ISSN 0024-8266

# mnassa

monthly notes of the astronomical society of southern africa
Vol 69 Nos 1 & 2 February 2010

## Eta Carinae Nebula

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monthly notes of the astronomical society of southern africa

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subscription rates

Non-members of the Society can obtain its publications by applying to the Business Manager at the editorial address. Within South Africa, the subscription rate for 2010 is R100 per volume (6 issues). Overseas subscription (via airmail only) is US $45.00 per volume. Back numbers, if available, are US $10.00 per copy.

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**Deadlines:**

Vol 69 Nos 3 & 4 (Apr 2010 issue), 01 Mar 2010
Vol 69 Nos 5 & 6 (Jun 2010 issue), 01 May 2010
Vol 69 Nos 7 & 8 (Aug 2010 issue), 01 Jul 2010
Vol 69 Nos 9 & 10 (Oct 2010 issue), 01 Sep 2010

**Cover picture: Eta Carinae Nebula - Wide Field**

Dieter Willasch from Somerset West photographed, what he regards as "the most beautiful of all Southern Sky Nebulae", showing the full extent of the fantastic nebular structure, created by the extremely bright radiation of the variable giant star Eta Carinae and some young star clusters in the centre of the image. (also see p.10)

Source: http://astro-cabinet.com

mnassa
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assa news

## Council Matters

Maureen Rogers has taken on the position of Membership Secretary and was welcomed by Council on 8 September 2009.

Council is also seeking members to occupy two other positions, following two resignations. Laurie Simone, who intends to emigrate, resigned as Secretary after the last Annual General Meeting and Cliff Turk has resigned as Business Manager due to pressure of other business (he remains as Treasurer). Council sincerely thanks these members for their work for the Society, freely given.

Pat Booth has taken on the position of Secretary to deal with correspondence *pro tem*, for which she is also thanked. Minutes of Council meetings are being taken by Ian Glass.

Though an attempt was made to appoint a Business Manager with a small salary, this has unfortunately fallen through and a replacement is still urgently needed. Ms Isobel Bassett and various helpers are thanked for getting this year's *Sky Guides* out to bookshops and individual customers.

Tony (A.P.) Jones has also decided to step down from editing the *Sky Guide*. A subcommittee has been negotiating with a possible new editor and it is hoped that an appointment (which carries some remuneration) can be announced following the 2 February 2010 Council Meeting. ☆

## ScopeX 2010

The very popular ScopeX will be held on 17 April 2010 by the Johannesburg Centre at their usual venue, the War Museum next to the Johannesburg Zoo. Since its inception in 2002, ScopeX has gone from strength to strength with something new every year. For more information, visit www.scopex.co.za or contact Lerika Cross (ScopeX Co-ordinator) at lerika@icon.co.za or call 082 650 8002. ☆

## Ninth Biannual ASSA Symposium: Notification

The Pretoria Centre is proud to announce the dates for the ninth biannual astronomy symposium. The symposium will take place at the Silverton campus of the Council for Geoscience on Thursday 7 October and Friday 8 October 2010. The preliminary program for Saturday includes a morning visit to HartRAO and a guided tour through the Tswaing meteorite impact crater during the afternoon.

People interested in delivering papers are invited to send a short synopsis to Andrie van der Linde at andrie@eridanusoptics.com. You can also make a preliminary booking if you plan to attend.

Details on registration fees and suggestions for accommodation, etc will be available soon. ☆



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## Spectacular meteor over the Northern Province

Magda Streicher

A very bright meteoric event took place over the northern parts of South Africa and southern Botswana/Zimbabwe on Saturday, 21 November 2009 at around 23h00. It was widely seen, as far north as Gweru, Zimbabwe, Durban in the south and Boshof in the west. A few surveillance cameras recorded footage of the actual meteor while others showed their night scene turn into "day" and shadows tracking the movement of the source. All over the internet blogs exploded with reports and most news media covered accounts of sightings. In many cases people were woken up by the blinding light and in some instances, by the sound. One such person, who was lucky enough (or is it not!) to have been close enough to the action, was our own Magda Streicher. She wrote:

"We spent the weekend of 21 November 2009 with friends on our farm which is 20 km north of the small town of Alldays (see map). Located at 22˚30S, 29˚07E, the farm is barely 30 km from the Pont Drift border post which guards the border between South Africa and Botswana. The Beitbridge control post to Zimbabwe is ~90 km to the east.

"It was partly cloudy and we spent most of the evening indoors. We decided to turn in shortly before 23h00. I hardly got to the bedroom when I suddenly saw a bright glow through the curtains of the Bushveld outside lighting up, as if with a huge flashlight. The next moment a loud double impact sound, like a bomb blast, hit us – it sounded as if something massive struck the ground. This was followed by an after-sound in the form of a rumble, lasting about three seconds, causing the windows to rattle. Then suddenly … dead silence. I immediately knew it had to be a meteor and wondered if it impacted or exploded in the air.

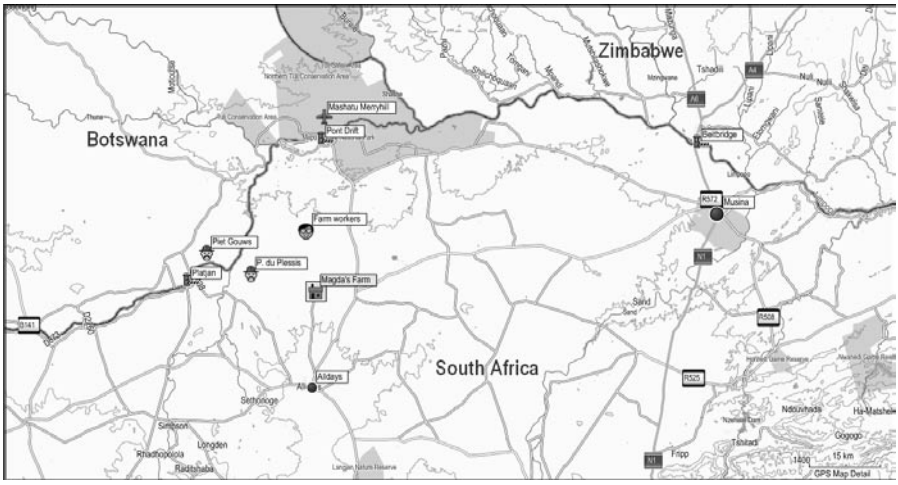
"Someone in the room next door happened to be looking out the window when it struck. She regarded it to be the brightest light she ever saw. It lit up the velt as far as the eye could see – bright enough to read a book. She estimated the time to be 23h00.

"Early the next morning (Sunday, 22 November) I started calling various people around the area. The first person I spoke to was Johan Willemse who stays near the Platjan border post, some 30 km west of us. He reported that the blinding meteor turned into a fiery red-purple fireball. At this stage a loud sizzling sound was heard, burning smoke was seen with the earth rumbling and windows shaking madly. Others, all in a radius of 20 km around us, reported the following: Philip

du Plessis thought his house has been blasted away. Pieter Lombard saw the meteor as a glowing, burning ball of fire. A double flash was seen by Piet Barkhuizen and at the house of Derick-Piet Gouws a wall cracked and it sounded as if the door was moving in its frame. He also heard the hissing sound, saw smoke and a very red western horizon. Due to good rains no fires were reported in the area around us, which could have helped to indicate an impact area. I also spoke to farm workers further north of us who said that the meteor went nearly overhead, in the direction of Pont Drift. Seismic calculations attempted by Pete le Roux from the Mashatu Merryhill airfield, put the blast epicentre at an area about 5 km east of Pont Drift. However, this is mere speculation.

"The furthest away that the sound was heard (that I know of) was a farm close to Soutpansberg (~80 km south of us) and around 50 km inside Botswana, about 100 km west of us."

At the moment, Tim Cooper, ASSA's Comet and Meteor Director, is still busy analysing the mass of eyewitness reports while Claire Flanagan of the Johannesburg Planetarium is attempting to extract trails and positional information from the surveillance camera footage. A Geophysicist, Roger Gibson, has been looking for the end-point (in case any debris fell) and Water Resource Engineer and a Meteorite Collector, Ronnie McKenzie, has been searching on the ground. We are looking forward to a full article on their findings in a future issue of *MNASSA*. ☆




**A map, generated using Garmin's *MapSource* GPS software, indicating some of the localities discussed in the text. The map extents are 90 x 200 km.**

## Union/Republic Observatory Archives

Word has been received from Mrs Annette Joubert, Acting CSIR Archives and Record Service Manager, about the future disposition of the Union/Republic Observatory archives (see April 2009 issue of *MNASSA*).

Approval has now been received from the CSIR Executive to give away the printed publications and the collection of glass photographic plates. They will be housed by the Johannesburg Centre of ASSA in Observatory, Johannesburg and will be moved in March this year.

Digitisation of relevant glass plates and making them internationally available will be an option. Two members of the International Astronomical Union showed interest and concern following the April *News Note*.

The National Archives of SA recommended that the written archives be donated to the National Archives as a collection, specifically to the Cape Town Branch, where they will be accessible to the SAAO as well as to students. The negotiations regarding this have still to be started. ☆

## MeerKAT and SKA now driving SA Astronomy

The Department of Science and Technology (DST) is showing more and more interest in supporting the South African SKA bid as the decision between South Africa and Australia on the final site approaches. The following three *News Notes* illustrate some recent developments.

