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• Okkie de Jager (1961 – 2010) • Licensing of Green Lasers •

• Observing Saturn for 30 years • Berto's 100th Supernova •

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Cover picture: EPOXI Comet Fly-by

Comet Hartley 2 as imaged on 4 November 2010 during a fly by of the EPOXI mission. At that time the image was taken, the distance between the comet nucleus and the space probe was about 700 km. The nucleus is about 2 km long and appears to be spinning around its long axis. Image Credit: NASA/JPL-Caltech/UMD/Brown

ASSA
Astronomical Society of Southern Africa

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Vol 70 Nos 1 & 2 February 2011

assa news

Scholarships News

A SAAO-ASSA Scholarship for 2010 has been awarded to Riyaadh Jamodien who matriculated from Eben Donges High School, Kraaifontein, in 2009. This year Riyaadh is in his first year of studies towards a BSc degree at Stellenbosch University.

Riyaadh Jamodien

No other ASSA or SAAO-ASSA scholarships were awarded. In 2011 the ASSA Scholarship and three SAAO-ASSA Scholarships (each worth R5 000) will be available. The closing date for applications is 14 January 2011. More info about the scholarships is at http://assa.saao.ac.za/html/25_scholarship.html

Rocco Coppejans

Rocco Coppejans, who held a SAAO-ASSA Scholarship in 2008 and 2009, obtained his BSc degree with distinctions from the University of Pretoria at the end of 2009, and this year has been accepted into the National Astrophysics and Space Science Programme (NASSP) at UCT and studying for his BSc (Hons) degree. He is joined by Mpati Ramatsoku, who held the SAAO-ASSA Scholarship in 2007 and 2008, and who completed her BSc at UCT in 2009. She is also in the NASSP at UCT and is also studying for her BSc (Hons) this year.

Wendy Williams, ASSA Scholarship holder in 2006 and 2007, is in the second year of her MSc in the Astronomy Department at UCT. Her thesis is entitled ‘A near-infrared study of HI galaxies in the Zone of Avoidance’ and aims at measuring Tully-Fisher distances to a large number of galaxies that lie behind our own galaxy.

Renée Holzek, holder of the ASSA Scholarship in 2005, continues with her DPhil studies in cosmology at Oxford University. ☆

Two more Double Stars discovered from Bredell

Tim Cooper, Bredell Observatory.

Summary

Two previously un-catalogued double stars are described. GSC 05842-00685 has component stars of magnitudes 12.2 and 13.3, separated by 15.1″ in position angle 125.9°. GSC 05842-00089 has component stars of magnitudes 12.0 and 12.7, separated by 9.3″ in position angle 67.4°. A third component is possibly located at a separation of 2.1″ in position angle 72.9°.

Discovery

On the evening of 12 November 2010 while conducting CCD photometry on asteroid 199 Biblis I noted that two stars in the images appeared double, prohibiting the use of these stars as photometric reference stars. My original image is shown is Plate 1. Reference to the Washington Double Star Catalogue yielded no previously catalogued double stars at the position of these images. Further investigation yielded the parameters described below for the two systems. All coordinates are epoch J2000.0, right ascensions are sexagesimal format (hh mm ss) and declinations are in degrees, minutes and seconds of arc.

Parameters for GSC 05842-00685

The HST Guide Star Catalogue gives a single star in position 00 18 06.63, -18 59 17.7 with a Pmag of 12.9 but identifies the object as non-stellar. Further investigation yielded the parameters for the two stars as listed in Table 1. These indicate the visual magnitudes of components A and B are 12.2 and 13.3 respectively. By measurement of the 2MASS data I derive a separation of 15.1 arc seconds in position angle 125.9°. The large difference in proper motion seems to indicate the pair is an optical double.

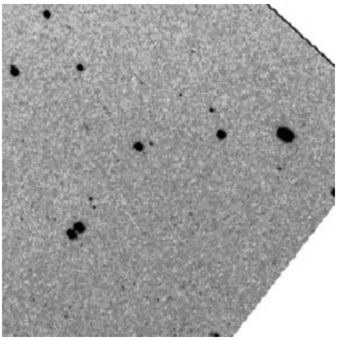


Plate 1. Author's original image taken on 12 November 2010 at 18h24 UT. The blank areas at upper and lower right are due to rotating the field to match the LEDA image below. Asteroid 199 Biblis is just left of centre.

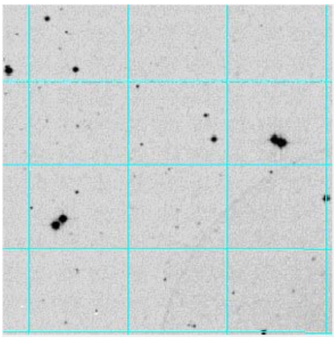


Plate 2. Image showing both double stars, GSC 05842-00685 at lower left and GSC 05842-0008 centre right. North is up and east to the left. The vertical lines are separated by 10 seconds in right ascension and the horizontal lines by 2 minutes in declination.

