadic. AMS Event 1915-2023.

Event 436 – 2023 April 7 – Muldersdrift, Gauteng

Observed by Manuela Smith at approximately 00h15, 'saw a bright light which seemed to fall and burn out', duration 2 seconds, initially orange-red colour becoming bright green, blue and white. The fireball showed a persistent train. From a sketch provided path very approximately from az/alt 60°, 55° to 65° 53°, and there is a reasonable agreement with the radiant of the Anthelion (possible eta Virginid) meteors.

Event 437 – 2023 April 8 – Kleinbaai, Pearly Beach, Western Cape

Observed by Anthony Melly from Kleinbaai at about 17h00 during nautical twilight. The sun's altitude was –6.7° at the time. Bright white ball, duration about 3 seconds, and from an image supplied the path could be determined relative to the stars of alpha and gamma Crucis and alpha and beta Centauri, from roughly az/alt 121°, 39° to 179°, 28°, that is RA/Decl. 11h40, –43° to 18h28, –84°. Path length 48°, angular velocity 18°/sec. Fragments were breaking off 'in a sparkler style fashion and shortly after it totally burnt out and disappeared'.

Arina Botes saw the fireball from Kleinbaai at 17h01, she was on her stoep looking south and saw a thick yellowish streak of light high above the horizon descending from left to right. She said 'it suddenly broke up into small fragments of light and dissipated within 1-2 seconds'. It was gone before she could show anyone.

Marlize Vosser was on the beach at Pearly Beach and saw it through fluffy clouds, large bright ball with a long tail, duration 3-4 seconds. It appeared like the path was curved or 'arching' downwards and there were small pieces breaking off.

From the approximate path provided by Anthony Melly, the fireball was most probably sporadic, but also possibly Anthelion, as the path is traceable to the western extremity of the broad region from which these meteors originate during the month of April.

Acknowledgments

Thanks to Peter Morris for his continued efforts to forward reports of fireballs from Zimbabwe. Images for Events 431 and 434 are courtesy of Paul Ludick using GMN cameras ZA004 and ZA005. Data from GMN with credit to references: Vida, D., Gural, P.S., Brown, P.G., Campbell-Brown, M. and Wiegert, P., 2020. Estimating trajectories of meteors: an observational Monte Carlo approach–I. Theory. MNRAS, 491(2), pp.2688-

2705, and Vida, D., Segon, D., Gural, P.S., Brown, P.G., McIntyre, M.J., Dijkema, T.J., Pavletic, L., Kukic, P., Mazur, M.J., Eschman, P. and Roggemans, P., 2021. The Global Meteor Network - Methodology and first results. MNRAS, 506(4), pp.5046-5074. Events 431 and 434 were plotted using Gnomonic Atlas Brno 2000.0 by Vladimir Znojil (1988), WGN 16:4, pp 137-140.

Gearings Point Astronomy Education Display

Pierre de Villiers, Hermanus Centre, ASSA

The Hermanus Astronomy Centre (HAC) designed and oversaw the fabrication and installation of an Astronomy Education Display inside the Whale Watching Ring at Gearings Point adjacent to the Old Harbour (GPAED) in Hermanus during 2022.

This was the culmination of a 13 year long saga that started with the approval of a proposal for an Astronomy Education Centre & Observatory by the Overstrand Municipality (OSM) through re-zoning on 1st September 2019. Execution was delayed by insufficient funding, for which an application was submitted to the National Lotteries Committee (NLC) in Jan 2010. A grant was received from the NLC in March 2014, by which time a Consent Use application instead of the already approved re-zoning was required by new development scheme of the amalgamated OSM. An appropriately revised proposal was submitted, and only finally turned down in Nov 2019. Two years were lost due to COVID, but a revised proposal for an Astronomy Education Display at Gearings Point (GPAED) was submitted to the NLC in Dec 2021 and finally approved on 7th April 2022.

The GPAED is a permanent display of 36 astronomy education tablets covering 21 different topics, which give an introductory but comprehensive overview of Astronomy.

In addition, the Trig Beacon area has been substantially enhanced with interesting educational features. These include:

- A 3m Analemmatic sundial flush with the paving
- North, East & West vertical sundials against the trig beacon plinth
- An explanation of origin of the Equation of Time (EOT) with an EOT components graph and an EOT analemma also against the trig beacon plinth
- A tablet with arrows pointing towards granite ‘V’-slots over which the sunrises and sunsets can be viewed at the Cardinal point equinoxes and solstices.

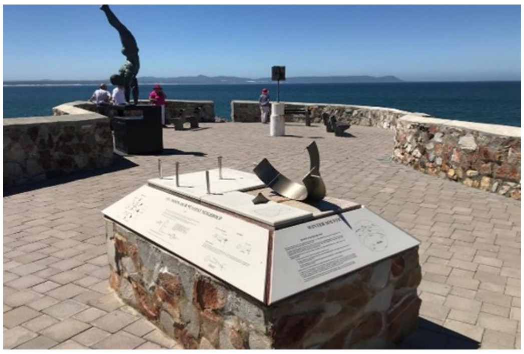


Fig 1. Shows the Whale Watching Ring at Gearings Point before the GPAED upgrade

Fig 2. the Analemmatic sundial with the North vertical sundial and EOT components graph against the trig beacon plinth, with the educational tablets against the Whale Watching Ring wall in the background. The activity induced by the Analemmatic sundial makes it the star of the show.

Fig 3. The North and East vertical sundials with the EOT diagrams below them. Note the rubber gnomons, preferred to stainless steel to mitigate accidental injury risk.

The Educational Tablets

The educational tablets' topics vary from a description of the structure, composition and evolution of the universe on the East side of the Ring, whereas those on the West side relate to practical observational aspects.

The East side tablets take one on a journey from Earth, the Moon, The Sun, the Solar System, our Milky Way and other galaxies and clusters of galaxies to the Large-Scale Structure of the Universe. There are two historical tablets covering Ancient Astronomy and Pioneering Female Astronomers. Finally, there are some elementary cosmology tablets: The Big Bang, the Cosmic Pie, Stellar Evolution & the Origin of the Elements.

The West side practical tablets describe the functioning and use of The Eye, Binoculars and Telescopes as observational aids, together with tablet describing Space Telescopes and phenomena they observe (as of 2022).

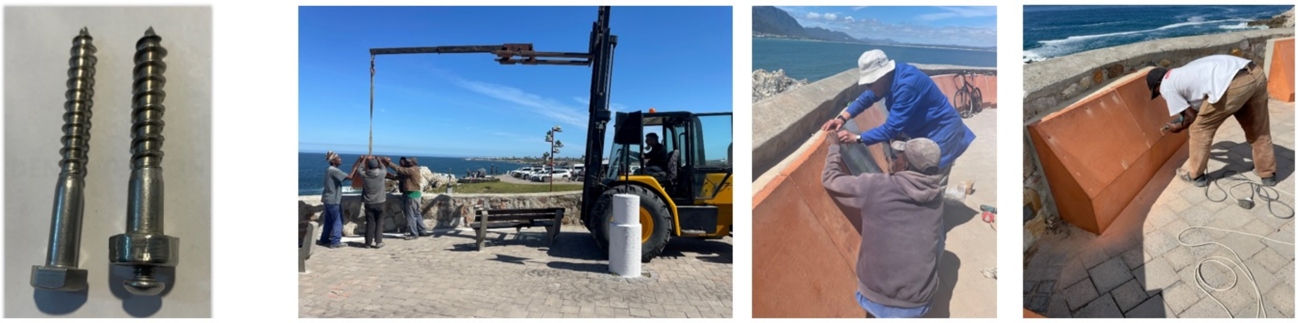


Fig 4a. Installing the educational tablets.

Fig 4b. Installing the tablets – more details.

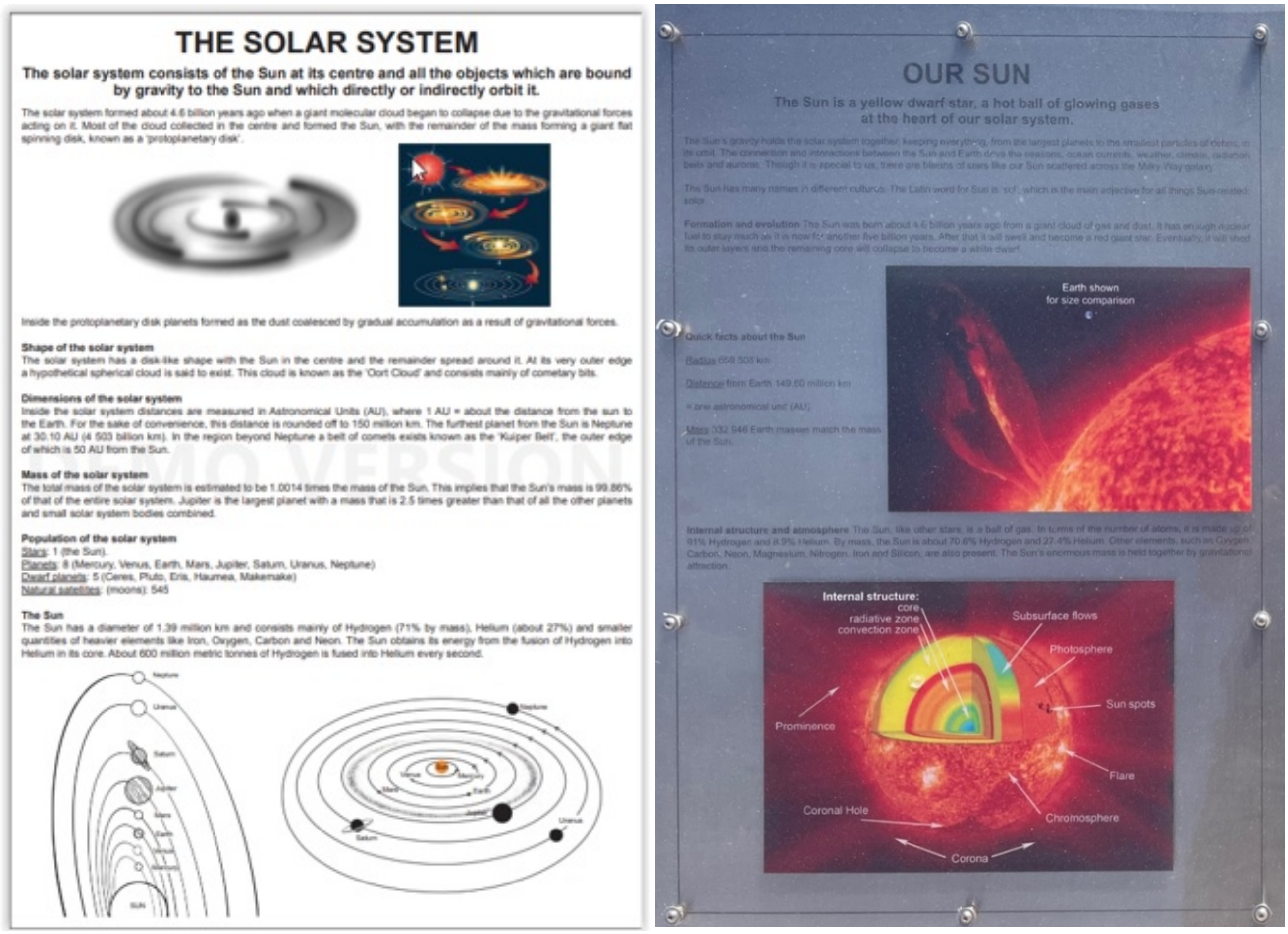
Fig 5 . The completed installation.