Further, it is rumoured that a new headquarters institute for MeerKAT and hopefully SKA will soon be announced, probably to be located in the Cape Town area. ☆

## Human Resources for Radio Astronomy in South Africa

One matter of concern has been human resources: up till recently the radio astronomy community in South Africa has been a small one. In a recent speech, the Minister of Science and Technology, Mrs Naledi Pandor stated: "In 2004 the DST, through the NRF, and the South African SKA Project Office initiated a human capital development programme. From the outset, the programme set itself the goal of increasing the number of highly-skilled scientists and engineers able to support the SKA and MeerKAT during the design, construction and operational phases of the telescopes. To date the programme has provided bursaries and grants awarded to:

- 11 postdoctoral fellows
- 83 PhD and MSc students
- 43 undergraduate and honours students
- 6 interns
- 5 trainee technicians
- Thirty seven postgraduate bursaries have been awarded to students from other African countries."

## New Research Chairs

In a recent statement, five entirely new South African SKA Research Chairs related to the SKA project have been announced by the Department of Science and Technology. These new Chairs will form part of the South African Research Chairs Initiative (SARChI) of the Department of Science and Technology (DST) and the National Research Foundation (NRF). The procedure for appointing these professors has now been streamlined: the slow and cumbersome process previously used caused serious frustration among previous possible appointees.

The table below shows which chair has been made available to which South African university as part of the country's commitment to strengthen cutting-edge science and engineering and to hosting the Square Kilometre Array.

Each of the successful universities is now expected to find an internationally recognised and dynamic researcher to take up the position. The intention of this initiative is to strengthen and further build up a world-class and dynamic astronomy and instrumentation community in Southern Africa.

The Chairs are awarded for a period of 15 years, subject to review every five years, and together are worth a total of R240 million (€ 22 million) over this period. This is in addition to the R140 million which the DST has already committed to a bursary programme – the *SKA Youth into Science and Engineering* - for study in astronomy,

| University | Research Focus for SKA Research Chair |
|---|---|
| Stellenbosch University | Electromagnetic Systems and EMI (Electromagnetic Interference) Mitigation for SKA |
| Rhodes University | Radio Astronomy Techniques and Technologies |
| University of Cape Town | Extragalactic MWL (multi wavelength) Astronomy |
| University of the Witwatersrand | Radio Astronomy |
| University of the Western Cape | Astronomy and Astrophysics |

physics and engineering in fields related to the Square Kilometre Array and South Africa's MeerKAT Radio Telescope**.**

Specific research areas are observational radio astronomy, observational multi-wavelength astronomy and radio astronomy instrumentation, specializing in one or more of digital signal processing, distributed data processing, RF broadband feeds, receivers & cryogenic packages and EMC and EMI

South African universities were invited to apply for the Research Chairs in an open, competitive process. ☆

## Concrete progress at Meerkat

Meanwhile, on 10 December 2009, it was announced that MeerKAT Precursor, KAT 7, had seen its first interference fringes from a celestial source. The project reached a major milestone on 3 December 2009 when interference fringes were seen between two of the dishes which have now been constructed on the MeerKAT site. This milestone was reached ahead of schedule – it was originally scheduled for 18 December 2009. This is a major achievement for the MeerKAT team. The subsystems were developed and tested in Cape Town and integrated in the integration laboratory in the MeerKAT Cape Town office. Fringes were seen from a range of radio sources within a few days of the final subsystems arriving on site for installation. Although a great deal of work remains to be done on the MeerKAT precursor, the speed with which this milestone was achieved has demonstrated again the commitment and competence of the South African SKA Project's MeerKAT team.

Five dishes have now been installed on site and it is expected that the seven composite dishes of the precursor will all have been installed on the site by the end of January 2010. ☆

**The scene at the MeerKAT site.**

## Conference in Cape Town

A conference titled *Communicating Astronomy with the Public 2010 (CAP 2010) – Building on the International Year of Astronomy 2009* will be held at the Ritz Hotel, Sea Point, Cape Town, on 15-19 March 2010.

Following the previous conferences in this series, it aims to address the modern challenges in astronomy communication through a global perspective. Major themes of CAP2010 will be the outcome and legacy of the International Year of Astronomy 2009 (IYA2009) as well as techniques for how to make public astronomical knowledge global and accessible to everyone across national, language, political, social and cultural borders and to those with impairment limitations. It is expected that over 200 delegates will attend, most from abroad. See www.communicatingastronomy.org/cap2010/index.html for further details. ☆

## Former ASSA Scholar Wins S2A3 Medal

Renée Hlozek's work on dark energy has won her this year's S2A3 Medal from the South African Association for the Advancement of Science. The medal, which comes with a R15 000 prize, is for original research at master's level and is awarded annually by each South African university and university of technology to the most outstanding master's degree research student in a scientific discipline.

Renée was the ASSA Scholarship holder in 2005 when she was a student at the University of Pretoria. Her BSc there included astronomy modules at UNISA. In 2006 she went to UCT to do honours in astrophysics. She has since obtained an MSc in astrophysics at the same university.

Her MSc thesis was about challenges in the study of dark energy, the mysterious form of antigravity believed to be responsible for the acceleration of the Universe. Hlozek found that this topic excited her because there are so many unanswered questions in cosmology and there is so much to learn. While at UCT, she worked with two other students under Prof Bruce Bassett on developing a statistical code package that has been downloaded over 1 000 times internationally and is used both for teaching and research.

She is currently a Rhodes Scholar, reading for her DPhil at the University of Oxford. She is working on data from the Atacama Cosmology Telescope, which measures small fluctuations in the cosmic microwave radiation from the early Universe. These small fluctuations give information on what the Universe is made of and how it evolves with time.

(Based on an article in the UCT *Monday Paper*, 7-13 December 2009.) ☆

## Atacama Large Millimetre/submillimetre Array (ALMA) Milestone

ALMA is a large interferometric set of telescopes somewhat similar in concept to the SKA but working at much shorter wavelengths and designed to answer quite different scientific problems. It is a collaboration between US, European and Japanese radio astronomers and is situated on the Chajnantor plateau, at an altitude of 5 000 metres in the Chilean Andes.

ALMA has just passed a key milestone. Astronomers and engineers have, for the first time, successfully linked three of the observatory's antennas. Having three antennas observing in unison paves the way for precise images of the cool Universe at unprecedented resolution, by providing the missing link to correct errors that arise when only two antennas are used.

On 20 November 2009 the third antenna for the ALMA observatory was successfully installed at the Array Operations Site, the observatory's "high site". Later, after a series of technical tests, astronomers and engineers observed the first signals from an astronomical source making use of all three 12-metre diameter antennas linked together. They are now working around the clock to establish the stability and readiness of the system.

When complete, ALMA will have at least 66 high-tech antennas operating together as an "interferometer", working as a single, huge telescope probing the sky in the millimetre and submillimetre wavelengths of light. The combination of the signals received at the individual antennas will enable detailed 2-dimensional images to be formed.

Several additional antennas will be installed on the Chajnantor plateau over the next year and beyond, allowing astronomers to start producing early scientific results with the ALMA system around 2011. After this, the interferometer will steadily grow to reach its full scientific potential, with at least 66 antennas.

More info: www.almaobservatory.org ☆

## Observatory Director suspended

An announcement was made on 25 January by Dr A. van Jaarsveld, President of the National Research Foundation, that the Director of the South African Astronomical Observatory, Prof P. A. Charles, has been suspended pending a disciplinary investigation relating to "communication within the organisation". An independent chairman is to be appointed. No further details were given.

Dr Peter Martinez has accepted the post of acting director to head SAAO in the meantime. ☆

## Death of Geoffrey Burbidge

Geoffrey Burbidge (24 September 1925 – 26 January 2010) was a famous – and in recent years, controversial – theoretical astrophysicist who worked at the University of California, San Diego. He was born in England in 1925 and received his PhD from the University of London in 1951. His wife was Margaret Burbidge, equally famous as an astrophysicist, but on the observational side.

In 1957 he and his wife were co-authors, together with Fred Hoyle and William Fowler, a noted nuclear physicist, of a famous work on stellar nucleosynthesis. This classical paper, referred to as the *B²FH model*, after the initials of their surnames, was to become the standard picture of how the elements in the universe had been built up from primeval hydrogen.

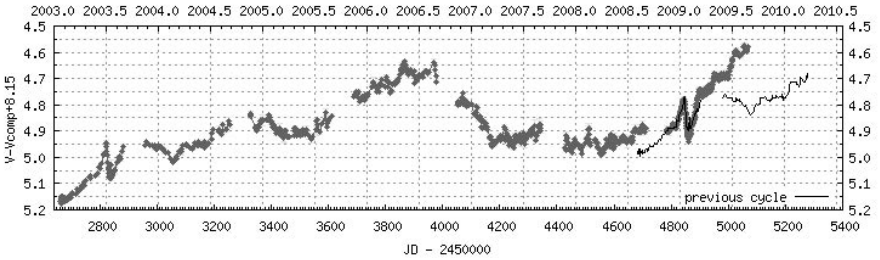
In recent years Burbidge was known mostly for his alternative cosmology which contradicts the Big Bang theory. According to him, the universe is oscillatory and as such expands and contracts periodically over infinite time. This theory, due to its controversial nature, brought him a certain amount of fame (or even infamy).