Catalogue		Component A	Component B
NOMAD1	Designation	0710-0003889	0710-0003894
	RA	00 18 06.58	00 18 07.40
	Dec	-18 59 17.6	-18 59 26.5
	Vmag	12.2	13.3
	Bmag	13.4	----
	Rmag	11.4	13.0
	Jmag	11.6	11.9
	Hmag	11.3	11.6
	Proper motion RA	-14.6 mas/yr	54.6 mas/yr
	Proper motion Dec	3.3 mas/yr	-0.7 mas/yr
UCAC3	3UC	143-000879	143-000881
	RA	00 18 06.58	00 18 07.40
	Dec	-18 59 17.6	-18 59 26.5
	f.mag	12.8	13.4
	Jmag	11.6	11.9
	Kmag	11.3	11.5
	Proper motion RA	-13.4 mas/yr	50.0 mas/yr
	Proper motion Dec	-3.8 mas/yr	2.9 mas/yr
USNO-A2.0	Designation	0675-00118051	0675-00118126
	RA	00 18 06.65	00 18 07.21
	Dec	-18 59 17.6	-18 59 26.4
	Bmag	12.6	13.1
	Rmag	12.7	13.0
USNO-B1.0	Designation	0710-0003852	0710-0003856
	RA	00 18 06.57	00 18 07.29
	Dec	-18 59 17.5	-18 59 26.6
	Proper motion RA	-18 mas/yr	
	Proper motion Dec	4 mas/yr	
PPMXL	RA	00 18 06.58	00 18 07.39
	Dec	-18 59 17.6	-18 59 26.4
	Proper motion RA	-12.5 mas/yr	54.9 mas/yr
	Proper motion Dec	0.6 mas/yr	1.0 mas/yr
2MASS	2MASS identifier	00180658-1859174	00180740-1859263
	RA	00 18 06.59	00 18 07.41
	Dec	-18 59 17.4	-18 59 26.3
	Jmag	11.6	11.9
	Hmag	11.3	11.6
	Kmag	11.3	11.5

Table 1 Parameters for Component A and B of GCS 5482 685

Parameters for GSC 05842-00089

The HST Guide Star Catalogue gives a single star in position 00 17 44.83, -18 57 26.1 with Pmag 11.5, but indicates the object as non-stellar. Both Plate 1 and the LEDAS image (Plate 2) indicate the object is at least double. Close inspection of the LEDAS image leads one to believe the object may be comprised of possibly three stars. Further investigation resulted in the data in Table 2, with the 2MASS catalogue showing two stars, which I have taken as components A and B, but with some catalogues giving data on three stars, from which I inferred the presence of component C.

By measurement of the 2MASS data I derive a separation for components A and B

Catalogue		Component A	Component B	Component C
NOMAD1	Designation	0710-0003809	0710-0003813	0710-0003810
	RA	00 17 44.60	00 17 45.17	00 17 44.74
	Dec	-18 57 27.4	-18 57 24.1	-18 57 26.8
	Vmag	12.0	12.7	----
	Bmag	12.0	----	11.5
	Rmag	----	12.6	----
	Jmag	10.8	11.6	----
	Hmag	10.5	11.3	----
	Pr.Mot. RA	-240 mas/yr	-39.7 mas/yr	----
	Pr.Mot. Dec	-227 mas/yr	-48.6 mas/yr	----
UCAC3	3UC	143-000858	143-000860	Not listed
	RA	00 17 44.60	00 17 45.17	
	Dec	-18 57 27.8	-18 57 24.1	
	f.mag	12.0	12.9	
	Jmag	10.8	11.6	
	Kmag	10.4	11.2	
	Pr.Mot. RA	24.5 mas/yr	-33.3 mas/yr	
	Pr.Mot. Dec	2.9 mas/yr	-41.4 mas/yr	
USNO-A2.0	Designation	0675-00115663	0675-00115707	0675-00115665
	RA	00 17 44.80	00 17 45.20	00 17 44.83
	Dec	-18 57 26.2	-18 57 22.6	-18 57 24.9
	Bmag	11.2	12.8	11.6
	Rmag	10.7	11.6	10.5
USNO-B1.0	Designation	0710-0003774	Not listed	0710-0003775
	RA	00 17 44.74		00 17 44.80
	Dec	-18 57 26.8		-18 57 26.5
	Pr.Mot. RA			-18 mas/yr
	Pr.Mot. Dec			-22 mas/yr
PPMXL	RA	00 17 44.59	00 17 44.77	00 17 44.80
	Dec	-18 57 27.5	-18 57 26.2	-18 57 26.5
	Pr.Mot. RA	28.2	10.0	-13.4
	Pr.Mot. Dec	9.1	8.1	-24.6
2MASS	2MASS ident.	00174458-1857275	00174516-1857239	Not listed
	RA	00 17 44.59	00 17 45.16	
	Dec	-18 57 27.5	-18 57 23.9	
	Jmag	10.8	11.6	
	Hmag	10.5	11.3	
	Kmag	10.4	11.2	

Table 2 Parameters for Components A, B and C of GCS 5482 089

of 9.3 arc seconds in position angle 67.4°. Using the NOMAD1 data for component C I derive a separation for components A and C of 2.1 arc seconds in position angle 72.9°.

Acknowledgements

I would like to thank William I Hartkopf of the USNO for email communication in respect of these stars and the confirmation that neither was previously listed in the WDS catalog. The 2MASS data is courtesy of a joint project of the University of Massachusetts and the Infrared Processing and Analysis Centre / California Institute of Technology, and funded by the National Aeronautics and Space Administration and the National Science Foundation, USA.

Plate 2 is reproduced from the Leicester Digitized Sky Survey (LEDAS), using data obtained from the Leicester Database and Archive Service at the Department of Physics and Astronomy, Leicester University, UK. ☆

ASSA Award for Cuan Watson

The Director of Education & Public Communications of The Astronomical Society of Southern Africa, Case Rijsdjik, has awarded Louis Trichardt High School Matric student, Cuan Watson, a Merit Award for his involvement during the International Year of Astronomy in 2009. Cuan has unselfishly given up his time and has always been willing to assist in astronomy outreach events. His conduct at the various schools, universities and sidewalk events has been of the highest standard and his readiness to help, be it handing out information/pamphlets/posters, manning the telescope, helping to set up equipment or the building of Southern Star Wheels and MoonScopes is exemplary and commendable.