There are tablets describing Celestial Objects in the Southern Skies (popular among Northern Hemisphere visitors), Tips for Observing, The Celestial Sphere and Zodiac, Sky Maps and how to use them, Astrophotography and finally a status summary of Space Exploration and the search for extra-terrestrial intelligence (once again as of 2022).

The educational tablets are 560W x 795H mm 316L Stainless Steel (SS) sheets of 2 mm thickness mounted at 60° onto pre-cast concrete slabs at about 100 mm above the paving, to read like a 2.7x enlarged A4 portrait page when standing in front of them. Black and White "printing" is achieved through chemical etching onto the SS tablets, whereas Colour diagrams or photos are Reverse Printed onto 3mm Perspex covers and mounted 7 mm above the stainless steel.

Educational Tablet Examples

It is impossible to give a comprehensive overview of all the educational tablets' content in an article of this nature. This article is therefore limited to two examples of tablets, which will give an indication of the content level, together with a photo of one of the installed tablets to show what the final product looks like.



Figs 6a and 6b. Examples of educational tablets. On the left, one of the designs; on the right an installed tablet.

Security was a prime concern for an outdoor display at a very popular venue containing over R300,000.00 worth of stainless steel. The most secure and practical design was to machine (eliminating grip) and tap M8x70 SS Coach Screws, which were then epoxied into mounting slab holes with strongest SS/Concrete mix available from ABE. 3mm Perspex colour printed (where applicable) covers were then screwed and Locktite-ed into the taps in the Coach Screw heads with M4 button head screws.

Final cleaning, screwing and Locktite-ing was only done after the epoxy had fully hardened and installation was complete. The first tablet installed being read by a Haitian tourist within two minutes of completion!

Project Sequence

The sequence of the project elements was dictated by its nature:

- Approval of a Site Development Plan. Despite receiving written approval of the project from the OSM in March 2019, it was almost accidently learnt that a site development plan was required for approval by the OSM's Building Control Officer as well as the Local Heritage Committee early in May. This in turn required an urgent survey of the site, draughting a site development plan and submitting to the relevant authorities. The Local Heritage Committee's enthusiastic approval was obtained on 14 July.

- Science Editing of the educational tablet drafts. This was crucial as the drafts were compiled by various members of the HAC committee, all amateurs and each with a different approach and style. Although scientifically correct, the drafts were not uniform in style or layout and definitely not reader-friendly and reader-attractive. Prof Mike Bruton, who was involved in the design and construction of double-digit science centres throughout Africa and the Middle East, did an outstanding job of converting the amateur drafts into a reader-friendly and reader-attractive format with uniform style and layout within 6 weeks on 12th July – a truly Herculean undertaking! Successfully crossing this first hurdle was effectively a Go/No Go decision point to go ahead or abandon the project as a potential white elephant. Mike Bruton's excellent work was significant.

Graphic Design of the edited tablets was the next sequential stage of the project, which was initially completed by the end of July, but there were final tweaks as the project team became aware of them. During July four parallel processes were initiated

- The detailed design of educational tablets to incorporate the most secure fixing for valuable SS tablets in an outdoor display. Machining of the M8x70 SS coach screws against vandalism added substantial costs, but the final design works well
- The detailed layout design for the chemical etching of the Black & White text onto SS and Reverse Printing of all colour diagrams or photos onto Perspex. This process was intensely interactive and was only finally signed off for production on 9th September and the final delivery was received on 22nd November
- The design and casting of the pre-cast mounting slabs, completed in September.
- Casting of the foundations for final installation in situ (completed by end July).

Final Installation was started on 25 October and finally completed by 25th November. It was back-breaking hard work for the three GPAED committee members (Deon, Derek & Pierre) with assistance of two builder's hands.

October/November was still tourist high season for overseas tourists, which elicited many discussions and compliments. The apparently most knowledgeable of these spent about two hours exploring the display

The complete set of educational tablets can be found at the following website: www.hermanusastronomy.co.za under the Centre Activities tab.

A YouTube link to a recording of a comprehensive overview of the GPAED project from its conceptual to final installation is available at:
www.youtube.com/watch?v=rN2NxgWzoEY

The website also contains a pdf transcript of the YouTube recording.

Conclusion

Since completion the display has proven to have achieved one of its primary objectives: Attracting the attention of all visitors to the Whale Watching Ring, the single spot that gets the most visitor feet of any in Hermanus.
Only time will tell the extent to which the main objective of stimulating an interest in astronomy in particular, and science in general, has been achieved; It is a fantastic educational facility which adds significant educational and tourism value to the Gearings Point area. The Hermanus Astronomy Centre must now endeavour to stimulate the use of this facility by schools or community interest groups as much as possible.

My years as an Astronomer

Ian Glass (SAAO)

Abstract: Though many astronomers date their interest from childhood, my involvement began only in my student years. I started out as a physicist with an interest in cosmic rays that eventually led me towards astrophysics in general. As a graduate student I began with Solar Wind studies but afterwards moved into the nascent field of X-ray astronomy. During this time I also got involved with stellar interferometry and this ultimately led me to infrared photometry which became the main theme of my career. Some of my main invesigations are outlined in this autobiographical fragment.

I grew up in a village called Malahide, near Dublin, until I was 12, and my early education was in a local school that was unusual for the Ireland of the time in that it had children of both sexes and both religions (Catholic and Protestant). My father was an electrical engineer. I had two cousins who were university students studying chemistry and a neighbour who was a physicist working on cosmic rays. So I had some exposure to science quite early on.

We moved when I was a teenager to Dublin to be nearer to secondary schools. Mine was a small one with boys from many different backgrounds. It had about 220 pupils and my strongest subject was mathematics. One of my hobbies of those years was electronics - receivers and transmitters for radio and television. Themionic valves had not yet been displaced by solid-state devices.

I entered Trinity College Dublin in 1957 to study Mathematics and Natural Sciences. The student body then numbered about 3000. Physics as taught there was rather “soft core”, ie non-mathematical, even though ETS Walton, the department head, was a Nobel prize winner. There was very little astronomical or physical research going on in Ireland. Today, things are very different since Ireland is now a prosperous country that is part of the European Union and is a member of various European scientific organisations. I got to know most of the local practicing researchers of the time but I felt that it was not sensible to pursue a reseach career locally. I resolved to go to the USA for my PhD.

I was awarded a Research Assistantship at MIT. This required that one spent about a third of the time working, usually on some kind of research, for an academic staff member. In my case this was Prof Frank Scherb who was part of the team that first studied the Solar Wind, using an early space probe (Explorer X). This probe measured the Earth’s magnetic field and, once it had crossed the boundary of the “geomagnetic cavity” in the general direction of the Sun, the plasma flowing from the Sun.

A PhD usually took about 5 years, of which the first two at least were occupied with lecture courses. The main hurdle, before starting on a thesis, was to pass a tough "General Examination" on all of classical and modern physics. During the first few years, between attending lecture courses, I worked on analysing satellite data and later on a prototype device to detect deuterium in the Solar Wind using the nuclear reaction t(d,n)α. At that time I built up some interesting vacuum systems and ion sources to test instruments used for Solar Wind flux measurements.

The 1960s were particularly exciting years in astrophysics through the opening up of new spectral regions for exploitation. One can think of the discovery of pulsars, quasars, the cosmic microwave background, radio spectral lines, celestial γ-rays, X-ray sources and infrared excesses, to mention just a few things. MIT groups were involved in many of these. So it was a good place to be to participate in new developments.

X-rays from space had only recently been discovered and for my PhD thesis I worked with Prof George Clark on hard X-rays from the Crab nebula, attempting to see if there were any lines in the spectrum (between about 20 and 70 keV). This involved developing a complete instrument with large-area proportional counters and flying it on a high-altitude balloon. I took on responsibility for quite a large project. Following a successful flight and the analysis of the data it produced, my PhD was awarded in 1968, somewhat delayed by the fact that I was knocked out for quite a long period by illness.