Like his friend Fred Hoyle, he was never afraid of speaking his mind and he had no patience with bureaucrats. When working in the early 1970s at the Royal Greenwich Observatory, where his wife Margaret was Director, he was heavily critical of the way in which astronomy was being administered in the UK, leading ultimately to both their resignations in disgust. In spite of this he subsequently directed Kitt Peak National Observatory in the USA from 1978 to 1984. ☆

## Eta Carinae continues brightening

At more than 100 solar masses and 4 million times the luminosity of our Sun, Eta Carinae is one of the most massive and luminous stars in our galaxy. It balances dangerously on the edge of stellar stability and its ultimate fate – complete self-destruction as a supernova. The continual brightening trend of the central star in the eta Carinae Nebula, regarded by some to be decades ahead of its expected schedule, has raised an alert among the professional community.

In the framework of an international campaign to obtain multi-wavelength observations, one group who instituted an annual optical CCD monitoring program of eta Car is that of Fernández-Lajús et al. of the Observatorio Astronómico de La Plata. At the end of their 2009 season they concluded that the innermost central region ($r < 0.15$ arcsec) of Eta Car increased by 0.5 mag in mid-2009 and that a new maximum was reached around 14 July 2009. Eta Carinae is suspected to

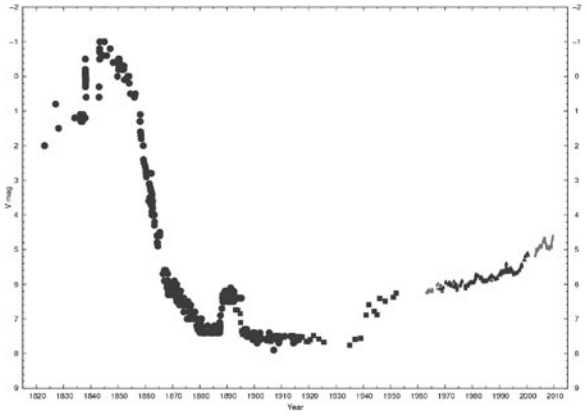



**The most recent V light-curve from BVRI Differential photometry by the Observatorio Astronómico de La Plata over a complete orbital period of Eta Carinae. The thin solid line shows the expected behaviour, based on the previous cycle.**

be a binary system with a period of 5.54 years and it was expected to undergo an X-ray eclipse in mid-2003. This event was detected as a kind of "eclipse" in photometry by La Plata. The optical monitoring is now complete for a whole orbital period (Fernández Lajús et al., 2009, *A&A,* 493, 1093) and the 2009.0 "eclipse-like" event was detected (Fernández Lajús et al., 2010, *New Astronomy*, 15, 108).

Those who visually observed the Eta Carinae system for a while have noticed that, where one used to see a nebula with a faint core towards the centre, it now looks like a star with a nebula. The light from the star now accounts for more than half the total output of eta Car.

In 1843 eta Car underwent a spectacular eruption that made it the second brightest star in the sky. During this violent episode it ejected 2 to 3 solar masses of material from its polar regions. This material, travelling at speeds of close to 700 km/s, formed two large, bipolar lobes, now known as the Homunculus Nebula. After the great eruption, eta Car faded, erupted again briefly fifty years later, then settled down again at about 8$^{th}$ magnitude.



**This historical light curve depicts the visual apparent brightness of Eta Car from 1822 to date, updated with recent observations from La Plata. It contains visual estimates (big circles), photographic (squares), photoelectric (triangles) and CCD (small circles) observations.**

About 100 years after the main eruption, around 1940, Eta suddenly changed its state. The spectrum changed and the brightness started to increase. Unfortunately this event was very poorly observed, so we don't know exactly what happened. All we know is that by the 1950s the spectrum had high excitation Helium lines in it that it didn't have before and that the whole object, the star plus the Homunculus, was gradually increasing in brightness.

During this whole time eta Car has been shedding material via its ferocious stellar winds, resulting in an opaque cloud of dust in its immediate vicinity. Normally, this much dust would block our view of the star, so the current brightening is either due to something destroying the dust, or the stellar wind not producing as much dust as it did before. One hypothesis is that Eta Carinae has taken this long to readjust from its explosion in the 1840s and that, due to its stellar wind decreasing, it is slowly returning to the state it was in more than three hundred years ago – in the 1670s – when it was a fourth magnitude, blue, hot star.

Even amateur astronomers with modest equipment can help untangle the mysteries of eta Carinae. Anyone with a telescope, CCD or spectrograph is therefore encouraged to observe this most intriguing object on a regular basis. ☆

## Free Spirit and ample Opportunity

If there were ever a better example of the Energiser Bunny, it must definitely be NASA's two Mars rovers, Spirit and Opportunity, still operating, though not flawlessly, on the Red Planet since early 2004. However, the writing now seems to be on the wall for Spirit.

Originally designed for a three-month-duration, 275 m travel distance mission, both rovers are still functional after six years, with Spirit logging 7.7 km and Opportunity 20 km, in substantially different missions on opposite sides of Mars. With five mission extensions under their belt, both rovers found important evidence of lengthily localized episodes of surface or underground water, capable of sustaining life during early Martian history – their main scientific objective.

Their lives were not without trouble thus far. In July 2007, during the fourth mission extension, Martian dust storms blocked sunlight to the rovers and threatened their ability to gather energy through their solar panels, causing engineers to fear that one or both of them might be permanently disabled. However, the dust storms lifted, allowing them to resume operations.

Spirit is occasionally plagued by short episodes of amnesia. During these events, the craft fails to record data from the day's ac-

tivities into non-volatile "flash" memory when it powers down for its energy-conserving periods of "sleep". Although a nuisance, these occurrences are not critical and set back operations a day or two when they happen.

**On SOL 1925 (2 June 2009) Spirit photographed its underbelly using the microscopic imager on the robotic arm, revealing a rock which is complicating efforts to break free from the sand pit. The angle shows the true orientation of the rover relative to the local terrain.**

Two years into their mission, Spirit's front right wheel ceased working and had to be dragged along as it moved. This worked until reaching an impassable sandy area when a second wheel also stopped rotating. To add insult to injury, on 1 May 2009, during its fifth mission extension, Spirit's three left wheels broke through the crusty surface and the craft became stuck in the soft silica powder underneath, at a site called "Troy". Engineers have since been trying all sorts of maneuvers to escape this sand pit without much success. A third faulty wheel is now also in question. In June 2009 operators manoeuvred its robotic arm, which is fitted with a microscopic imager, in an attempt to see what is going on underneath the craft. Although this camera is designed to focus at targets only 6 cm away, the resultant out-of-focus mosaic of images showed enough detail to ascertain that the underbelly is resting on a sharp rock (see picture). Maneuvers now concentrate on attempts to get soil to fall into the trenches and raise the rover slightly.

With the Martian winter slowly setting in and Spirit receiving less and less sunlight, as well as being unable to position the solar panels properly, it faces running into an energy deficit in the weeks ahead. Unless there is power available to keep its critical electronic boxes warm, Spirit risks freezing to death. In an effort to conserve power, NASA Headquarters managers now face the imminent decision to formally halt further extraction maneuvers except for utilising a climbing motion onto its dead wheel, in an attempt to park it at a slightly better angle for solar array electricity generation. Power predictions are looking quite challenging for the rover sitting at its current attitude, where it will be mid-winter in May.

Meanwhile, on the other side of the planet, Opportunity, in much better health, continues to race its own lifetime (at a turtle's pace) over much more monotonous terrein, toward the massive Endeavour crater, still more than a year of roving ahead. ☆

# Why does South Africa need the SKA?

Does the SKA fall within South Africa's reach but may exceed our grasp? ... is one of the many statements that motivational speaker, Dr Adrian Tiplady, tackled in his keynote address at last year's annual NSTF (National Science and Technology Forum) Awards where Case Rijsdijk was recognised (see *MNASSA* 68, 5&6, p.92).

Tiplady started off his speech with the question "Why does Africa need the Square Kilometre Array?" which he then went on to answer …

It is a question often posed by a public that is cognisant of the many high priorities that South Africa, and Africa as a whole, faces. We are currently engaged in an international race, competing to host a multi-billion dollar, cutting edge astronomical facility that, in my view, may very well be mankind's last great astronomical adventure still bound on earth. Do we, as South Africans, have the skills and expertise to compete within the world's scientific community, to produce scientists and engineers of the highest calibre that will compete in the global knowledge economy? (answer at the end)

Today the world faces economic recession and a financial crisis like never before. Uncertainties in food, water and energy supply loom, whilst climate change has become an ever present maxim in the implementation of global policies. Africa suffers from the unrelenting scourge of preventable diseases such as Aids and malaria. Why, then, has South Africa, and Africa, announced to the international community that "we have the desire to become the international hub for astronomy?"

In the US, President Barak Obama has committed to significantly increasing investment into science, as one of the most important parts of stimulating the economy. In his address to the US National Academy of Science, President Obama said: "At such a difficult moment, there are those who say we cannot afford to invest in science, that support for research is somehow a luxury at moments defined by necessities. I fundamentally disagree. Science is more important for our prosperity, our security, our health, our environment and our quality of life than ever before".