Cuan Watson

A few of the IYA venues and events that Cuan was involved in were: 100 Hours of Astronomy (Louis Trichardt), Winters Nights (Louis Trichardt, Round Table), Tshipise, BendeMutale (Pafuri), University of Venda (Thohoyandou), Elim High School (Elim), Letaba Show (Tzaneen), Makhado Crossing (Louis Trichardt), Galilean Nights (Louis Trichardt & Thohoyandou), as well as numerous impromptu sidewalk astronomy events during IYA and 2010 organised by Limpopo Astronomy Outreach and the Soutpansberg Astronomy Club. ☆

(top-left) Cuan's fist explanation of how to use the SouthernStar Wheel at Elim High School was a resounding success.

(left) Cuan Watson and James Coronaios setting up outside the popular Tshipise resort at the start of July school holidays.

Karoo and Southern Star Parties

After its initial success in 2009, the second **Karoo National Starparty**, arranged by the Pretoria Centre, took place on the weekend of 6 – 9 August 2010 at their usual venue about 20 km north of Britstown in the Karoo, right next to the N12 at the Kambro Padstal. The reason for this locality, apart from the fabulous Karoo skies, is that it is almost exactly halfway between Gauteng and the Cape Town area. The starparty was again well attended by stargazers from across the country and the Karoo lived up to its reputation and provided magnificent views.

The 2011 event is already being planned for 29 April - 2 May 2011. The weekend chosen is just after the Easter Weekend, offering the option of spending even longer observing the fabulous Karoo skies by getting there early! As always, book early to avoid disappointment! Contact Wilma Strauss (the Manager of Kambro), directly at 083 305 6668 or e-mail: kambro@worldonline.co.za for bookings. For information see http://pretoria-astronomy.co.za/events.htm or contact the organisers; Johan Smit (072 806 2939) and Danie Barnardo (084 588 6668).

If one star party is not enough, keep an eye out for the **Southern Star Party**, planned for 4 - 6 March 2011, to be held on a farm between Bonnievale and McGregor in the Western Cape. Although individual dark-sky observing is still paramount, a number of group events are also planned. Willie Koorts, Edward and Lynnette Foster, Martin Lyons, Suki Lock and Auke Slotegraaf are hard at work to make it happen, so make a note of this date. For more information, regularly explore their blog at http://southernstarparty.wordpress.com and/or send email to *southernstarparty@gmail.com*. ☆

ScopeX 2011

The very popular ScopeX will be held from 09h00 - 21h00 on 7 May 2011 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. ☆

Kevin Govender appointed Director of the OAD

After an intensive and extended recruitment exercise Mr Kevin Govender has been selected as the first Director of the Office for Astronomy Development (OAD). The selection panel, which included both local and international senior scientists and dignitaries, reviewed a large international pool of expertise, before making the announcement.

Mr Govender, currently the head of the Southern African Large Telescope (SALT) Collateral Benefits Division at the South African Astronomical Observatory (SAAO) and has been driving the SAAO's involvement in education, outreach and community development activities for the last 5 years.

He will take up this prestigious position as Director of the OAD with effect from 1 March 2011. The OAD, an initiative of the International Astronomical Union (IAU), will coordinate a wide range of activities designed to stimulate astronomy and its development throughout the world.

Earlier in the year, the IAU, the body that is the global organization of astronomy, announced that the SAAO would host the OAD. This decision reflects SA's standing in the international astronomical community. Prof George Miley, IAU Vice President for Development and Education, said that he was particularly pleased that the Executive Committee chose South Africa and the South African Astronomical Observatory, because South Africa is a role model for combining world-class astronomical research facilities with a pioneering programme of astronomical outreach.

Dr Ian Corbett, General Secretary of the IAU, noted that this was a momentous occasion and the start of something really new, really challenging but also something which should have profound, far-reaching long term consequences for astronomical community and not just for the developing countries. It is wonderful that South Africa has joined with the IAU in this endeavour, and has demonstrated the determination and commitment necessary to make this a success.

The ASSA council and members congratulates Kevin on his appointment and wishes him well in his new position.

For further details on the OAD itself, see *MNASSA*, Vol 69 Nos 5&6 p.81, and www.saao.ac.za/no_cache/public-info/news/news/article/185/41/

The Office for Astronomy Development is generously supported through the IAU and the South African Department of Science and Technology. ☆

Ten Years of the IRSF and the Future

The Infrared Survey Facility or IRSF at Sutherland, a 1.4m telescope dedicated to infrared surveys, was opened officially on 15 November 2000. It was the result of an agreement signed in August 1998 between the South African Astronomical Observatory and the Graduate School of Science of Nagoya University in Japan. Most of the cost was met by a grant from the Japanese Ministry of Education but the building was paid for by South Africa. The observing time on the telescope is divided accordingly.

This year marks the 10th anniversary of the opening and a special conference "10 Years of IRSF and the Future" was held on 16-18 November at Nagoya University. It was attended by a significant delegation from SAAO and UCT, mainly from the user community and also by the main Japanese astronomers involved, such as Prof Shuji Sato, the PI for the telescope, and Prof Tetsuo Nagata who supervised the construction. There were also a few participants from other user countries.

The conference covered the scientific highlights of the ten years of work with the telescope. The major accessory instrument has been the SIRIUS camera, a 3-channel infrared camera with three 1024 x 1024 HgCdTe infrared arrays covering the J, H and K bands. More recently, a wide-field polarimetry at-

tachment called SIRPOL has been added. The conference covered the technical aspects of the instruments and the data reduction pipeline before going on to discuss the scientific results.

Surveys are the principal product of the IRSF and excellent results have been achieved on the Magellanic Clouds, the Galactic Centre and the population of dwarf galaxies. Repeated observations have enabled the identification of numerous variable stars, useful as distance indicators as well as yielding information on the chemical history of the surveyed regions.