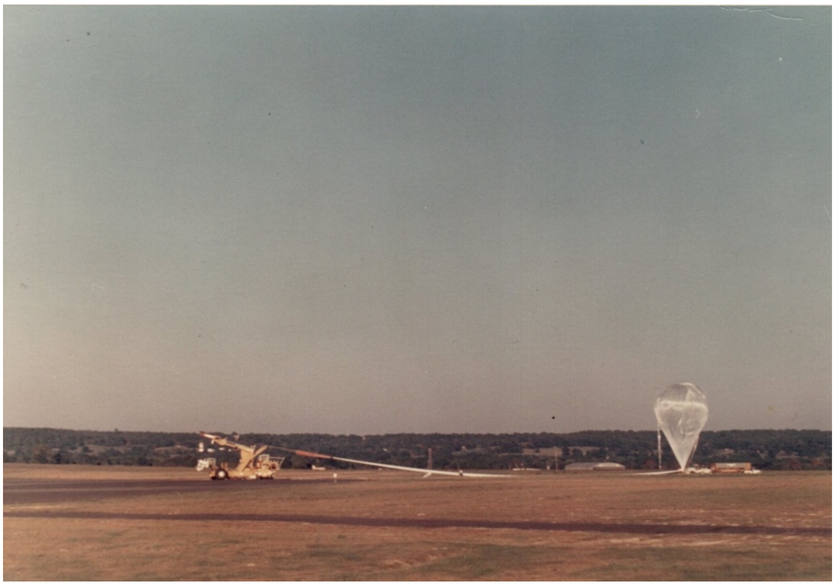


Fig 1. A 10 million cu ft balloon ready for launch. Only the top is filled with helium and when it is let go the launch vehicle manoeuvres until the balloon is taking the load before releasing. The balloon fills out as it reaches altitude (~40 km). There is a parachute above the payload that allows a slow descent at the end of the flight.

I carried on in X-rays as a post-doc. My main project was to work on another aspect of the hard X-rays from the Crab Nebula, viz. timing each photon arrival to about a millisecond, so that its X-ray "light curve" could be studied modulo the pulsar period.

This showed that what had been the interpulse actually became the dominant one at higher energies.

As a kind of private project during the period I spent at MIT I was interested in stellar interferometry. This I carried out in collaboration with Jim Elliot (then a Harvard graduate student and later famous for the discovery of the rings around Uranus). It was the first successful attempt to make quantitative measurements of interference fringes from a Michelson-type stellar interferometer and was an important step in the development of the subject. This work attracted the attention of Gerry Neugebauer, one of the pioneers of infrared astronomy and he invited me to work at Caltech as a post-doc.

Thus in 1969 I switched wavelengths to the infrared, in which I worked for the rest of my scientific career. At Caltech I gained experience in infrared equipment design, which involved vacuum, cryogenic, optical, electronic and computational expertise, beyond the competence of conventional astronomers. I worked frequently at Mounts Wilson and Palomar. The 200-inch was then the largest telescope in the world and I met many of the best-known astronomers of the time. My US visa had however expired and I was lucky enough to meet Donald Lynden-Bell at Caltech who suggested I should go to work in England at the Royal Greenwich Observatory (RGO).

My first year at RGO was spent in developing an infrared photometer that covered the atmospheric transmission bands from 1.25μm to 20μm. While there, I met Michael Feast (who was visiting), Michael Penston, David Allen and Louise Webster, all of whom were keen to make infrared observations. The UK climate is not a good one for photometry and so I arranged to be sent in October 1971 as a visitor to the Cape where the Sutherland Observatory was under construction and the observing weather was expected to be much better.

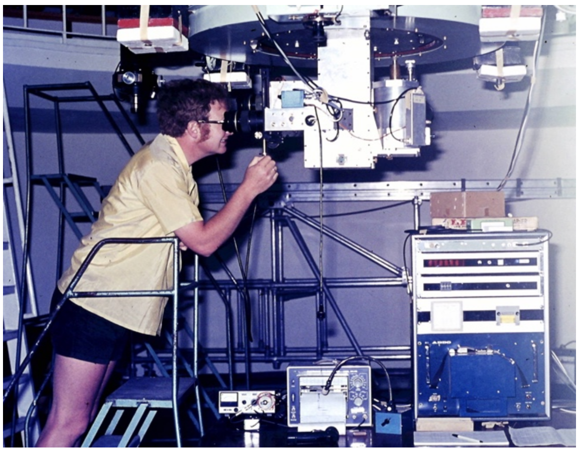


Fig 2. My first photometer on the 1.0 m telescope in Sutherland around 1973. Data were recorded primarily on punched tape. On-line reductions started ca 1980

Looking back, the three years I spent observing with the 18-inch telescope in Cape Town, the 74-inch telescope in Pretoria and the 40-inch in Sutherland were the real beginning of a productive career. The Southern hemisphere was then almost virgin territory in the infrared and many types of objects had not yet been explored at these wavelengths. Further, interstellar extinction is very much less than at visual wavelengths, so that even the Galactic Centre with *ca* 30 magnitudes of visual extinction becomes visible in the K-band at $2.2\mu\mathrm{m}$ and is open to investigation. Even in the North, little was known of the infrared properties of many kinds of objects. My first task was to set up a network of accurate infrared standards in the South, tied to Johnson's in the North. This was done with the 18-inch, by observing bright non-variable stars at constant altitude and spaced around the sky. The 1m telescope was not ready at Sutherland until November 1972, so I observed at the Radcliffe Observatory in Pretoria, then still the joint-largest telescope in the South. In Pretoria, I benefitted from collaborations with colleagues there such as Michael Feast, Louise Webster and Robin Catchpole. Others from the RGO – Michael Penston and David Allen - came out to work with me and I was soon producing many papers per year – in fact, I think I wrote the majority of papers from the SAAO in some of its early years, although in principle I was a member of the Royal Greenwich Observatory at that time.

As my photometers and spectrometers came to be in demand by other users, they had to be idiot-proofed and their use simplified and automated as far as possible. On-line reduction via a minicomputer was implemented around 1979, with programming help from Luis Balona. New and improved detectors required updates of the equipment from time to time to make the most efficient use of the telescopes.

I observed many emission-line objects such as old novae and ultra-luminous stars in the Magellanic Clouds, often finding anomalous infrared emission, indicating the presence of red stars in multiple systems and strong mass-loss. I observed the Chamaeleon and R CrA T-associations to look at the IR colours of very young stars. Some of these had already been picked up by Karl Henize in Bloemfontein as Hα emitters.

In the early 1970s, very few X-ray sources had been identified and, of course, this naturally interested me. They were not particularly expected to be unusually bright in the infrared, but I decided to go for them anyway. One object that I found was the stellar counterpart of GX1+4, whose identity was clinched by Feast through spectroscopy that revealed broad emission lines. I also worked on Cir X-1 and found it to exhibit cyclic flaring. Both these sources have been monitored extensively ever since.

In extragalactic astronomy the QSO 3C273 and a few Seyfert galaxies were already known to exhibit unexpected amounts of infrared emission and I made a point of studying these and other galaxies with peculiar nuclei. Several of the latter showed anomalous infrared emission.

I returned to the RGO in 1974 but could not observe as easily as from the Cape, having to mount expeditions to a 60-inch telescope in Tenerife and to the AAO in Australia which had just then started work. However, Sir Richard Woolley, then head of SAAO, had made me an offer to work here. A South African wife and the opportunity of observing frequently at Sutherland overcame my qualms about the political situation and I joined SAAO in 1975.

Some of my most significant discoveries were in the field of red variables – Miras, and Semi-regulars. My colleague Tom Lloyd Evans had found a number of Miras in the LMC and SMC and I observed these over a few years, finding that they obeyed period-*K* ($2.2\mu m$) and period $- M_{\mathrm{bol}}$ relations. Infrared was the key to success since the visual region of late-type giants is eaten into by deep molecular bands and is not representative of the bolometric output of these stars. The discovery of this relation led to many further investigations and, for example, the use of Miras as distance indicators.

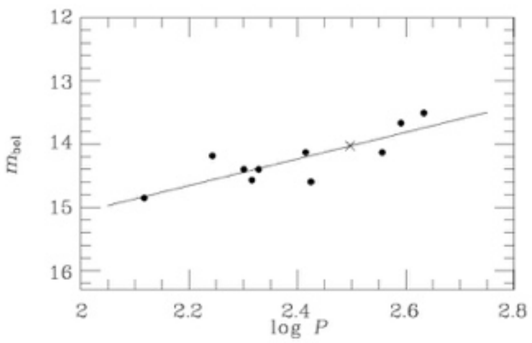


Fig 3. First evidence for the period-luminosity diagram for Mira variables (Glass & Lloyd Evans, 1981).

Follow-up papers compared the properties of long-period and irregular variables in different environments, such as the Galactic Centre, the Magellanic Clouds and the Solar Neighbourhood. The nearby stars were at that time difficult to characterise because their distances were not precisely determined (pre-Gaia) and even their periods were not always well known. Recent automatic repetitive photometric surveys with computerised reductions are yielding improvements here.