He went on to say: "The pursuit of discovery half a century ago fuelled our prosperity … in the half century that followed. The commitment I am making today will fuel our success for another fifty years. That's how we will ensure that our children and their children will look back on this generation's work as that which defined the progress and delivered the prosperity

of the 21st century. …. The fact is that an investigation into a particular physical, chemical or biological process may not pay off for a year or two, or a decade, or not at all. But when it does, the rewards are often broadly shared……..And that's why …… the public sector must invest in this kind of research – because while the risks may be large, so are the rewards for our economy and our society. ….. It was basic research in … the photoelectric effect that would one day lead to solar panels. It was basic research in physics that would eventually produce the CAT scan. The calculations of today's GPS satellites are based on the equations that Einstein put on paper more than a century ago".

Even with the wealth disparity between the USA and South Africa, science and technology on the African continent is still seen as key to our ability to solve the problems of development that will determine the future of Africa and South Africa. Investment in mega-science facilities has never been as important as it is today, where the brain drain, ill equipped school leavers and the lack of funding for higher education facilities to pursue areas of basic research have a directly detrimental affect on our ability to participate in the global knowledge economy, where we become innovators as opposed to consumers of technology.. And to retain these people, to stem the flow of skilled people leaving these shores, we need to provide flagship projects, such as those in astronomy, that place cutting edge development in a variety of scientific and engineering disciplines at its core competency.

In 2003, the Department of Science and Technology and the National Research Foundation decided to enter into a race with four competing countries to host the world's largest radio telescope. The Square Kilometre Array, as it is known, began as an international project in 1991, and currently involves 55 institutions across 19 countries. At a capital cost of more than $2 billion USD, the international consortium aims to have the SKA up and running by 2022, spending a further $150 million USD per year for the next 50 years in running costs. Much of this expenditure will be spent in the host country. The instrument is projected to be between 50 and 100 times more powerful than any radio astronomy facility ever built, an array of some 4 500 radio telescopes distributed over an area 3 000 km in extent. Combining the signals from each of these telescopes using a supercomputer 100 times more powerful than anything that exists today will create a virtual telescope, spanning 3 000 km in diameter, with a total collecting area of one square kilometre – the equivalent of over a million DSTV satellite dishes. This will result in an instrument with unparalleled sensitivity and resolution.

Today we believe we understand just 4% of all the matter and energy in the universe. The world's astronomical community are striving to answer some of the great fundamental questions that face the world's scientific community, and also raise new questions – not just in astronomy but indeed in fundamental physics. Instruments such as the recently launched Herschel and Planck telescopes are being put into orbit 1.5 million km away from earth, collecting the kind of data that is possible now because of technological innovations in the last 10 years. Data that could help us answer the very mysteries of the universe. Plans are afoot to venture outside of the earth, and even place telescopes onto the dark side of the Moon.

The SKA is part of this frontier of new instruments. Some of the many questions to be answered are: What is the nature of dark energy – a mysterious force that acts in opposition to gravity on very large distances, repelling massive objects from each other with ever increasing force? How did the universe and all that is contained within it evolve – radio signals have been travelling through the universe for 13 billion years, and we are only receiving some of them today as we take "pictures" of the big bang and the first stars and galaxies. We will be able to make snapshots of the universe through time.

Mankind has long striven to answer the question of whether there is life on other planets? The detection of biomolecules, or even artificial radio transmissions, may answer this. These questions and more, however, probably do not approach the rich rewards that will come from not what we plan to investigate, but rather what we haven't planned for. Radio telescopes today are not remembered for what they were built, but instead for what they serendipitously discovered.

When South Africa, with a rather small human capital base in radio astronomy at the time, submitted its bid in 2005, we took the international community by surprise. Any degree of afro-pessimism was dismissed, however, when South Africa was shortlisted along with radio astronomy international heavyweight – Australia. Why? Because we have something that no amount of financial investment could ever buy. We have one of the best locations in the world to build and operate astronomical facilities, and a very committed Department of Science and Technology and National Treasury.

The Southern African Large Telescope in Sutherland has one of the darkest skies in the world – and the proposed SKA core site, just 80 km northwest of the town of Carnarvon in the Northern Cape, has one of the best radio frequency environments in the world, free from a majority of the

interfering radio signals that plague most of the world's radio astronomy facilities. Furthermore, because of our geographic location on the planet, the very best astronomical sources to observe pass right overhead – we literally have the best window on the planet out of which to gaze upon the universe, and explore the centre of the Milky Way Galaxy.

Protection of this site is of the utmost importance – not only to protect South Africa's geographical advantage, but to preserve the site for the world's astronomical community. To meet this requirement, the Department of Science and Technology has promulgated the Astronomy Geographic Advantage Act, which allows for the establishment of an astronomy reserve in the Northern Cape Province - a reserve in which astronomy facilities are protected from sources of optical and radio interference.

The Australian Minister of Science has described winning the SKA bid as being like winning the Olympic site bid every day for 50 years. If the right to host the SKA were to be awarded to South Africa, and its seven African partner countries, we would become a premier centre for research in astronomy and fundamental physics – going hand in hand with cutting edge development in the engineering technologies that co-exist with this field of research.

As many of the technologies do not yet exist, to build the SKA will require a significant international effort in the fields of information and communication technology, supercomputing, mechanical, radio frequency, software and electronic engineering, physics, mathematics and, of course, astronomy - all fields that provide a basis for a strong knowledge economy. In 2004 the DST, together with the NRF, decided that simply competing to host the SKA would not meet the aims of building a knowledge economy – what was needed was a flagship project that would provide an opportunity to increase the skills base of our young scientists and engineers. We needed to participate in the technology development for the SKA, to grow a substantial base of scientists and engineers in South Africa that would be able to use, operate and maintain the SKA. And so was born the Karoo Array Telescope – an SKA science and technology pathfinder.

MeerKAT, as it is now known, will be the first radio interferometer built for astronomical purposes in South Africa. It will consist of 80 dishes, and once completed in 2013 will be one of the world's premier radio astronomy facilities that will have not only South Africa scientists, but the world's astronomical community, clamouring to use – nine years before the SKA is scheduled to be commissioned.

Over the course of the last five years, we have built up a team of some 60 young scientists and engineers who are working on the technologies and algorithms required for the MeerKAT, which will in turn test the technologies for the SKA. Many of these people would have most probably left these shores already, looking for more exciting projects to work on in Silicon Valley, or other technology clusters. However, the lure and attraction of such a project as MeerKAT, and the larger SKA, has kept them here. Although none had any radio astronomy training, the team has quickly become an international leader in the development of technologies for radio astronomy facilities, which in fact are the generic technologies upon which the digital age depends, and are highly likely over many years to generate spin-off technologies, innovations and patents. They have managed to do this through international collaboration with institutions such as Oxford, Cambridge, Manchester, Caltech, Cornell and Berkeley, as well as the national radio astronomy observatories in the USA, India, Italy and The Netherlands. We are also working closely with several South African universities and companies.

Amongst other things, the team has developed the first every radio telescope made from composite materials, and is playing a leading role in the international development of digital hardware for real time data processing. The first seven MeerKAT dishes are being constructed as I speak.

In a recent editorial in the local *WattNow* magazine, Paddy Hartdegen says the following of the SKA and MeerKAT projects: "In my view, gee whiz projects such as the SKA and the MeerKAT go a long way to encouraging youngsters to take science and engineering disciplines more seriously. And if there is some thrill attached to science, astronomy or mathematics, then the students will apply themselves more diligently at primary and secondary schools, to ensure that they will have the necessary qualification to enter a university". He goes on to say "I believe that projects such as the SKA can actually foster the sort of compelling interest that is reserved for sports stars and pop musicians".

So, is Paddy Hartdegen right? Do the SKA and MeerKAT projects have the qualities that will attract students into science, engineering and technology? In 2005, we initiated a Youth into Science and Engineering program, to rapidly grow the human capital base in astronomy and engineering in South Africa. To date, we have awarded 142 post-doctoral fellowships, PhD, masters degree, honours degree and undergraduate degree bursaries. We are currently awarding approximately

45 bursaries per year. We are assisting universities to increase their astronomy research capacity, and to develop additional capacity to supervise students through international supervisory programs. The question is, can these students stand on there own two feet within the international astronomical community?

For the last three years, we have held a post-graduate student conference for our bursary holders, where each student presents the results of his or her research. We invite a number of international experts to attend. To date, none have declined the invitation – not due to the opportunity for a holiday in Cape Town, but instead because of the astounding reputation this conference has grown internationally due to the quality of students and research. Professor Steve Rawlings, Head of Astrophysics at Oxford University, said on his departure "I am awfully impressed by what I have seen at this conference and how things have exploded on the science and engineering side on such a short timescale. South Africa is doing all the right things for the SKA".

So, what has the establishment of a flagship project resulted in? People. Skilled people. The new measure of financial prosperity. Skilled people who are helping to change South Africa's reputation as a place of high technology investment, research and development. These students, who cross the race and gender lines, may never stay within the field. However, they will carry the skills they have learnt into new areas, and their impact will be felt through a variety of socio-economic lines.

The SKA and the MeerKAT have matured into a project of which we, as the South African scientific community, can be proud. It is a project that should capture the South African public's imagination, young and old alike.

Do we, as South Africans, have the skills and expertise to compete within the world's scientific community, to produce scientists and engineers of the highest calibre that will compete in the global knowledge economy? We have in the past, and we will continue to do so.