Another important area for infrared surveys is star-forming regions and several papers dealt with these. In extra-galactic work, the surveying of galaxies partly hidden by the Milky Way featured prominently. Observations of luminous (LIRG) and ultra-luminous infrared galaxies (ULIRGS) also were described.

An important new field is the discovery of Cepheid variables in the spiral arms of the Milky Way galaxy. These have the possibility of revealing the outlines of its spiral structure, difficult to visualise otherwise because we are embedded within it.

The future part dealt with the design and possible applications of a new wide-band spectrometer for the IRSF. The last session covered SALT, MeerKAT and possible future programmes that could involve them and the IRSF. The SA Virtual Observatory, a data-mining tool, was also covered.

Over the 10 years of its existence, using the IRSF has led to lengthy visits by quite a few Japanese astronomers and students and many friendships have been formed between them and their South African counterparts. This conference was a useful opportunity for the South Africans to meet them on their home ground. ☆

Closure of the Nigel Observatory

Luciano Pazzi *(lucianop@telkomsa.net)*

More than 42 years ago the establishment of the Nigel Observatory was announced, *MNASSA* July 1968. It is with regret that the author is now announcing the closure of the observatory.

The observatory has been active in many fields. Total lunar occultations were observed for a number of years and reported to the Royal Observatory, Greenwich. In addition many grazing occultation were observed, either as part of a group or individually during excursions to various locations. In the late 1970s variable stars were observed, mostly for the AAVSO. This was followed, in the mid-1980s, with the photoelectric photometry of variable stars, which became the backbone of the observatory's work till its closure. Many papers where published during this time and are available from www.adswww.harvard.edu. Other work carried out at the observatory appeared in several other scientific publications.

Many people from the surrounding area have visited the observatory over the years, including school and other interested groups. Of late unfortunately the interest of the youth and public has drastically waned: a sign of deteriorating interest in the sciences and the advent of information becoming readily available on the internet.

The observatory closure is primarily due to the author's advancing age and the need to invest into new technologies, the photoelectric photometer has been mostly supplanted by CCD devices, an expense that the author can ill afford.

Heartfelt thanks are due to all those people that over the years have supported the observatory, unfortunately they are too many to mention individually. ☆

obituary

Okkie de Jager (1961 – 2010)

Adri Burger (Prof)

Prof Okkie de Jager of the Centre for Space Research of North-West University lost his valiant battle against cancer on 14 December 2010 at the age of 49.

His main field of interest was gamma-ray astrophysics, and included theoretical work, data analysis, instrument design and also innovative astro-technologies. He remained active until the day that he was admitted to hospital for the last time, less than two weeks before his death. We mourn the passing of a brilliant researcher whose dedication to his work, positive outlook on life and contagious enthusiasm for exploring the unknown and explaining the unexplained, made him a great colleague and a much sought-after collaborator.

Ocker Cornelis de Jager was born on 9 April 1961 in Pretoria. He completed his Matric in Parys, Free State, and his undergraduate and graduate studies at the Potchefstroom University for CHE (now North-West University). In 1987 he completed his PhD in Physics with a thesis entitled "The analysis and interpretation of VHE gamma-ray measurements" under the supervision of Prof Christo Raubenheimer.

He was appointed as Junior Lecturer in 1984 at the then Potchefstroom University, Research Scientist in 1985, Senior Research Scientist in 1988, and Associate Professor in 1994, and was promoted to Professor in 1996. Prof De Jager established himself in the field of gamma-ray astrophysics during the early years of his career and was awarded the President's Award of the National Research Foundation (NRF) of South Africa twice for his contributions to this field of research. In 1991 he won the competitive National Research Council Research Associateship, which enabled him to complete a Post Doctoral Research Associateship at NASA Goddard Space Flight Center. There he worked with Dr Alice Harding, and they were the first to develop a relatively accurate procedure to predict the high-energy to very high-energy gamma-ray spectrum of the Crab Nebula. Subsequent gamma-ray observations confirmed the predicted gamma-ray fluxes. He also worked with Dr Floyd Steckerof NASA Goddard Space Flight Center and they were the first to predict the cosmic horizon for very high energy gamma-rays from active galactic nuclei with relative accuracy. This opened a whole new field of research and serves as the motivation for new large projects which attempt to reduce the gamma-ray threshold so that the cosmic horizon can be increased. Many other successes followed, and in 1995 he received the Shakti P Duggal Award for exceptional contributions in cosmic-ray physics, and in 1996 the British Association Medal for the Advancement of Science.

De Jager became involved at the international level very early in his career. Between 1989 and 2003 he made significant contributions towards human capacity development for the MAGIC gamma-ray experiment in La Palma, Spain, a large atmospheric imaging Cherenkov telescope. He was also involved in the High Energy Stereoscopic System (H.E.S.S.) since the late 1990s, and was Group Leader for the South African participation in this highly-successful gamma-ray project. The H.E.S.S. collaboration was awarded the prestigious European Descartes prize for Research for 2006, and the 2010 Rossi Prize of the High Energy Astrophysics Division of the American Astronomical Society. In 2005 De Jager was elected to serve on IUPAP's Commission on Cosmic Rays. He was leader of the working group on Supernova remnants, Pulsars and Plerions (WGSPP) for the international Cerenkov Telescope Array since 2008. The fact that De Jager was offered the directorship of a prestigious European research institution is testament to his international standing; that he turned it down demonstrated his loyalty to his country.