Another significant discovery arose from a second long-term monitoring programme – this time, of active galaxies, particularly Seyferts. By 1976, infrared detectors had improved greatly, making it easier to observe faint objects such as BL Lacs and QSOs. I also made further studies of emission-line galaxies with peculiar nuclei that often turned out to be strong infrared emitters. Interspersed with other programmes over many years, I observed repeatedly 41 of the brightest Seyferts that were then known, having been discovered through morphological studies and X-ray surveys. One of these, Fairall 9, happened to be studied simultaneously by the IUE satellite and the cross-correlation of these observations with mine showed a long delay of over a year between the ultraviolet variations and the infrared response. The implication is that the infrared is emitted by a dust shell at about a light-year distance from the central luminous black hole. This was an important confirmation of the "standard model" for active galactic nuclei. Most Seyfert nuclei were shown to vary in the infrared, but the spectral shape of the variable part of the flux was shown to stay constant and characteristic of the temperature at which silicate dust sublimates. The study of "Flux Variation Gradients", (in collaboration with Hartmut Winkler) turned out to be a powerful method for separating out the nuclear component of active galaxies, distinguishing it from the underlying stellar and gaseous emission.

Before the advent of infrared array detectors, images could only be made by raster scanning. The central $1° \times 2°$ of the galaxy had been surveyed only basically and I decided that it could be mapped in much greater detail, given our access to time on the 1.9m telescope. I designed a special triple (simultaneous 3-colour) photometer working simultaneously at *JHK* (1.25 to $2.2\mu\mathrm{m}$). Patricia Whitelock wrote the data acquisition software and Robin Catchpole generated the final images. The joint observations involved 477 10-minute scans over three observing seasons!

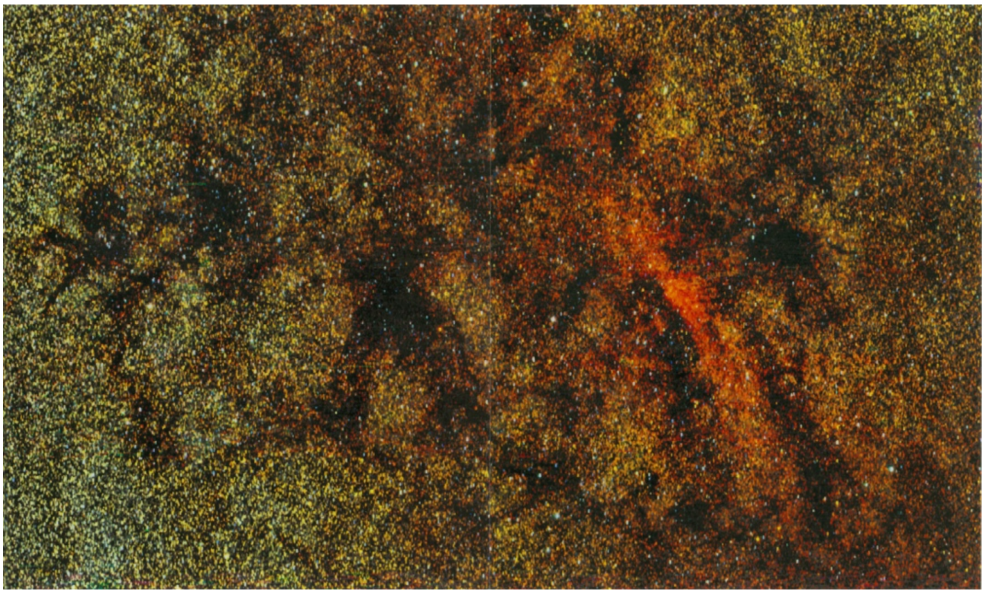
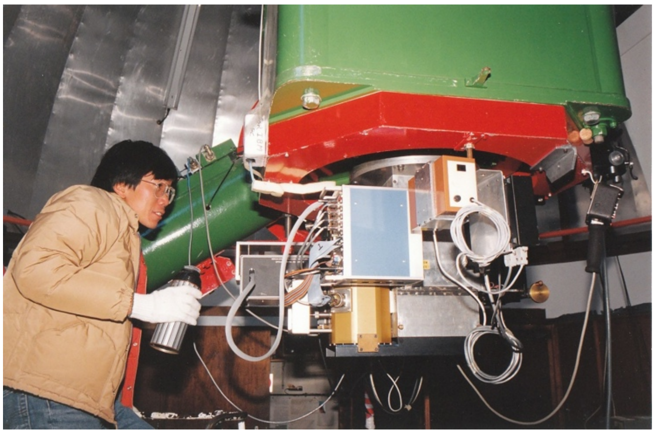


Fig 4. JHK map of the central $1° \times 2°$ of the Galaxy. This was the best such image at the time and shows the dark cores of dense molecular clouds against the stellar background. These correlated well with low-velocity ^{13}CO.

When infrared array detectors were developed, several years after conventional CCDs, the best ones were not available to users outside the United States because of military restrictions. Most IR arrays use two-layer construction, one for the infrared detectors and the other for a silicon-based readout. I spent a considerable amount of my time building cameras using such arrays as were available, often with less than desirable characteristics. However, an early success used a monolithic Mitsubishi PtSi device with very low quantum efficiency but very large format (1040 × 1040 pixels). Using this, we searched an area of $24 \times 24\,\mathrm{arcmin}^2$ around the centre of the Galaxy for Mira variables using the PtSi camera (see below), obaining periods and light curves for several hundred of them.



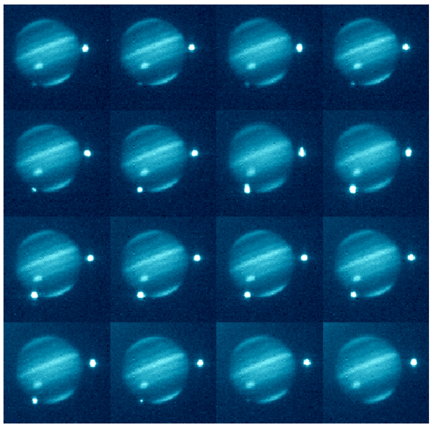


Fig 5 . Left Kaz Sekiguchi filling the Dewar of the PtSi infrared camera. Right: One of the fragments of comet Shoemaker-Levy colliding with Jupiter in July 1994, imaged at 2.2 μm. Our infrared photographs created a sensation on the Internet. I wrote a special chip readout programme to enable these observations.

Infrared satellites such as IRAS, ISO and their successors have extended the range of wavelengths beyond those that can be observed from the ground. The Centre of the Milky Way galaxy passes overhead in the South but cannot be observed at visible wavelengths because of dense intervening interstellar dust clouds, as mentioned. I made a point of looking for the near-IR counterparts of obscured IRAS sources near the Centre, which in some cases turned out to be ultraluminous. One of the most interesting is the “Quintuplet”, a cluster of luminous young stars that I observed further with Andrea Moneti and others using early imaging equipment at ESO, Chile.

In the 1990s I became involved with the ISO mid-IR infrared satellite launched by ESA. I proposed to the P.I.s during the planning stage that it should observe “Baade’s Windows” of low interstellar extinction, close to the Galactic Centre, that can be observed even in visible light. These have the advantage that their constituent stars are essentially at a uniform distance and their absolute magnitudes can easily be compared. Using variability data mined from the MACHO gravitational lensing experiment together with previous spectroscopic surveys and ISO long-wavelength observations it was possible to form a well-defined multi-wavelength sample of semiregular variables. Their mass-loss rates were examined as a function of luminosity and pulsation period. This and some other work showed that both variability and mass-loss in late-type stars started at earlier spectral types than had been realised. Some of this work was done with colleagues at the the European Southern Observatory and the Institute of Astrophysics in Paris. Collaborators in this work included David Alves, Andrea Moneti, Shashikiran Ganesh and Mathias Schultheis.

I was not usually involved with planetary work, though on occasion I observed occultations of background stars by circum-planetary rings with my MIT student friend Jim Elliot and his group. We observed several events involving Uranus and Neptune, helping to delineate their ring structures. This work required the development of special electronics capable of yielding millisecond resolution.

I have given here a very abbreviated account of just some of my scientific work and I should emphasize that much of it was done in collaboration with colleagues, many of whom have already passed away. For various lengths of time I visited other institutes such as the University of Arizona, ESO, Cambridge (both Mass and non-Mass), IAP (Paris), PRL (Ahmedabad), Nobeyama and Tokyo where I was involved in many fruitful collaborations. Altogether, I have been author or co-author of 220 or so papers in my career with over 10,000 citations and a reasonably respectable H-index of 57. I also wrote a textbook on infrared astronomy.

Not mentioned above is my extensive technical work, which sometimes took up a good fraction of my time. Without advances in instrumentation, astronomy itself does not advance! Over the years I designed and largely constructed several infrared and other instruments, among which were photometers, spectrometers and cameras. These were among the most frequently used pieces of equipment at SAAO for 30 years. I was even involved in updating the pointing and control system of the early SAAO telescopes to achieve quicker setting and greater pointing accuracy. When CCD detectors became available easily (the first system at SAAO was supplied by University College, London) I designed sensitive acquisition cameras for the 1.9m and 1.0m telescopes that made use of early frame-transfer chips. I also designed a CCD detector system for the 1.9m spectrograph. These devices had much higher quantum efficiencies, in fact several times higher, than the photoelectric tubes used up to that time and improved the competitiveness of our (by then) relatively small telescopes. Of course, a lot of this work was in collaboration with the excellent technical staff at SAAO.

Like most astronomers I was heavily involved wih computers. My first experiences were with Fortran 2 and Fortran 4 on an IBM 709 at MIT. Later I used the Univac at UCT and Nova minicomputers at SAAO. On-line control got me into Nova and later PC-AT assemblers; OCCAM and Transputer assemblers also. Much of my later work was in C. Fortunately there was a lot of help available at SAAO!

As an individualist, I enjoyed working in a field where one person or a small group could build a piece of equipment, use it and write up the results. So far as infrared is concerned, the era of this type of astronomy has now passed and it is virtually impossible to avoid working as a member of a large team.

Fig 6. My infrared laboratory in the McClean building, ca 1985. Visible are storage vessels for the cryogens liquid nitrogen and liquid helium, a mass-spectrometer detector for vacuum leaks and various electronic items. Most detectors were operated at temperatures of ca 63K and some were at ca 1.2K [Photo: RM Catchpole].