The answer, therefore, is a resounding .... ***yes***. ☆

# The Astronomical Museum at SAAO

I.S. Glass (SAAO)

**Summary:** The origin of the Astronomical Museum at the South African Astronomical Observatory is related. Descriptions are given of its home in the McClean building and of some of the instruments on display.

**Introduction**

The SAAO Astronomical Museum came into existence about 1987 when the Technical Building was opened and the infrared laboratory was moved from the old McClean Laboratory to the new location. Robin Catchpole and I had been concerned about the slow disappearance of historical items from the Observatory and we obtained permission to convert the old laboratory into a Museum. This was not a moment too soon: for example, when we searched for the Gill heliometer we found that it had been stolen from the storeroom where it had been kept. Other items, such as densitometers by Moll and Casella had also disappeared. They were almost certainly sold for scrap.

There is unfortunately no science museum in South Africa to which institutions such as SAAO can donate historical equipment. It does not take much imagination to realize, given the many discoveries, instrumental and otherwise, made in this country, what an interesting collection could be formed if the many items stored in various laboratories could be put together. Two of the most interesting original instruments from the foundation of the Royal Observatory, the Mural Circle and the Transit telescope, were scrapped in a fit of official vandalism around 1950. It is believed that the Victorian standard weights and measures, which used to be kept at the Royal Observatory, are still languishing in some storeroom of the South African Museum.

The whole SAAO Museum project was part-time and very low-budget. It barely met with official approval, being regarded as a diversion from our main task of astronomical research. The main change we made to the laboratory was to have fluorescent lights installed in its Victorian glass-fronted cupboards. The room was also re-painted. A number of display boards were found in storerooms and installed in the room. Robin organized for the ancient hydraulic pump which operates the rising floor of the telescope to be enclosed in a glass case.

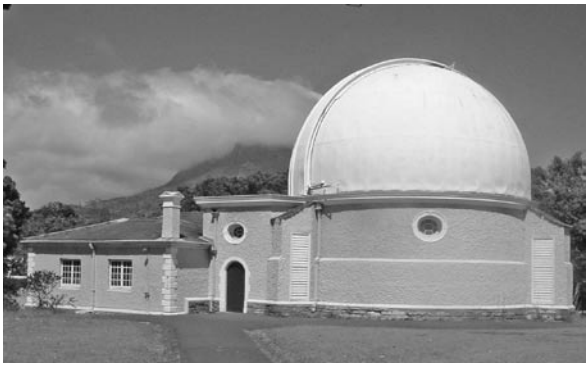
When we announced our intention of creating a museum, various people came forward with small instruments etc that they had been 'saving'. We were spoilt for choice. A great many interesting items of moderately large size, such as Hartmann spectro-comparators and various measuring machines, could not be fitted into the limited space available. Other antique items, such as regulator clocks and chronometers, are still distributed through various offices.

At first, the Museum was the only display area available for showing off the work of the Observatory and some of the poster displays concentrated on current or recent activities, such as the work on the Magellanic Cloud Supernova SN1987A and the Comet Shoemaker-Levy/Jupiter collision, which we had observed successfully in the infrared. Nowadays, however, the lobby of the Auditorium contains exhibits and posters about recent astronomy in South Africa, both at the SAAO and elsewhere. This has left the museum in the McClean free to concentrate on its original plan of preserving old equipment.

There is at present no particular person assigned to look after the Museum, so that the updating of displays and the cleaning of the insides of the display cases, which requires some sensitivity, has to be done by a volunteer such as my (retired) self. We are fortunate that past employees were able to make contributions. Ethleen Lastovica (former librarian) contributed many of the graphic displays. Recently, Isobel Bassett has collected together pieces of equipment jettisoned when several photographic darkrooms were abandoned and has laid them out in the McClean darkroom, the last remaining one at SAAO.

**The Building**

The building which houses the museum, although officially named the Victoria after the then Queen, is usually called "The McClean", after its donor, Frank McClean (1837–1904) of Rusthall, Kent, a prominent English engineer and amateur astronomer in the late 19th Century. It was designed by the famous architect Sir Herbert Baker (1862–1946), who was responsible for many colonial buildings, and was finished in 1896.



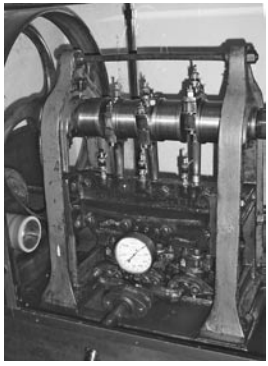
**The Herbert Baker designed McClean dome and adjoining laboratory (above) with its Grubb telescope inside (right)**

**The McClean Telescopes**

The main telescope was designed for spectroscopy – at the time a departure from the traditional positional work that was carried on at the Royal Observatory. It was for some time the largest refractor in the Southern hemisphere. During the 1930s, spectroscopy was supplanted by parallax work. This programme drew to a close in the 1970s, and this telescope is now used only for occasional projects. In fact, three telescopes of about the same focal length are mounted side-by side. They were built by Sir Howard Grubb of Dublin and have glass objectives – a problem for many modern observations because they do not transmit most ultra-violet and infrared wavelengths. The largest lens, of 24 inches diameter, was designed to perform best in blue light as the photographic plates available in those days were insensitive to other colours. The next largest telescope, of 18 inches diameter, was designed for visual observations and is still used today for viewing by the public. A third telescope, also designed for use by eye, was used as a guider for long photographic exposures. Another, shorter, telescope called the 'Old astrometric Camera' is also attached to the same mount.

In the Museum is a huge objective prism, the largest ever made at the time. When it was in use in front of the telescope, the star images were spread into spectra.

The telescopes were originally driven to follow the stars by a heavy-duty clockwork motor regulated from the observatory time service by means of a special pendulum which is still to be seen in a cabinet on the wall. Every time the pendulum tip passed through a blob of mercury on the contact at the bottom an electrical impulse was generated. This impulse was used to check if the drive was fast or slow and to regulate the speed accordingly. Nowadays an electric motor driven at sidereal 50Hz frequency is used instead.



**The 24-inch objective prism (left), Victorian DC motor (centre) and Victorian 3-cylinder hydraulic pump (right).**

The rising floor of the dome is driven by hydraulics so that the observer can stand or sit at a convenient height for looking through the telescope. At the entrance to the building is a reservoir, in the form of a massive weight, which stores the hydraulic power. When the reservoir gets too low, a 3-cylinder pump restores it automatically. The original DC motor that drove this pump is on display. It was returned to us from the Fort Wynyard Naval Museum when it closed down. Electrical power for the motor came from the battery house next door (today known as the "1896 Building" from the date on its gable). The batteries in turn were charged by a steam-powered generator.

The dome was made by Cooke of York and was originally driven by a hydraulic motor working from the same supply as the floor.

**The Laboratory**

The laboratory was used until the1920s for making measurements of the spectra of substances that might be found in the atmospheres of stars. The spectra of substances found on the earth could be compared with those obtained from the stars. It is believed to have been the first spectroscopic laboratory in South Africa.

**Telescope Models**

The Museum contains several pre-construction models of telescopes – the SALT (Southern African Large Telescope), the 74-inch (1.9m), the 40-inch (1m) and a 3.5m altazimuth telescope similar to the ESO New Technology Telescope that was proposed for Sutherland before the SALT project came along.

**The McClean laboratory as it appeared around 1900 as a spectroscopic laboratory (top), in the 1980s as an infrared laboratory (middle) and today as a museum (bottom).**

**SALT model:** The Southern African Large Telescope (SALT) is now operating at Sutherland. This model was the first one built and was used to persuade funding agencies to support the project. The telescope was officially opened in November 2005, after taking about 5 years to construct. The design is an updated version of the Hobby-Eberly telescope of the University of Texas and it offers a large light collecting area at a fraction of the cost of a conventional telescope, though at the expense of some versatility. SALT is currently the largest single optical telescope in the world in terms of usable primary mirror area.

**74-inch Grubb Parsons model:** This wooden model was made by Grubb Parsons about 1934 to show what the 74-inch telescope would be like. The actual telescope was built in 1938 and erected in Pretoria for the Trustees of the Radcliffe Trust, a private British foundation. It was bought by SAAO from the Trustees and has operated since 1976 in Sutherland. A photograph of the actual telescope as it now exists is on the wall of the Museum. It was once the 5th largest in the world and the largest in the Southern hemisphere. A turret was used instead of a dome so that a moving platform could give easy access to the Newtonian focus at the top of the telescope tube. Wind tunnel tests in later years suggest that, in fact, a turret is better than a dome for giving the best optical conditions in wind.

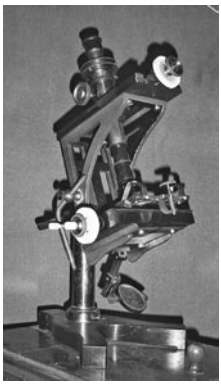
**Miscellaneous Instruments**

**Zeiss Blink Comparator:** Among the larger instruments is a Zeiss blink stereo-comparator (left), dating from the first decade of the 20th century. This was used for comparing two plates taken at different times to look for changes. These could have been due to moving objects such as asteroids or stars that vary in brightness. With a similar instrument, the nearest known star (Proxima Cen) was found at the Union Observatory, Johannesburg, by R.T.A. Innes.