His international involvement did not diminish his interest and his involvement in science in South Africa, especially multi-wavelength astronomy. He served on various NRF and DST panels, was a lecturer in the National Astrophysics and Space Science Programme (NASSP), and also sponsored local outreach programmes. He was author or co-author of 170 publications in international refereed journals, and eight masters students and eight PhD students completed their studies under his supervision or co-supervision. In 2008 he was awarded a DST/NRF Research Chair in Astrophysics and Space Physics. During 2010 he presented three invited talks at international conferences. He also held two technology-based patents.

Outside of astrophysics, Prof De Jager had a keen interest in the postal history of South Africa. He received an award for his exhibit entitled "Centenary Celebration of the Postal History of the Union of South Africa" during the "Joburg 2010 International Stamp Show", held in October in Johannesburg.

Prof De Jager is survived by his wife, Estie, and thirteen-year old daughter, Danél. ☆

Visit to Super-Kamiokande

Ian Glass

The recent IRSF conference in Japan was followed by an opportunity for the South African and other overseas delegates to visit the Kamioka Observatory in the mountains of Gifu province. This world-famous installation is centred around a detector that searches for the elusive neutrino 'fundamental particles'. Though they have been 'known' of since the 1930s, they interact only to the slightest extent with other matter and so are extremely difficult to detect.

The detector is situated hundreds of metres deep within a mountain, in what was formerly a mine. The visitors drove by bus through a tunnel, into the area where the Observatory is situated, and had to wear hard hats! The rock above absorbs the ordinary charged cosmic ray particles and cosmic gamma-rays. Special efforts are also made to avoid contamination by traces of radon gas, a radioactive substance often found in deep mines.

The detector is a huge stainless steel tank containing 50 000 tons of continuously purified water. It is in the form of a cylinder 39.3 m in diameter and 41.4 m tall. It is lined on the top, walls and bottom by 11 129 gigantic blue-sensitive photomultiplier tubes. Outside the main volume is an outer detector with 1 885 tubes that serves to detect and reject any energetic particles that arrive in spite of the massive shielding provided by the mountain.

Any neutrino that happens to interact with the water will generate a charged particle. If energetic enough, this particle will travel faster than light in the water and give rise to a shock wave of blue light called Cerenkov radiation. This light is then detected by the photomultipliers.

The thermonuclear reactions in the core of the Sun are a powerful source of neutrinos and from the observed fluxes the validity of solar models can be checked. Among the results obtained so far are evidence for a finite mass for the neutrino as well as the detection of 'neutrino oscillations'. In February 1987 the supernova SN1987A caused a large flux of neutrinos, some of which were detected by the original Kamiokande detector.

There are many other experiments at the Kamioka Observatory under way to understand the nature of neutrinos, to try to detect proton decays and to find dark matter. ☆

Image credit: Kamioka Observatory, ICRR (Institute for Cosmic Ray Research), The University of Tokyo.

100 Not Out!

Berto Monard

Introduction

NGC 1566 is the name of a beautiful nearby southern galaxy in the constellation Indus. It's a late type spiral galaxy that lies face-on to us. It's here that the author discovered his 100th supernova at the Bronberg Observatory, east of Pretoria, and so became the first amateur astronomer to reach that total in the southern hemisphere. The 'century' discovery was made on Aug 19.1, 2010 with a SN, magnitude of 16.8, and the IAU coded its name SN 2010el.

Supernova hunter, Berto Monard at his telescope (above) and outside the Bronberg Observatory, on the Highveld east of Pretoria (below).

It was in the same constellation that he had discovered his first supernova nine years earlier in galaxy NGC 1448. That SN had a very similar name (SN 2001el), because it was also the 123rd IAU sanctioned SN discovered in that year. That first discovery was made visually through the eyepiece. All consequent ones at the Bronberg Observatory were discovered using a CCD camera at the prime focus of the 30 cm RCX telescope.

At this moment, with observations dormant after having moved to the Klein Karoo, the official total number of SN discoveries stands at 106, all made at the Bronberg Observatory. Many of those SNe were discovered in galaxies close to their solar conjunctions, either during dawn, low in the East or during evening twilight low on the western horizon and mostly in the winter season. The open horizon of the observatories location combined with the latitude of the Bronberg Ridge helped, as did the long clear winter skies on the highveld that created this niche.

Observing strategy

The target galaxies of the Bronberg search program lie at distances between 10 and 400 million light years(ly), most of them around 200 million ly (or 60 Mpc). The selection of those galaxies was the end result of a comprehensive study of all aspects concerning SN production and the types of galaxies where they likely occur. Sizes, orientations of and distances to the galaxies were also considered in the planning.

The CCD target program consists of about 2 000 galaxies that are expected to produce SN, some more than others. In winter-time galaxies north of the equator are observed regularly while not at all in the summer. The calculated magnitude limit of the observation image was such that SNe would be detectable 1.5 magnitude below peak brightness for each galaxy. This means that nearly all galaxies observed require a collection of images to be taken and stacked up to the required depth. All these parameters were researched and listed over a period of 3 years to finalise an optimized target list, which is definitely the base of the successful endeavour at Bronberg.

Observation cycle of those target galaxies depends on their individual merits with respect to expected SN production and is seasonally bound. The general strategy at Bronberg was different from the going trend: doing less galaxies more often instead of doing more galaxies sporadically. This approach improves the chance for early detections, often before the SN reached its peak brightness, which greatly increases the scientific value of such a find.

Nine years of discovery: an overview

Although every single discovery has its own story, most of the memories have faded with time. Some of those discoveries are well remembered, each for its own reasons. Here are some of the highlights.

The first SN discovered with a CCD at Bronberg was SN 2002bq. It occurred in ESO 377-5, a rather insignificant, late type spiral galaxy. It was the first of many and proved that the search programme was quite effective. The second discovery in that year was SN 2002cy. The galaxy NGC 1762 was north of the equator and close to solar conjunction at the time of discovery and no follow up was possible by the large observatories. Another four SNe were picked up in 2002.