Fig 7. Dewar graveyard: Some of the camera and photometer cryostats that I designed, seen here about the time I retired officially (2005).

In retirement I have worked on astronomical history, and have written several books. Themes that have interested me include the Grubb telescope company, the French astronomer N-L de La Caille who was the first serious astronomer to work at the Cape, Proxima Centauri and the history of the Royal Observatory, Cape. I have tried to encourage an interest in the history of astronomy in South Africa and further afield and also in saving and preserving such records and historical instruments as remain.

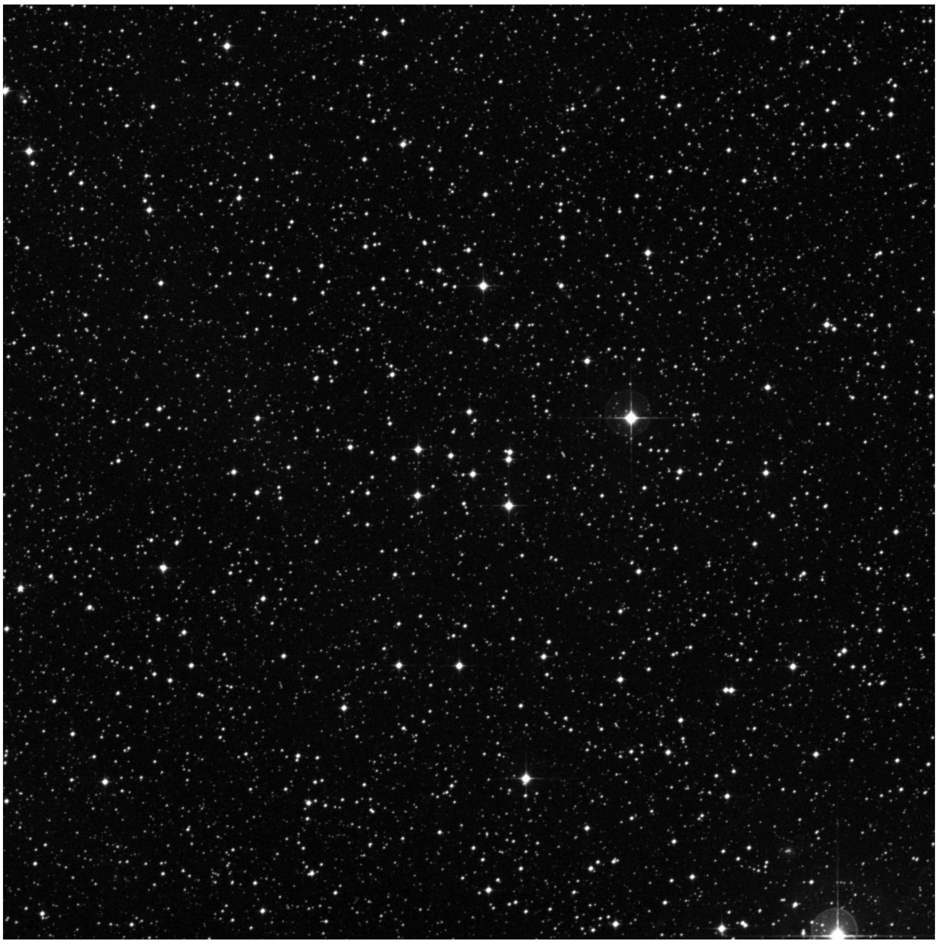
Streicher Asterisms

Magda Streicher

Magda Streicher's numbered asterisms were completed with number 106, but there are still about 30 unnumbered ones which DSH (Deep Sky Hunters) catalogue has.

All images are from http://archive.stsci.edu/cgi-bin/dss

STREICHER – J0840-62
Carina

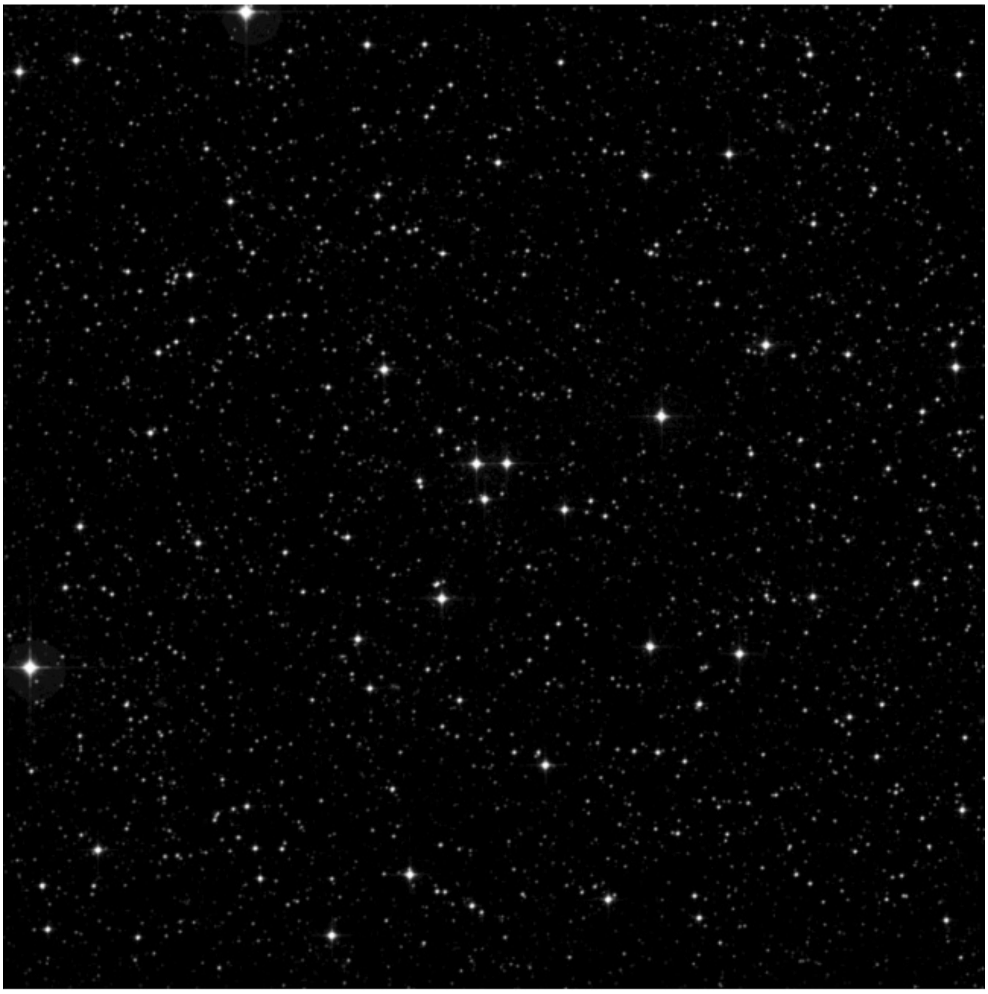


This is an amazing group of stars in a nice square shape. Fainter stars fill in the gaps between them with the north-western corner star is a look-a-like double. The brighter slightly yellow coloured star HD 74277 is visible a few arc-minutes towards the west of the group.

OBJECT	TYPE	RA	DEC	MAG	SIZE
STREICHER DSH J0840-62	Asterism	08h40m.36	-62°33'.57	10.2	4.4'

STREICHER – J0919-73
Carina

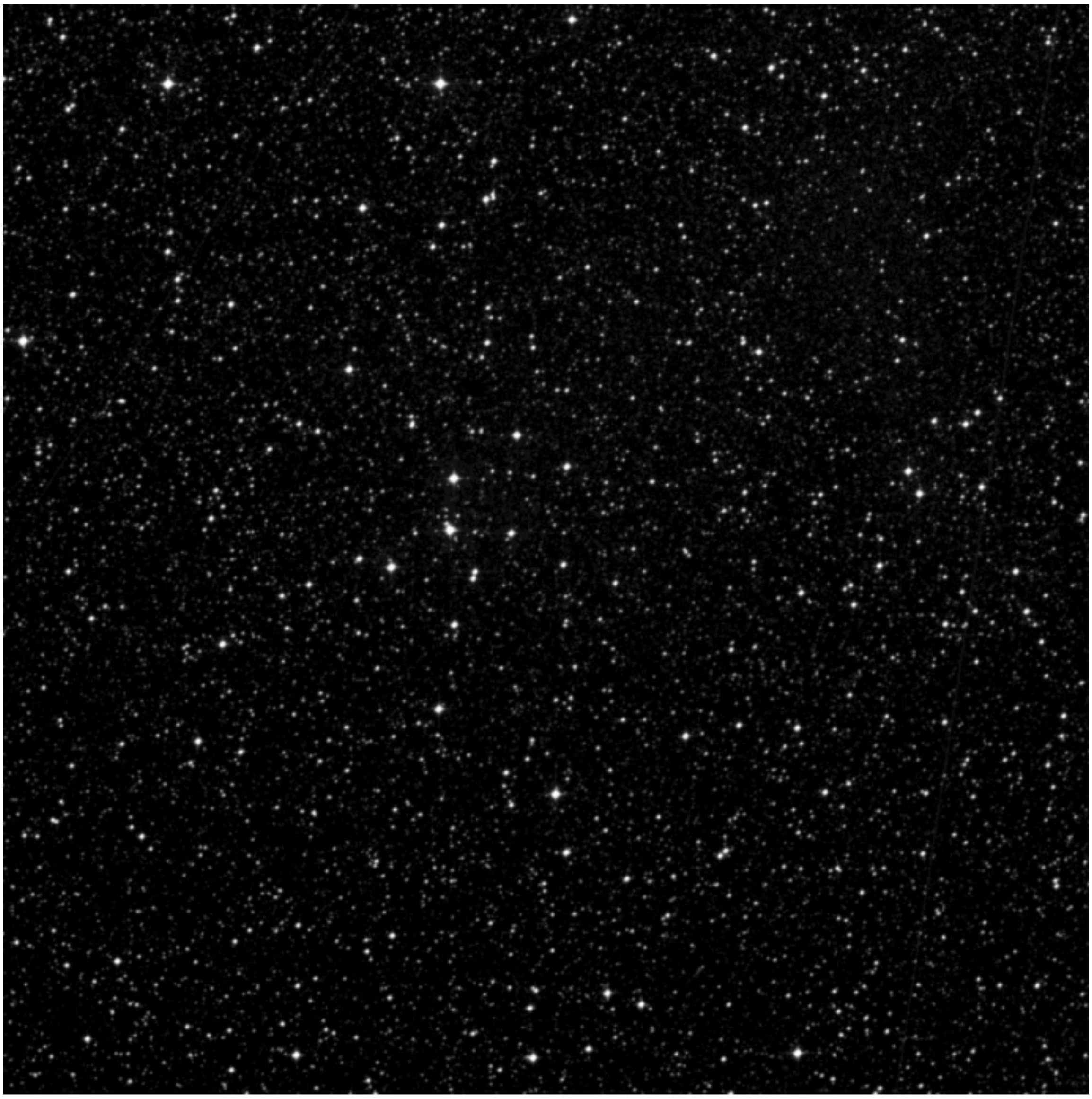
A good example of a wide triangle within a smaller triangle of close stars towards the middle. Except for one star to spoil the formation which is situated in the south-west. The outside triangle consists of the brightest magnitude 9.3 white colour star towards north-west, blue-white magnitude 9.7 north-east and a yellow-coloured magnitude 10.6 south that seems double. Not seen as a type of an asterism, although special.