**Dollond Repeating Transit:** The so-called 'repeating Transit,' built abut 1820, was one of the original instruments of the Royal Observatory and was used tem-

**Models of SALT (far left) and the 74-inch Radcliffe telescope.**

**The instrument collection includes a Zeiss Blink Comparator (left-top), Bamberg Altazimuth Instrument (left-bottom), Dollond Repeating Transit (centre) and a travelling microscope (right).**



porarily by Rev Fearon Fallows, the first HM Astronomer, in a wooden Settler's Hut, while he waited for the permanent Observatory buildings to be completed. Used for finding the positions of stars, it is essentially a large theodolite and is called 'repeating' because its circles can be read in two places to increase accuracy. It was described in the first issue of *Memoirs of the Royal Astronomical Society*. This instrument was found damaged and in pieces in a cardboard box in the Instrument Workshop. Its restoration is due to Doug Metcalfe.

**Travelling microscopes** used for measuring the positions of images on photographic plates are also on show. These could measure to about one micron (micrometre). That shown on the left was capable of measuring in the x and y directions and was made by the Potsdam firm of Ottto Töpfer. Its date is unfortunately not known.

Other similar instruments in the Museum are two Hilger single-screw measuring machines and an unusual Zeiss spectrum-measuring double microscope, with a scale under one end and the plate of interest under the other.

**Bamberg Altazimuth Instrument:** $2^{5}/_{8}$-inch Altazimuth instrument by Carl Bamberg (Berlin). This was borrowed in 1906 by the Transvaal Observatory (later Union and even later Republic Observatory) from Oscar Backlund of the Imperial Russian Observatory, Pulkowa,

and never returned. It is located in the former fume cupboard of the Laboratory. I believe it was used for observations related to timekeeping. On one occasion I showed Alexander Boyarchuk, a senior Soviet academician, around the Museum. When he saw the Bamberg instrument, he suggested it ought to be returned. So I told him that when Russia had an Imperial Observatory again we might consider it!

**Some items in the display cupboards**

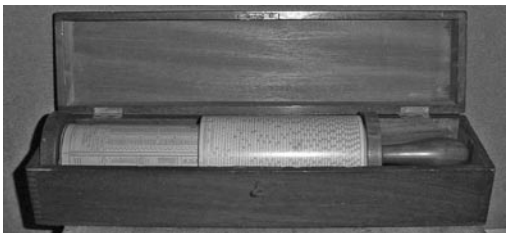
**Display Cupboard 1:** This is devoted to apparatus for spectroscopy, mostly used in the McClean Laboratory in its original spectroscopic incarnation. There is a diffraction grating by the pioneer Henry Rowland of Johns Hopkins University in Baltimore. Such gratings split up light like a prism and allow one to determine the chemical composition of its source, among other things. Another, larger, grating was ruled at Mount Wilson Observatory.

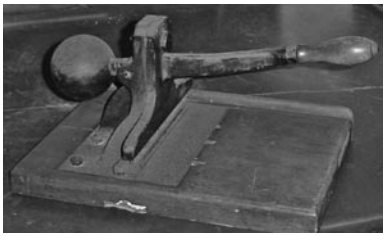
An interesting item, rarely seen, is a transmission echelon, a high-resolution grating of a kind designed by Albert Michelson. These were very difficult to construct because of the high precision required. The present example was made by the firm of Adam Hilger, London.

**Display Cupboard 2:** Shows some typical office equipment used at the Royal Observatory. At the top are mini-computer components from the 1970s and a manual card punch. Cards were the commonest input medium for the early digital computers.

On the next shelf down is a roll of 'red tape', used by civil servants for tying up bundles of documents. Though not strictly an astronomical instrument, the multi-hole punch is almost certainly one of the earliest ones ever made and is thought to have come from the Ransomes and May factory that built special equipment for the (UK) Astronomer Royal, Sir George Biddle Airy, a consummate bureaucrat. Letters were strung together at first in files, using shoelaces, and later bound. The Royal Observatory Cape followed his system.

The Royal Observatory used to employ people called 'computers' to do the extensive arithmetic involved in the reduc-





**Office equipment includes a cylindrical slide rule and a very early multi-hole paper punch.**

tion of data. The advertisement shown seeks 'girl computers'. Among famous people employed in this monotonous task were the radio personality Eric Rosenthal, the Nobel prizewinner Allan Cormack and Willem de Sitter, who later on discovered that the field equations of general relativity had a solution allowing an expanding universe.

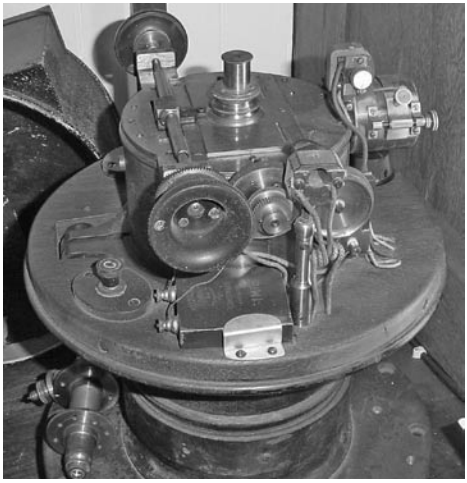
A circular slide rule and some early mechanical calculators are also shown. Astronomers frequently used 'Crelle's Tables', which were multiplication tables, to aid in their calculations.

**Display Cupboard 3:** Shows among other things some of the various detectors used at the Observatory – a photomultipliers, McGee Spectracon, Varo image tube, CCD chip, and an infrared array detector. The Fabry photometers on the next shelf were something almost unique to the RO Cape. The image of a star was spread out and the density of the image was read to determine its brightness instead of the more usual but less accurate method of measuring the diameter of an in-focus image.

A large induction coil in the bottom of the cupboard was used for generating 'spark' spectra of various elements for comparison with celestial spectra.

**Display Cupboard 4:** The large speculum-metal (a brittle copper-tin alloy) mirror was cast and figured in 1810 by Sir William Herschel and formed part of a telescope that was bought second-


**Cupboard 3 displays a photomultiplier tube with explanatory sketch (bottom-left), while cupboard 4 contains the two famous lenses that started the photographic era in astronomy, the Ross (right) and the Dallmeyer lens (bottom-right).**



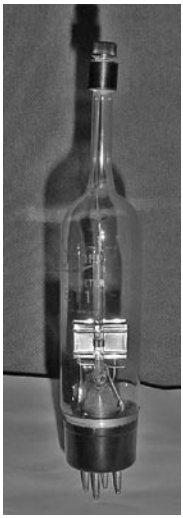
**The eyepiece-end of the 'Airy Transit Circle' (left), an instrument originally mounted in the main building, and the signal pistol used for firing time signals from the Observatory roof.**

hand when the Royal Observatory was formed. Herschel made a considerable fortune from building telescopes, but few of these instruments were used by their owners as effectively as he was able to use them. Fallows, the first HM Astronomer at the Cape, never even unpacked his Herschel reflector.

This small brass-mounted Ross lens was used to photograph the Great Comet of 1882 and inspired Gill to make the first ever photographic survey of the sky (the Cape Photographic Durchmusterung or CPD) when he saw that the stars in the background had been registered on the plate. The larger brass-mounted lens is that used by for the CPD survey at the Royal Observatory in Cape Town from 1885 onwards. It is a portrait lens made by Dallmeyer. In Gill's time the sky in Cape Town was much clearer and freer of light pollution than it is now. Gill had to finance the survey himself by devoting half his salary towards it for several years, owing to the jealousy of the Astronomer Royal at Greenwich who contrived to deny him a research grant. All the plates taken for this survey remain in Groningen, Netherlands, where they were analyzed by Jacobus Kapteyn, Gill's collaborator.

**Display Cupboard 5:** The bottom shelf contains remnants of the 'Airy Transit Circle' which used to occupy one room of the main building of the Royal Observatory. A photograph shows the shutters in the south face of the building which could be opened for observing. On the shelf are the objective lens and the eyepiece end of the telescope.

A signalling pistol dating from the early 19th century was used to communicate time to ships at the harbour. There is a



**The original Grubb governor-regulated, weight-driven clockwork motor of the 6-inch telescope (above). Chemical apparatus include a mortar and pestle (top-right) and electrometer valves (right).**

brass mould and some bullets used with a Colt revolver that the Observatory at one time possessed. It was used to protect officials bringing pay packets from the bank.

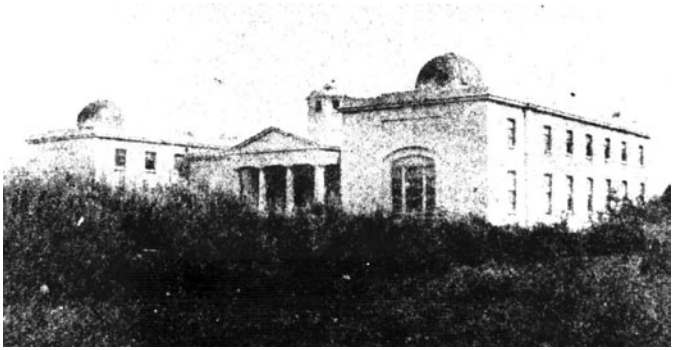
The original Grubb governor-regulated clockwork motor of the 6-inch telescope is also on display. The power was derived from a descending lead weight and the speed was regulated by a friction-controlled governor.