Only 4 SNe were discovered in 2003, two of them occurred in smaller galaxies that happened to be on the image together with the program galaxies.

Discovery of SN2004ej of NGC3095 (CSP), one of many that were discovered in 2004 in nearby galaxies.

In 2004 was much better: there were 10 discoveries. SNe 2004ab, 2004cx, 2004de and 2004ej were all found in nearby galaxies. Some of them became quite bright. The last find of the year was SN 2004gt in NGC 4038, one of the Antennae galaxies. The SN ocurred in the middle of a dense HII region.Deep images made by the Hubble Space telescope before and during the SN appearance allowed researchers to pinpoint the environment of the progenitor star.

2005 was an even more productive year with 15 SN discoveries, which included two in more distant Abell clusters. The reason for inclusion of these Abell cluster fields, was the large number of galaxies visible on the images. While more distant than in the typical program galaxies, SNe of type Ia would be well visible around peak brightness. Most of those cluster core galaxies are lenticular or elliptical. They are not expected to produce type II SNe, according to present knowledge and my observations will increase the eventual bias in this regard.

Two SNe were discovered in galaxy ESO 244-31 that year, one in January and the other one in December. There were no previously recorded SNe in that galaxy. Research showed that this was an example of a SN productive galaxy, not unlike M83, but unfortunately much It's much further away in space at an estimated distance of about 300 million ly. Stu Parker from New Zealand has in the meantime discovered another SN (2010cm) there.

SN 2005at was found in the nearby spiral galaxy NGC 6744. Another interesting SN was found in NGC 214, a galaxy with declination +25.5º and during the southern winter this galaxy is not visible from the northern hemisphere.

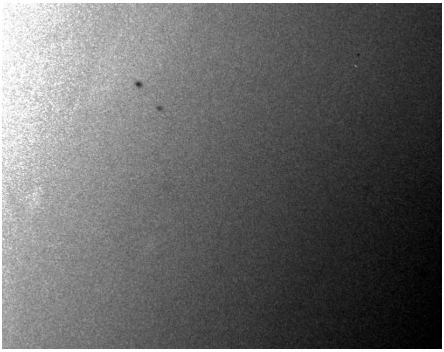
The following year, 2006, was almost as productive with 14 SN discoveries. Two appeared in NGC 1316, a galaxy better known as Fornax A, a strong radio galaxy near the centre of the Fornax cluster. Both SNe were of type Ia and SN 2006dd reached a peak magnitude of 12.1. Both SNe were visible simultaneously for a short while. Other interesting SNe were 2006T, 2006bh and 2006ce. They all were relatively nearby. The latter occurred in NGC 908 and had a magnitude of 12.4 at discovery, when the galaxy had just come out of solar conjunction.

Despite a very good start with three SNe discoveries within 24h and a fourth three nights later, there were only 10 SN discoveries in 2007. One of those SNe (2007Y) occurred in the nearby galaxy NGC 1187. It was of type Ib and it didn't become very bright. Unfortunately, burglaries in the observatory, damage to cabling and theft of the pcs on two occasions brought observing to a halt just before the winter. When observations eventually resumed most of the cloudless winter nights had passed. SN 2007le was a late find near the core of the nearby equatorial galaxy NGC 7721. SN 2007st was found on the south-western horizon in galaxy NGC 692, just before its solar conjunction. Only three follow-up observations of this SN were possible.

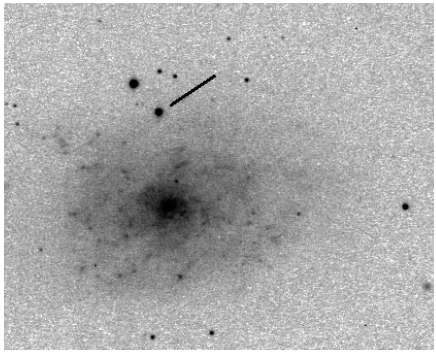
(above) SN2007le discovered near the core of the nearby equatorial galaxy NGC 7721(CSP).
(below) The discovery SN2007Y in NGC1187. This never became very bright and turned out to be a Type 1b SN (CSP).

The year 2008 made up for the weak harvest of the previous year with some very interesting discoveries. SN 2008bk was discovered on 25 March in the very nearby Sculptor galaxy NGC 7793. Observations of that galaxy were not supposed to happen before April as it was still very close to the Sun. By way of experiment it was decided to image this galaxy on the morning of March 25, well into dawn and with the low Eastern observatory wall obstructing a large part of the view. After processing, the resulting image was very poor as expected. Only three star like shapes were visible, all supposedly brighter than magnitude 13. The bright galaxy itself was not visible, but the core was although only just. However poor the image, from the star pattern, and the accurate pointing of the telescope, it was clear that one of these three stars was a new appearance. Observations the next morning over a more substantial time produced a slightly better image, confirming the presence of the new object. Consequent reporting of this find and the confirmation resulted in the naming of this discovery as SN 2008bk. The measured magnitude was 12.6 and the SN would reach peak brightness shortly afterwards around magnitude 12.5. It would stay near that magnitude for the next three months. It took more than a month after discovery before professional observatories were able to follow up on this SN and confirming it as a type II. The intrinsic brightness of this SN and its closeness to us, allowed it to be followed it for more than a year. [1]

Less than a month after that discovery a possible SN was found in NGC 300, another nearby galaxy and also a member of the Sculptor Group. The object remained rather faint and spectral data were different from that of any type SN. The researchers also found that the energy release was much higher than that of a typical nova.