OBJECT	TYPE	RA	DEC	MAG	SIZE
STREICHER DSH J0919-73	Asterism	09h19m.01	-73°51’.51	9	7.5’

STREICHER – J1034-67
Carina

This grouping consists of about dozen stars, in the range of magnitude 9.5, just barely outstanding. By the looks of it the asterism somewhat had a reverse look of a nice soup-spoon impression. It is a busy starfield with the closest known deep sky objects more than 2° away.

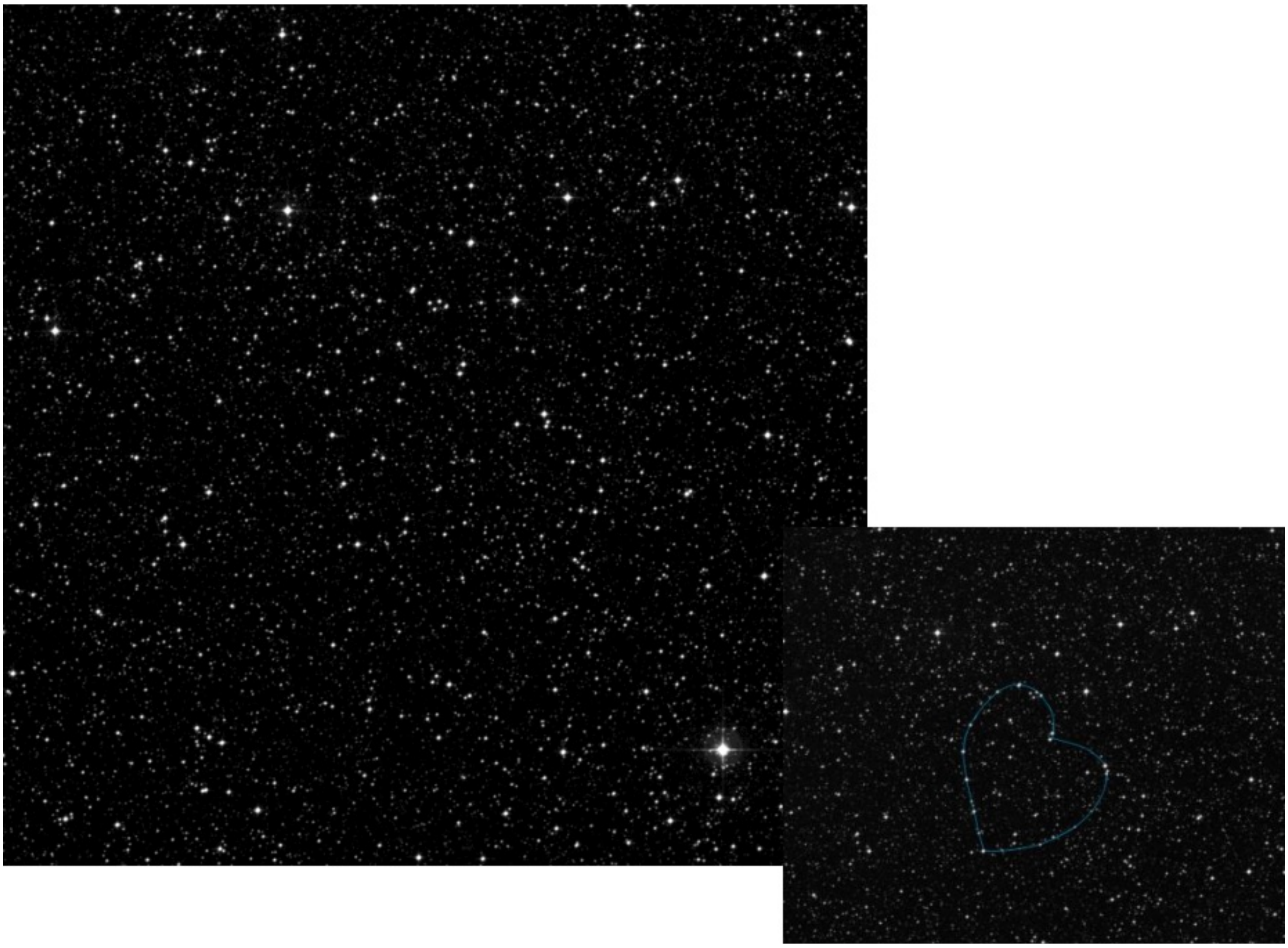


OBJECT	TYPE	RA	DEC	MAG	SIZE
STREICHER DSH J1034-67	Asterism	10h34m.24	-67°25'.00	9.5	9'

STREICHER – J1638-71
Apus

Call it a dream or reality but I search for an asterism represents a heart shape of sorts. My luck came around when I spot such an impression, well shall we call it more or less. This starry heart represents a modest assortment of several bright and faint stars in combination not well lifted out of the surrounding starfield. A truly rich heart of starlight just a degree north-east from NGC 6101

OBJECT	TYPE	RA	DEC	MAG	SIZE
STREICHER DSH J1638-71	Asterism	16h38m.36	-71°38’.12	12	14’



STREICHER – J1719-52
Ara

A slender pointed north-east to south-west grouping, situated east of a much busier starfield. The planetary nebula NGC 6326, with a magnitude of 12 is situated a degree north.

OBJECT	TYPE	RA	DEC	MAG	SIZE
STREICHER DSH J1719-52	Asterism	17h19m.48	-52°28'.12	11.5	4'

STREICHER – J1801-51
Ara

Faint stars display a barely seen snaky-S, require some imagination to pick out from a rich starfield. Towards the north-eastern side of this slender S-shape patches of starless voids can be glimpse.

OBJECT	TYPE	RA	DEC	MAG	SIZE
STREICHER DSH J1801-51	Asterism	18h01m.52	-51°51’.33	10.5	22’

Colloquia

Colloquia and Seminars (now Webinars) form an important part of a research facility, often as a sort of pre-publication discussion or a discussion of an individual's current research, and as such it is virtually impossible to "publish" this material. However by recording the topics discussed in the form below does indicate to those, who are unable to attend, what current trends are and who has visited to do research: it keeps everyone 'in the loop' so to speak
These form an important part of a research facility, often as a sort of pre-publication discussion or a discussion of an individual's current research, and as such it is virtually impossible to "publish" this material. However, by recording the topics discussed in the form below does indicate to those, who are unable to attend, what current trends are and who has visited to do research: it keeps everyone 'in the loop' so to speak

With the passing of CV19, these Colloquia and Seminars are returning slowly to their normal face-to-face format, but a spin-off from the pandemic is that Colloquia and Seminars are often Hybrid sessions. It has also meant that now there Webinars on interesting topics from around the globe! The editor however still focusses very much on sessions held locally, by South African astronomers or visitors to South Africa

Title: Precision Polarimetry -- MeerKAT and VLA Observations of 3C286 and 3C138
Speaker: Dr. Rick Perley (NRAO)
Date: 1 March
Venue: Seminar Room, RW James (UCT) – Hybrid
Time: 13h00

Abstract: Accurate polarimetry requires knowledge of the Electric Vector Position Angle (EVPA) of at least one calibrator source -- necessary for circularly polarized systems like the VLA and VLBA, and useful for linearly polarized ones like MeerKAT, the SKA, and the ngVLA. The preferred polarization calibrator is the quasar 3C286, which for decades was believed to have an EVPA of 33 degrees.

The advent of MeerKAT polarimetry has indicated the EVPA of 3C286 is significantly less than 33 degrees, and changes rapidly with decreasing frequency. Complicating the situation is the effect of ionospheric Faraday rotation, which becomes significant below 2 GHz.

In this presentation, I will describe our efforts to accurately determine the EVPA of 3C286 with both MeerKAT and the VLA, utilizing the Moon, Venus, and Mars as polarization angle calibrators and I will include, at the end of the talk, an update on the ngVLA project.