**Display Cupboard 6:** This contains old chemical and physical apparatus used in the laboratory and elsewhere around the Observatory, including crucibles, radio valves, electrometer valves, thermometers, galvanometers, balance weights mortar and pestle. The electrometer valve was used for amplifying the very small currents produced by photoelectric cells.

The lowest shelf contains one of the photometers and electrometer amplifiers employed by the late A.W.J. Cousins to establish his photometric standards that are still used worldwide. These are fundamental to all astronomical brightness measurements made in the southern hemisphere and ultimately, to our knowledge, of the size of the Universe.

**Ante-room to the dome**

This room was intended to be the formal entrance to the dome and has an elaborate Baker-style front door. An exhibition originally prepared by Ethleen Lastovica for the 175th anniversary of the Royal Observatory is displayed here. It incorporates graphic material from the earliest days of the Royal Observatory up to recent times under the SAAO. Included is what is believed to be the earliest photograph (ca 1843) of *any* observa-



**This 1843 (ca) picture (left) of the Main Building by Charles Piazzi Smyth is likely to be the first ever picture of an observatory. The McClean photographic darkroom (below) has recently been restored to its former look.**

tory, made by Charles Piazzi Smyth, who joined the Royal Observatory in 1834 at the age of 16. He made the camera and photographic material himself. The process he used was known as "calotype". The original print belongs to the Royal Society of Edinburgh. Smyth's photographs are the earliest to have been taken in South Africa.

**Darkroom**

The darkroom of the McClean dome has been restored to its approximate appearance as it was last used. Photography was one of the most important techniques in use at the Observatory from 1882 until about 1980, well into the SAAO era. Every morning the lady computers would develop the previous evening's plates from the McClean and Astrographic telescopes and leave them to dry. Large plates of the Sun were taken twice daily with the Photoheliograph and a continuous record of Solar surface activity was made on 35mm film with the Lyot Coronagraph. Photography was also utilised in a kine-theodolite, used at one time for observations of artificial satellites and even to record the position settings of the Gill Transit Circle.

**Access to the Museum**

The SAAO Astronomical Museum is usually included in official tours of the Observatory. The general public may attend open nights on the 2nd and 4th Saturdays of each month at 20h00. Special tours for groups can sometimes be arranged.

**Acknowledgments**

I thank Mr Peter Robinson of George for taking some of the photographs. ☆

# *The never changing Chamaeleon*

by Magda Streicher
*magda@pixie.co.za*

Image source: Stellarium.org

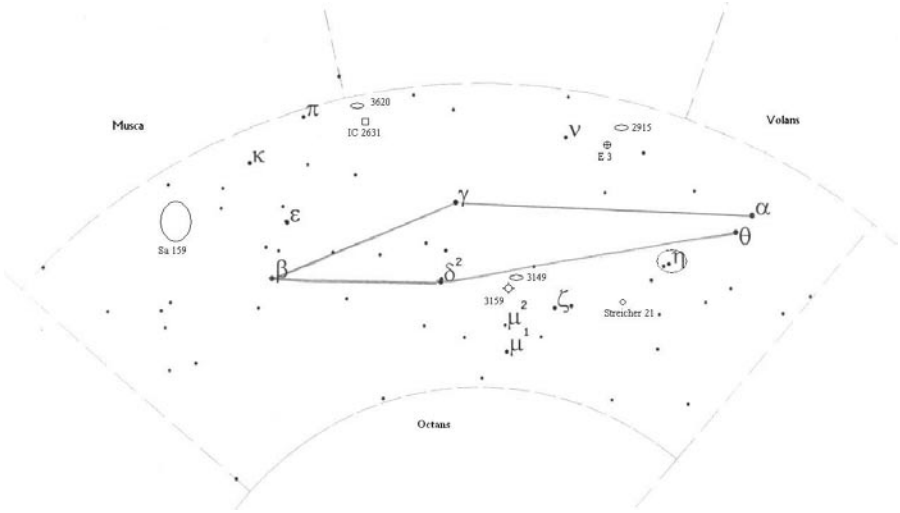
If there is one constellation named after one of the cutest little animals on earth, it has to be the chameleon – its slow, deliberate, step-by-step movement, elegant curly tail and historical appearance makes the chameleon one of the most impressive creatures ever. The dwarf chameleon occurs only at the south-western tip of South Africa, in areas of relatively dense vegetation. Another species is found in other parts of South Africa.

According to Auke Slotegraaf, this little land animal probably so impressed the Dutch seafarers that Pieter Plattevoet placed it on record as a star formation in 1598. The constellation was later published by Bayer as a companion to Musca the Fly, where it rightfully deserves its place among the stars.

Chamaeleon is situated only 10 degrees north of the south celestial pole. The rich Carina part of the Milky Way can be seen directly north of it. To the north-east is Musca the Fly, the only constellation named after an insect, dangerously close to the starry chameleon – fortunately facing the opposite direction, towards the constellation Mensa. Although Chamaeleon is quite faint – it contains no stars brighter than magnitude 4 – it must not be underestimated in any way.

When I first heard of the very talented and now well-known South African singer/songwriter, Chris Chameleon, I immediately thought of our own southern constellation by the same name – each of them so exceptional in their own right! So, while planning this article, I could not resist contacting Chris, and to my utter delight he agreed to contribute with some very appropriate words, written in his distinctive style:

*"not everybody gets a constellation named after them. well, i know i don't. but there happens to be this merry coincidence between my name and that of an inconspicuous constellation in the southern sky: chamaeleon! and it could just as well have been named after me, because there are many similarities between us. firstly, it is made up of, primarily, three stars. the letter three has been one of the most*




*important numbers to me for much of my life. emotional episodes, business ventures and even luck have all come in threes for me. i love the number, it's my favourite number. furthermore, the fact that it is an inconspicuous constellation is uncannily apt! that is what a chameleon does isn't it? a chameleon is meant to be there, pretty (as far as i am concerned though, i'll settle for 'interesting'!) to look at and unmistakable, but not easy to find in the first place. it blends into the night sky, concealing itself amongst the stellar foliage. then, the fact that it is in the southern sky also particularly appeals to me. for my work i strut my stuff all over south africa, in the usa, in the netherlands, in belgium, in england, in namibia (and even in rwanda!). but there is no place i can call home unless it's south africa. neither lights nor money nor temptations of an allegedly better life elsewhere prompt me to leave this country and the nocturnal firmament of a karoo night. i am at home in it as much as the chamaeleon constellation is in it's skies! finally, it confirms the chorus of what has, to date, been the biggest hit of my career, a song quite appropriately called "sterredank":*

*and when i look up and i count my stars*
*i see how they predict my future*
*for what i read in their shape and size*
*is that the road ahead is shiny bright!"*

The starry Chamaeleon stares into the night sky with two wide-open eyes, so to speak, represented by the magnitude 4 alpha and magnitude 4.3 theta Chamaeleontis, situated in the far western extreme of the constellation. The two stars shine with a lovely yellow hue and a dirty orange colour.

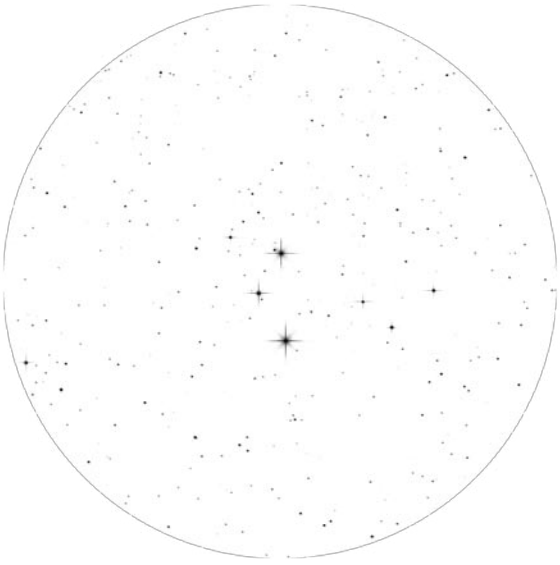
The stars around **eta Chamaeleontis**, 1.8 degrees south-east of theta Chamaeleontis, have been identified as a brand-new open

cluster (see picture). The cluster contains approximately ten super-white members which display the same proper motion through space. This now well-known cluster was only discovered in 1999 and has proved to be situated just 329 light years away and formed about 10 million years ago. Being, as far as we know, the fourth closest cluster to us, three of its members are visible in binoculars. What is more, there is an extremely faint galaxy, PGC 24516/ESO 18-G13, less than two arc-minutes east of eta Chamaeleontis, sharing this new cluster's territory.

The galaxy **NGC 2915** can be imagined to be riding on the back of the starry Chamaeleon. It is situated around one degree north-west of the magnitude 5.4 nu Chamaeleontis, in the northern part of the constellation. The galaxy displays an elongated north-west to south-east glow, pointing north-west to a pair of faint (magnitude 13) field-stars. Higher power and averted vision reveal a haze around the outer edge with a slightly brighter nucleus. About 8 arc-minutes to the south-west of the galaxy, the very yellow to orange magnitude 7.8 star HD82188 dominates the field of view.

The relatively unknown globular cluster ESO 37-01, or **E3** for short, is situated 43 arc-minutes south of the galaxy NGC 2915. Due to loss of stars resulting from tidal effects, E3 is a very loose, star-poor globular, one of the faintest known thus far. The globular reveals itself with just a soft glow between a handful of faint stars. With averted vision it grows slightly larger, but I was not able to see any points of scattered light. Perhaps this globular with its unusual name could inspire Chris to write a new song, dedicated to its unique name and place among the stars.