An experimental early morning image led to the discovery of SN2008bk in NGC7793 on 25 March 2008. Even though the image was poor, the star pattern revealed the SN.



Follow up images of SN2008bk in NGC7793 were difficult during the subsequent months better images confirming the SN were made, like this one, on 9 July 2008.

This was a new type of object, or rather it fell in a category of objects that had been had sporadically encountered before, they were all were given SN names. No SN designation in this case but the 'optical transient' in NGC 300 became an intensely studied object and is now referred to as a prototype of a new class of explosion. [2]

SN 2008cq occurred in a small lenticular galaxy East of NGC 5556. It was a type Ia discovered around peak brightness and many times brighter than that of its home galaxy. Other nearby SNewere found in NGC galaxies 3261 and 2997. The latter was very faint, no follow up spectra were taken and the type of SN is not known, although it is suspected to be a type Ib because of its short duration and faintness. The highlight of the year was the discovery of two SNe in the beautiful spiral galaxy IC 2522. Both SNe were core collapse type, stayed rather faint, but were visible simultaneously for a short while.

2009 was another good year with 18 discoveries. Many of these were found in equatorial and northern galaxies, two in the Virgo Group, one in M66 in Leo and one in NGC 5426. They were all discovered low in the western horizon, just before solar conjunction and SN 2009em was discovered in NGC 157, at this time and already past its maximum. As regular observers and theoreticians know, equatorial objects stay hidden for a long time during their trip behind the Sun. It is quite possible that SNe that occur early in that period are not detected at all. Therefore early observations after conjunction are of great importance. SN 2009hf was discovered in NGC 175 more than 10 days before the peak. The clear winter nights on the highveld allowed for a dense coverage of the brightness evolution.

The year 2010 not only brought world soccer to South Africa but also the 100th SN discovery at the Bronberg Observatory.

One of the more satisfying SN discoveries was SN 2010do in the equatorial galaxy NGC 5174. It was first imaged more than two weeks before it would reach its maximum brightness. Noticeable is that this SN was also independently discovered by the Lick Observatory Supernova Search (LOSS) group, less than a day later, just showing how dense SN search coverage is these days. But this time the Bronberg observations beat them to it!

SN 2010da was discovered in NGC 300, the nearby Sculptor galaxy where the 2008 transient occurred. This SN didn't get very bright either and was later found to be an energetic eruption of a Luminous Blue Variable (LBV) star. A similar event might have happened with eta Car nearly two hundred years ago. SN 2010el in NGC 1566 was officially the 100thSN discovered from Bronberg. Later discoveries of interest in 2010 were SN 2010fz in NGC 2967 and SN 2010hg in NGC 3001. Both were in their early development stages in nearby galaxies that were just before and after solar conjunction and therefore low on the western and eastern horizon in the winter sky. SN 2010hg was another SN that was discovered more than two weeks before its maximum. All observations were made low on the western horizon during dusk. The telescope mount was raised to add an extra data point of this SN! SN 2010hx in NGC 3258 was the last SN to be discovered from the Bronberg Observatory. The date was 16 September, less than a week before the move to the Klein Karoo.

Other observing programs

Although the author and the Bronberg Observatory are known for their SNe discoveries, the observatory is also well known as the Pretoria observing Centre for Backyard Astronomy, or CBA Pretoria. The participation in this global network has given the Bronberg Observatory additional status as it is also involved in time series studies of active cataclysmic variable stars (CV). In addition the observatory isinvolved in the initiative of the close monitoring of a large number of lesser known CVs that have contributed significantly to the scientific knowledge of those star systems. [3]

Since 2007 the Bronberg Observatory has also been involved as an invited participant in the Microlensing Follow Up Network (uFUN). Over the years several exoplanets were discovered by this collaboration via observed anomalies in the lensing light curve. [4] The monitoring of faint symbiotic star systems in the Southern hemisphere was started in 2004 and turns out to be a very rewarding project. It surely will be continued for as long as possible.

The way forward

All the Bronberg observing projects and participations are intended to be resumed shortly from the Klein Karoo, where a new observatory is being built. It will have two operating telescopes, but at the time of this writing still no name...

Although the difference in weather patterns in this region is expected to affect the density of some of those observing programs, there is firm hope that more SN discoveries will be on the cards.

Acknowledgements
Images of galaxies with SNe taken by the Carnegie Supernova Project are indicated by (CSP), but all the SNe shown in these images were discovered at the Bronberg Observatory.

References
[1] http://www.eso.org/public/sn2008bk.html
[2] Bond, Howard E et al 2009 "The 2008 Luminous Transient in the Nearby Spiral NGC 300", AAS 21343414P
[3] http://cbastro.org/
[4] http://www.astronomy.ohio-state.edu/~microfun/ ☆

Observing Saturn for 30 years – light, shadows and seasons

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1. Introduction

It is amazing what amateur astronomers achieve these days. With modern CCD cameras, anyone who is interested in the subject can produce images of a quality that a few decades ago, professional astronomers could only dream of. However, this sometimes creates the impression that unless you have a collection of fancy and expensive astronomical equipment, you cannot do any astronomy. This is not true, of course, and this paper presents an observing project of the planet Saturn that requires modest equipment only.

Saturn is the second largest planet in the solar system and one of the five planets visible to the unaided eye. What makes it famous is the fact that is has a spectacular ring system, and these rings are easily visible in a small telescope. Even though the Voyager and Cassini space probes and the Hubble Space Telescope have provided extraordinary images of the ringed planet, there is still a lot that can be seen on Saturn in a small telescope.

It takes Saturn 29.5 years to orbit the Sun and, like the Earth, it has seasons. How it appears to us not only depends on where it is in its orbit, but also on the position of the Earth relative to the Sun and Saturn. This means that in order to see the full cycle of seasons on Saturn, one would have to observe the planet for 30 years.