Title: Detecting Wave Dark Matter with Pulsar Polarization and Timing Arrays
Speaker: Prof. Tao Liu from Hong Kong University of Science and Technology (HKUST)
Date: 1 March
Venue: UKZN Venue: Online SAAO Zoom
Time: 15h00

Title: Prospects for multi-probe cosmology as gravity and inflation probes
Speaker: Dr. Jose Fonseca
Date: 3 March
Venue: UWC Room 1.35
Time: 11h00

Abstract: The next decade will see an overwhelming number of cosmological surveys coming online. The Square Kilometre Array Observatory (SKAO) will, among several other science cases, map the distribution of cold neutral Hydrogen in the Universe using its spin-flip transition emission line at rest of 21cm or 1.4GHz and a novel technique called Intensity Mapping (IM). The ESA lead space mission Euclid will detect millions of galaxies in the optical and near-infrared. Both experiments will map large volumes of the cosmos with significant footprint overlap in different parts of the spectrum. On these scales, signatures of local primordial non-Gaussianity (PNG) and horizon-scale General Relativistic (GR) effects can be found in the power spectrum. However, cosmic variance limits their detection, but combining different surveys allows us to beat down cosmic variance. This multi-tracer (MT) technique can, in fact, be a game changer on linear scales, but many other systematic effects may mimic primordial non-Gaussianity. We will start by reviewing the effect of primordial non-Gaussianity in the large-scale structure (LSS), and how general relativity affects the observed power spectrum. We will review the prospects of measuring PNG and in which scenarios one can attain an error smaller than unity. We will also show the need to include some of the GR effects as they mimic the PNG signal and would bias any such estimate. We will study how radio-optical synergies can be used in practice and which systematics need to be under control for future tentative measurements. We will finish by exploring further probes of the dark matter distribution such as Line IM and Gravitational waves.

Title: An approach to recognize an entity's potential for life
Speaker: Dr. Nape Mmapheto, 2 Military Hospital, Wynberg, Cape Town
Date: 16 March
Venue: SAAO – Auditorium
Time: 11h00

Abstract: There are at least 123 published proposals to define life, and none are acceptable by the scientific community, including NASA's working definition as "a self-sustaining chemical system capable of Darwinian evolution". The lack of consensus on a definition and distinction of life from non-life impedes scientific research, discoveries, interventions and inventions particularly in the field of astrobiology.

A spacefaring, soon-to-be interplanetary, species needs an approach to recognize an entity and its potential for life. Review of these proposals reveals a recurrence of the following themes: metabolism, reproduction, evolution, growth, adaptation, regulation and heredity, often through invasive techniques, fossil records or long-term studies.

This approach is not always feasible, however, an extrapolation reveals a dynamic spectrum of classification with a scale of increasing complexity based on the degree of morphology, locomotion and autopoiesis (MLA); complex entities have a higher potential. The spectrum accommodates any entity with conceivable MLA properties and can be used instantly with minimal potential violation of the subject and its environment. Although rudimentary, the MLA

Spectrum has applications in (1) Planetary Protection protocols, e.g. prevention of backward contamination, preservation of planetary conditions and natural development of entities where applicable; and (2) Initial response to novel encounters. This spectrum requires onsite observation of the subject and little to no experimentation. Future considerations should modify this spectrum, or use it as a basis for a more comprehensive method.

Title: Continuous gravitational wave observations to understand nature of compact objects
Speaker: Dr. Surajit Kalita from the University of Cape Town
Date: 21 March
Venue: UWC Rm 1.35 – Hybrid
Time: 11h00

Abstract: Over the past few decades, various direct or indirect observations have revealed some intriguing celestial objects, including super-Chandrasekhar white dwarfs (WDs), soft gamma repeaters (SGRs), anomalous X-ray pulsars (AXPs), and fast radio bursts (FRBs). Observations of over-luminous type Ia supernovae have so far predicted more than a dozen super-Chandrasekhar WDs, i.e. WDs exceeding the Chandrasekhar mass-limit of 1.4 solar mass. However, none of the super-Chandrasekhar WDs have been observed directly so far. SGRs and AXPs, on the other hand, were discovered via bursts in X-rays or soft gamma-rays. Most of these objects are confirmed to be highly magnetized neutron stars (NSs) due to their supernova remnant associations. However,

certain SGRs and AXPs do not appear to be associated with supernova remnants. As a result, many researchers argue that these can also be WDs. Furthermore, the masses of some WD pulsars are still unknown, and current electromagnetic observations can at best put a bound on their masses. Similarly, there are numerous models incorporating WDs and NSs for the progenitor of FRBs. Because most of these theories can explain the observed properties of FRBs, such as their pulse widths, flux, etc., it is not possible to single out the exact progenitor theory of FRBs. In my talk, I'll illustrate how gravitational wave (GW) observations can resolve all these dichotomies. If these objects rotate with a specific orientation, they can emit gravitational radiation continuously for a long time. I'll further show that various proposed GW detectors, such as aLIGO, Einstein Telescope, LISA, TianQin, DECIGO, and others, can detect such objects in the future with a high signal-to-noise ratio and thereby remove the shortcomings

Title: Galaxy Formation Simulations: Problems and Answers
Speaker: Prof. Neal Katz
Date: 22 March
Venue: Seminar Room, RW James – Hybrid
Time: 13h00

Abstract: Detailed numerical simulations have become a standard approach to understand galaxy formation and evolution, and are commonly used as framework for interpreting observations.

They have led to a new "baryon cycle" paradigm for galaxy formation where the CGM and IGM are interconnected repositories for baryons, which move from the IGM through the CGM and then onto galaxies through both hot and cold modes of accretion. Some of these baryons form stars and central black holes, but most leave galaxies through supernova and quasar winds and rejoin the CGM, from which they can potentially reaccrete. Unfortunately, simulations are sensitive to wind implementations. Interactions at wind/halo gas interfaces in the CGM occur on scales that are much below the resolution of any current or near future galaxy formation simulation, making a "brute force" approach not viable. To mitigate this impasse, we implement a new wind algorithm that explicitly models the "subgrid physics" in the wind-halo gas interaction analytically within a simulation, using the simulation to provide the physical characteristics that will inform the interaction. Unavoidably, this introduces a few free parameters but we can restrict them by matching observed galaxy properties.

Previous simulations using a more standard wind model approaches reproduced many observed properties of galaxies and metal-line absorption, but our new wind

implementation will allow us to tie empirical successes, and failures, more securely to the underlying wind physics, both the ejection (mass-loading factors and ejection speeds) and the interaction between the wind and gaseous halo, hopefully allowing the simulations to model physics instead of numerical errors.

Title: Gravitational Waves: Past, Present and Future
Speaker: Prof Alexandre Sevrin, Vrije Universiteit Brussel (VUB)
Date: 24 March
Venue: UWC Room 1.35
Time: 14h00

Abstract: Gravitational wave physics will be introduced and the current observational efforts summarized. Subsequently I will focus on the development of the 3rd generation instruments which is now proceeding at an accelerated pace focusing in particular on the "Einstein Telescope" initiative in Europe. I will also briefly present the department of physics and astronomy at the Vrije Universiteit Brussel (VUB). As the UWC and the VUB have a strategic international partnership agreement, this might provide an entrance to future collaborations, both from scientific and from educational points of view.

Title: Characterizing the Multiphase Interstellar Medium in the Milky Way and Beyond
Speaker: Dr. Nick Pingel
Date: 24 March
Venue: Seminar Room, RW James (UCT) – Hybrid
Time: 13h00

Abstract: The composition of the interstellar medium (ISM) is dominated by hydrogen which exists over several thermal phases: a cold molecular phase (H2) that fuels star formation, a cold and warm atomic neutral phase (CNM and WNM, respectively) that coexists at the same pressure (HI), and an ionized phase (HII) found around areas of recent star formation. The lifecycle and interplay between these different thermal phases are fundamental drivers of galaxy evolution, though many questions regarding the physics behind the transitions between these phases remain open. For instance, how does the WNM-to-CNM fraction vary over a wide range of environments (e.g., metallicity and regions with strong local stellar feedback)? And how do these gradients affect the transition to H2 to fuel future star formation? In this talk, I will present recent science highlights from observations of HI emission and absorption from two novel surveys: the Galactic ASKAP survey (GASKAP-HI) being carried out on the Australian SKA Pathfinder, which provides the most sensitive and spatially resolved view of the atomic gas in our own Milky Way and nearby Magellanic Clouds, and the Local Group L Band

Survey (LGLBS), performed with the Karl G. Jansky Very Large Array, that extends this view to prominent members of the Local Group, including the Milky Way analogue M31. These unprecedented observations probe the physical state of HI over a wide range of environments to provide touchstone data sets for the Magellanic System, Milky Way, and Local Group for the coming decade.

Title: Gamma-ray astronomy with the Cherenkov Telescope Array.
Speaker: Dr. Gernot Maier
Date: 3 April
Venue: James LT2A RW James (UCT)
Time: 13h00

Abstract: The Cherenkov Telescope Array (CTA) is the next-generation ground-based observatory designed to study high-energy gamma rays in the energy range from 20 GeV to 300 TeV. The project involves a global collaboration of more than 1,500 scientists and engineers and is currently entering its construction phase. Observations with the CTA observatory will address a broad range of astrophysical key topics, such as the origin of cosmic rays, acceleration of particles, physics of compact objects and jets, magnetic fields and radiation in cosmic voids, and the nature of dark-matter particles. This talk will give an introduction into ground-based gamma-ray astronomy, review recent results on gamma-ray binaries, and discuss in detail the status and scientific potential of CTA.