Situated halfway between eta and iota Chamaeleontis is the asterism **Streicher 21** (*Deep-Sky Hunters Catalogue*). It consists of a handful of magnitude 9 stars in a well-formed line from north-west to south-east that stands out beautifully against the back-



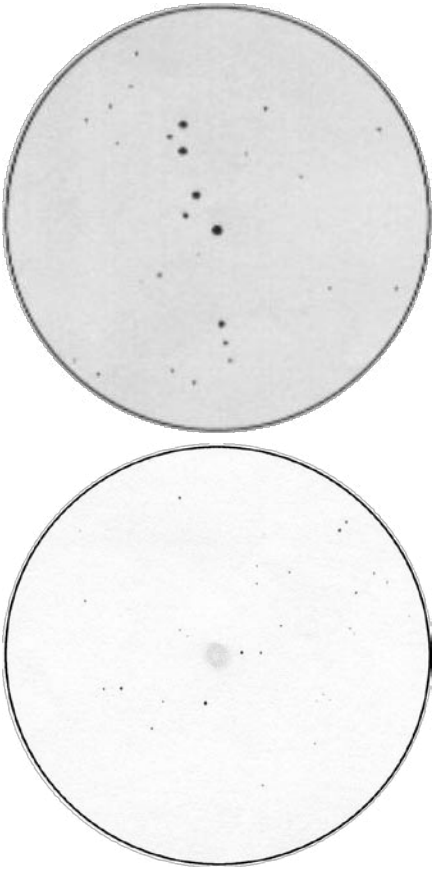
**The eta Chamaelontis open cluster, photographed by Lucas Ferreira (negative image shown for clarity).**

ground star-field. The shape of the stars resembles a reptile of another sort to me, complete with a tail pointing to the south.

Nicely tucked underneath the belly of Chamaeleon is the very faint galaxy, **NGC 3149**, situated 1.3 degree north-east of the magnitude 5 zeta Chamaeleontis. This faint, slightly oval, hazy glow in an east-to-west direction is barely visible, with just a glimpse of a brighter middle area. My notes indicate it to be a very difficult object to observe.

Do not give up hope, though. The beautiful, bright, remarkable planetary nebula **NGC 3195** is situated just around the corner, only 30 arc-minutes south of NGC 3149. Between these two deep-sky objects is a beautiful double star of around magnitude 9.5, displaying colours of yellow and orange. This planetary nebula is an appreciable soft grey mist, slightly oblong in shape (see sketch). With higher power, more of its characteristics come to the fore. The nebula becomes more clearly defined towards the western side in contrast with the eastern portion, which appears somewhat washed out. With the use of an oxygen filter the middle section becomes slightly darker, indicating that the planetary is hollow, but sadly, there was no central star to be seen. John Herschel discovered this planetary in 1835.

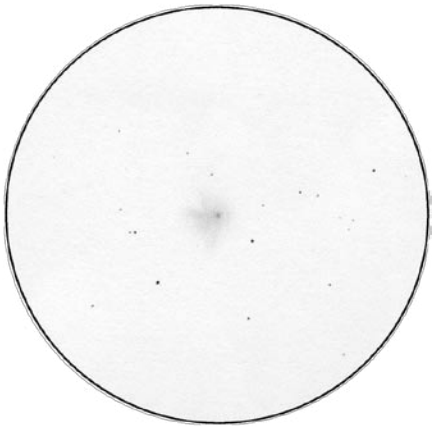
The double star gamma[1] and gamma[2] Chamaeleontis stands out exceptionally well because of the deep yellow colour of both stars and very aptly indicates the curved back of the little starry creature's form. The relatively brightly reflecting nebula **IC 2631** is situated 2.8 degrees north-east of gamma Chamaeleontis. It is a beautiful object, resembling in its soft play of light, a piece of illuminated frosted glass (see sketch). Using averted vision, hazy streaks of brighter nebulosity blow away from the magnitude 9 central star. The haze is slightly broken



**Sketches of the Streicher 21 asterism (top) and NGC 3195 planetary nebula.**

down towards the north-western side of the nebula. What held my attention was that the whole area seemed to be bathed in a misty cloud.

The edge-on galaxy **NGC 3620** is situated just 32 arc minutes north of IC 2631 and 32 arc minutes off the border with the Carina constellation. Only with averted vision can the thin, soft and faint substance of the galaxy be seen. This extremely faint galaxy appears in an east-to-west direction, and reveals a spotless surface without any outstanding features. A nice circle of faint field stars starts at the western side of the galaxy, extending around south.



**IC 2631 sketched using my 12-inch telescope at 218 power. N is at the top and E to the left.**

The constellation Chamaeleon is also home to a dark nebula which has been listed as **Sa 156** in Sandqvist's *Catalogue of Dark Nebulae,* published in 1977. Within an imaginary triangle, consisting of NGC 3620, beta Chamaeleontis and the border of Musca, this dark area can be looked for. It is a rather large dark patch around 3x2 degrees in area, lying in a roughly north-to-south direction, and is worth a search with the naked eye. But be sure to visit a very dark, transparent sky to be able to spot this elusive void.

We are indeed proud of the name Chamaeleon, whether linked to one of our country's top artists, the little land animal with its natural ability to change its colour and spots, or the renowned constellation Chamaeleon by the same name. ☆

| Object | Type | RA (J2000.0) | Dec | Mag | Size |
|---|---|---|---|---|---|
| eta Chamaeleontis | Open Cluster | $08^h41.3$ | -78°58′ | 5.4 | 8′ |
| Streicher 21 | Asterism | 08 51.0 | -80 10 | 11.0 | 22′ |
| E3 | Globular | 09 21.0 | -77 17 | 11.3 | 5′ |
| NGC 2915 | Galaxy | 09 26.2 | -76 38 | 12.4 | 2.4′ x 1.3′ |
| NGC 3149 | Galaxy | 10 03.8 | -80 25 | 12.8 | 2.0′ x 1.9′ |
| NGC 3195 | Planetary Nebula | 10 09.5 | -80 52 | 10.6 | 40″ x 30″ |
| IC 2631 | Reflection Nebula | 11 09.8 | -76 37 | 12.0 | 8.0′ x 7.0′ |
| NGC 3620 | Galaxy | 11 16.1 | -76 13 | 12.7 | 2.8′ x 1.1′ |
| Sa 159 | Dark Nebula | 12 59.0 | -77 10 | - | 3° x 2° |

## Step 1: Turn on your mirror ...

Go buy a can of antifreeze at the motor spares shop. Add iron-oxide powder and shake vigorously. Pour into a shallow pan. Spray on a pinch of powdered silver, and turn on a magnetic field. Voilà! – an instant mirror! Can it really be that easy? Not yet, but a promising new technology suggests that, someday the answer might be "yes."

Astronomers have toyed with liquid-mirror telescopes for decades. In theory, a shallow bowl of fluid, when spun slowly, assumes the paraboloidal shape needed for a reflecting telescope's primary mirror. This quirk of gravity is the key to the highly successful Steward Observatory Mirror Lab in Tucson, Arizona, where spinning ovens cast glass blanks for some of the world's largest telescopes.

The only suitably reflective liquid for spin-table mirrors has been mercury – not exactly the kind of material you want to spend any time with. Yet, despite mercury's toxicity, curious opticians continue to experiment with it, with India actually attempting a giant mercury-mirror telescope.

But the modern buzzword is "ferrofluid". It's what chemists call a suspension of extremely small iron-based particles in some kind of liquid. The result is a room-temperature fluid with magnetic properties, paving they way to a possible future ferrofluid telescope mirror.

Researchers at Université Laval in Québec, Canada have been experimenting with a concoction of ethylene glycol, mixed with maghemite, an iron oxide (something between magnetite and hematite). The maghemite particles are no more than 10 nanometers (100 angstroms) across, and they get coated with a type of acetic acid that prevents them from clumping together while in suspension. On the surface of this ferrofluid they then spray a small amount of similarly tiny silver particles to create a mirror-smooth surface that is more reflective than liquid mercury. Finally, by placing electromagnets under the container and adjusting the voltage applied to them, the shape of the surface can be altered – no spinning is needed.

Using this technique, they have created a lab-bench liquid mirror of 70mm aperture with an amazing $1/20^{th}$ wavelength accuracy – good enough for telescopic optics. These experiments yielded a spherical surface: the next step would be to create a paraboloid with the right combination of electromagnets.

You won't likely see antifreeze-and-silver reflectors in backyard settings – among other things, they have to be pointed straight up. But it's certainly a technology that bears watching closely. ☆

# astronomical society of southern africa

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 own journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* (bimonthly) and an annual astronomical handbook, *Sky Guide Africa South*.

**Membership:** Membership of the Society is open to all. Enquiries should be addressed to the Membership Secretary, ASSA, PO Box 9, Observatory, 7935, South Africa or to the e-mail address below. Entrance fees are R25. Full members paying R100 per annum receive *MNASSA* and the *Sky Guide*. The subscription year runs from 1 July to 30 June. Persons joining during January to June need to pay only half the annual subscription, plus the entrance fee.

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monthly notes of the astronomical society of southern africa
Vol 69 Nos 1 & 2 February 2010



Printed by Koerikai Document Solutions, Cape Town