Title: Commissioning of the James Webb Space Telescope's NIRISS instrument and the First Science Results
Speaker: Dr. Swara Ravindranath, Space Telescope Science Institute, Baltimore
Date: 6 April
Venue: SAAO Auditorium
Time: 11h00

Abstract: The successful launch, deployment, and commissioning of NASA's James Webb Space Telescope (JWST) has been a remarkable achievement and the early science results from the observatory are already pushing the frontiers in many areas of astronomical research. The Near-Infrared Imager and Slitless Spectrograph (NIRISS) on JWST is a versatile instrument that enables slitless spectroscopy and direct imaging at the wavelengths between 0.6 - 5.0 microns, along with high-contrast interferometric imaging capabilities. NIRISS Wide-Field Slitless Spectroscopy (WFSS) mode provides low resolution spectroscopy of all sources within the field of view and is ideally suited for detecting emission-line galaxies at high redshifts. The Single Object Slitless Spectroscopy (SOSS) mode on NIRISS is optimized for time-series observations and is a niche for exoplanet transit spectroscopy. The Aperture Masking Interferometry (AMI) offers high spatial resolution, high contrast imaging suited to detect binary companions at close separations. The first science results from NIRISS WFSS have revealed a suite of emission lines from low-mass galaxies, and absorption features from quiescent galaxies that provide crucial diagnostics of the ionized gas, dust, and stellar component at high redshifts. By combining the power of JWST/NIRISS and gravitational lensing, we are able to identify and study proto-globular cluster candidates around lensed galaxies. One of the key science goals of JWST is to advance our understanding of habitable worlds beyond the Solar System. NIRISS SOSS observations are already providing unprecedented transit light curves and spectroscopy that reveal the chemistry of exoplanet atmospheres. In this talk, I will provide a quick overview of the NIRISS instrument performance and highlight some of the impactful science results.

Title: Cosmic magnetic fields: A new window to the early Universe
Speaker: Dr. Jennifer Schober from EPFL Lausanne, Switzerland
Date: 14 April
Venue: UWC Room 1.35 – Hybrid
Time: 11h00

Abstract: Magnetic fields are observed on virtually all length scales of the present-day Universe, from planets and stars to galaxies and galaxy clusters. Observations of blazars suggest that even the intergalactic medium is permeated by magnetic fields. Such large-scale fields were most likely generated very shortly after the Big Bang and therefore are a unique window into the physics of the very early Universe.

In my talk, I will review theoretical models of magnetogenesis and confront these with observational constraints. I will address the possible origin of magnetic fields in the very early Universe, during inflation and the cosmological phase transitions, as well as their pre-recombination evolution in magnetohydrodynamical (MHD) turbulence. In particular, I will present results from high-resolution numerical simulations that show an efficient amplification of magnetic energy due to the so-called chiral anomaly, a standard model effect that necessarily leads to an extension of the MHD equations at high energies.

Title: Galaxy evolution surveys with MeerKAT: Selected updates from LADUMA and MIGHTEE
Speaker: Dr. Jacinta Delhaize, University of Cape Town
Date: 14 April
Venue: UKZN Astrophysics Seminar – Hybrid
Time: 15h00

Abstract: LADUMA and MIGHTEE are two galaxy evolution surveys well underway with the SKA precursor telescope MeerKAT. LADUMA (HI only) and MIGHTEE (HI and continuum) are both starting to produce exciting new papers, thanks to MeerKAT's excellent sensitivity. I will give a brief overview of these surveys and present selected updates. In particular, I will discuss source finding attempts using SoFiA on LADUMA data and the discovery of three giant radio galaxies (GRGs) in MIGHTEE. GRGs are the largest single galaxy-scale objects in the Universe, yet are relatively rare. The three discovered in the MIGHTEE-COSMOS field may be the first of a new population to be revealed through surveys like MIGHTEE, which provide exquisite sensitivity to diffuse, extended emission.

Title: Continuous gravitational wave observations to understand nature of compact objects
Speaker: Dr. Surajit Kalita from the University of Cape Town
Date: 21 April
Venue: UWC room 1.35 – Hybrid
Time: 11h00

Abstract: Over the past few decades, various direct or indirect observations have revealed some intriguing celestial objects, including super-Chandrasekhar white dwarfs (WDs), soft gamma repeaters (SGRs), anomalous X-ray pulsars (AXPs), and fast radio bursts (FRBs). Observations of over-luminous type Ia supernovae have so far predicted more than a dozen super-Chandrasekhar WDs, i.e. WDs exceeding the Chandrasekhar mass-limit of 1.4 solar mass. However, none of the super-Chandrasekhar WDs have been observed directly so far. SGRs and AXPs, on the other hand, were discovered via bursts in X-rays or soft gamma-rays. Most of these objects are confirmed to be highly magnetized neutron stars (NSs) due to their supernova remnant associations. However, certain SGRs and AXPs do not appear to be associated with supernova remnants. As a result, many researchers argue that these can also be WDs. Furthermore, the masses of some WD pulsars are still unknown, and current electromagnetic observations can at best put a bound on their masses. Similarly, there are numerous models incorporating WDs and NSs for the progenitor of FRBs. Because most of these theories can explain the observed properties of FRBs, such as their pulse widths, flux, etc., it is not possible to single out the exact progenitor theory of FRBs. In my talk, I'll illustrate how gravitational wave (GW) observations can resolve all these dichotomies. If these objects rotate with a specific orientation, they can emit gravitational radiation continuously for a long time. I'll further show that various proposed GW detectors, such as aLIGO, Einstein Telescope, LISA, TianQin, DECIGO, and others, can detect such objects in the future with a high signal-to-noise ratio and thereby remove the shortcomings.

Title: Exploring the Habitability of Jupiter's Moon Europa with NASA's Europa Clipper Mission
Speaker: Shawn M. Brooks Jet Propulsion Laboratory, California Institute of Technology
Date: 20 April
Venue: SAAO Auditorium
Time: 11h00

Abstract: Europa Clipper, NASA's latest flagship mission, is currently being assembled (http://bit.ly/clippercam) at the Jet Propulsion Laboratory in Pasadena, California, and is on pace for an October 2024 launch. It will swing past Mars in February 2025, where it will receive a gravity assist. A second gravity assist at the Earth in December 2026 will slingshot the spacecraft to an April 2030 rendezvous with Jupiter. Once at Jupiter, Europa Clipper will fly by Jupiter's satellite Europa nearly 50 times during its prime mission. Europa, with its geologically youthful surface (Bierhaus et al., 2009) and a subsurface ocean (Khurana et al., 1998), is believed to harbor potentially inhabitable environments beneath its icy surface. The primary goal of the Europa Clipper mission is to enrich our understanding of the potential habitability of this icy ocean world through the synthesis of a variety of distinct observation techniques.

Clipper will carry with it a suite of nine science instruments. The remote sensing payload includes the Europa Ultraviolet Spectrograph (Europa-UVS), the Europa Imaging System (EIS), the Mapping Imaging Spectrometer for Europa (MISE), the Europa Thermal Imaging System (E-THEMIS) and the Radar for Europa Assessment and Sounding: Ocean to Near-surface (REASON). In-situ measurements will be made with the Europa Clipper Magnetometer (ECM), the Plasma Instrument for Magnetic Sounding (PIMS), the SUrface Dust Analyzer (SUDA), and the MAss Spectrometer for Planetary Exploration (MASPEX). Clipper's telecommunication system will provide Gravity and Radio Science (G/RS), and valuable scientific data will be acquired by the spacecraft's Radiation Monitoring system (RADMON).

In this talk, I will describe the overarching goals of the Europa Clipper mission and provide an overview of its science operations. The second half of this talk will focus on the science of the Europa-UVS investigation. Designed and built at the Southwest Research Institute (SwRI), Europa-UVS will be used to explore Europa at wavelengths between 55 and 206 nm (Davis et al., 2022). Europa-UVS will be used to determine the composition and variability of Europa's exosphere, characterize any active plumes, explore the chemistry of the surface as it relates to endogenic and exogenic processes and understand the connections between energy and mass flow in the Europa atmosphere, neutral cloud and plasma torus (Retherford et al., 2018). Europa-UVS is the sixth in a line of ultraviolet spectrographs built at SwRI. Its sister instrument, JUICE-

UVS, will join Europa-UVS in the Jupiter system when ESA's JUICE spacecraft arrives in 2032.

Title: Testing Rover Science Autonomy in the Field
Speaker: Dr. Sanlyn Burner, Planetary Science Institute
Date: 28 April
Venue: SAAO Auditorium
Time: 11h00

Abstract: The Toolbox for Research and Exploration (TREX), a node of NASA's Solar System Exploration Research Virtual Institute (SSERVI), develops tools and research methods for exploration of airless bodies, like the Moon, Martian moons, and asteroids, that are coated in fine-particulate dust in order to prepare for human missions. Sanlyn Burner will share updates from the first two field seasons where the team tested autonomous rover science in the field by integrating multiple data sets through three scenarios, 1) standard rover exploration, 2) autonomous rover exploration, and 3) rover exploration along with a deployed "astronaut".

The **Astronomical Society of Southern Africa** (ASSA) was formed in 1922 by the amalgamation of the Cape Astronomical Association (founded 1912) and the Johannesburg Astronomical Association (founded 1918). It is a body consisting of both amateur and professional astronomers.

Publications: The Society publishes its electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly, the annual *Sky Guide Africa South* and *Nightfall*.

Membership: Membership of the Society is open to all. Potential members should consult the Society's web page : http://assa.saao.ac.za for details. Joining is possible via one of the local Centres or as a Country Member.

Local Centres: Local Centres of the Society exist at Bloemfontein, Cape Town, Durban, Hermanus, Johannesburg, Pretoria and the Garden Route Centre; membership of any of these Centres automatically confers membership of the Society.

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