This paper discusses Saturn observations from 1980 until 2010, covering the full period of 30 years. The telescope used was a 15 cm Newtonian reflector. Over the years Saturn was observed regularly and drawings made of the observations. In October 2010, this project was presented at the 2010 ASSA Symposium. A paper describing the first 24 years of Saturn observations appeared in *MNASSA* in 2004 (Cunow 2004).

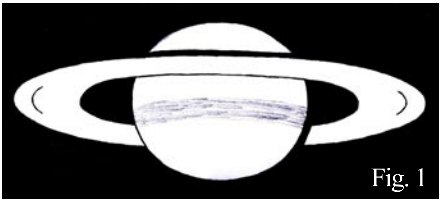

Fig. 1

2. Observing Saturn with a small telescope

When Saturn is observed with a small telescope, the main features visible are the planet and the rings. It is easy to see that the planet is oblate with the polar diameter being 10 % smaller than the equatorial diameter. Furthermore there are clouds on the planet's surface. The belts and zones in the clouds of Saturn show less contrast and are paler than those on Jupiter, but it is nevertheless possible to see some of the cloud bands covering the planet.

The most spectacular feature on Saturn is the ring system. It consists of two prominent rings, the A ring and the B ring, and many other much fainter rings. The B ring is located inside the A ring, and both rings are very bright and easily visible in a small telescope. Between the A ring and the B ring we find the Cassini division, an almost empty area that separates the two rings and appears as a dark lane between them.

Finally it is possible to see shadows on Saturn. The shadow of the planet is cast on the rings next to the eastern or western limb of the planet, and the rings' shadow is visible on the planet's surface north or south of the rings.

Figure 1 shows Saturn on 14 December 2006 through my telescope. One can see the planet with clouds, the rings with the Cassini division (the dark line in the ring system at each side of Saturn), and the shadows of the planet and the rings. If one compares Figure 1 with a picture of Saturn taken by the Hubble Space Telescope, it is obvious that the main features that are visible on the HST image can be seen in a small telescope as well. Cunow (2004) shows a comparison of the drawings with the HST picture "Seasons on Saturn".

3. Seasons on Saturn

3.1 How the Sun illuminates Saturn

The orbital period of Saturn is 29.5 years, and, because the equatorial plane of the planet is tilted by 26° 45′ relative to the orbital plane, Saturn shows seasons like the Earth. One full cycle of seasons, i.e., one Saturn year, corresponds to 29.5 Earth years.

The rings of Saturn lie in the equatorial plane of the planet, which means that at the March equinox on Saturn, the Sun rises for the northern side of the rings and sets for the southern side, whereas at the September equinox the Sun rises for the southern side of the rings and sets for the northern side. At the June solstice, the Sun reaches

Table 1. Seasons on Saturn

Season	Date
March equinox	3 March 1980
June solstice	11 December 1987
September equinox	19 November 1995
December solstice	26 October 2002
March equinox	10 August 2009
June solstice	22 May 2017

its highest position above the northern side of the rings, at the December solstice it reaches its highest position above the southern side. The angle at which the Sun shines onto the ring plane is given by the declination of the Sun in the sky of Saturn, ranging from -26° 45′ to +26° 45′. Table 1 gives the dates for the different seasons on Saturn.

3.2 How we see Saturn

The direction from which Saturn is illuminated by the Sun and the direction from which we are looking at Saturn are very similar. The maximum phase angle of Saturn seen from the Earth is only 6.4°. In the following, the angle at which we are looking at the ring plane will be referred to as the "viewing angle". It depends on the viewing angle how Saturn appears to us.

When the Earth crosses the ring plane, the viewing angle is 0, hence we see the rings edge-on. Because the rings are extremely thin (their average height is less than a kilometer), during a ring crossing they appear as a thin line or even disppear. Ring crossings take place around the March and September equinoxes on Saturn. Around the solstices, the viewing angle is largest and the rings appear wide open. After the March ring crossing and before the September ring crossing, we look at the northern side of the rings, after the September ring crossing we see the southern side. It should be noted that, because of the motion of the Earth around the Sun, the ring crossings do not take place exactly at the equinoxes, and the maximum viewing angle is observed a little bit before or after the solstice dates. Furthermore, if an equinox on Saturn takes place when the planet is close to opposition, the Earth crosses the ring plane not only once, but three times. Table 2 gives the dates for the ring crossings and the maximum viewing angles between 1979 and 2017.

Table 2. View of Saturn from Earth

Event		Date	Viewing angle
Ring crossing	south → north	27 October 1979	0° 0′
	north → south	12 March 1980	0° 0′
	south → north	23 July 1980	0° 0′
Maximum viewing angle	north	25 September 1988	26° 56′
Ring crossing	north → south	22 May 1995	0° 0′
	south → north	10 August 1995	0° 0′
	north → south	12 February 1996	0° 0′
Maximum viewing angle	south	8 April 2003	27° 01′
Ring crossing	south → north	4 September 2009	0° 0′
Maximum viewing angle	north	16 October 2017	26° 59′

The phase angle of Saturn changes periodically because of the Earth's motion around the Sun, and these variations influence the viewing angle to such an extent that the effects are visible in a small telescope.Most of the time, the viewing angle from the Earth changes into the same direction (increasing or decreasing) as the viewing angle from the Sun. For several months around opposition however, when Saturn is in retrograde motion, the viewing angle from the Earth changes into the opposite direction compared to the viewing angle from the Sun. This means that for an observer on the Earth the viewing angle increases and decreases periodically, and this effect is largest when Saturn is at its equinox. Around a solstice, the viewing angle hardly changes.

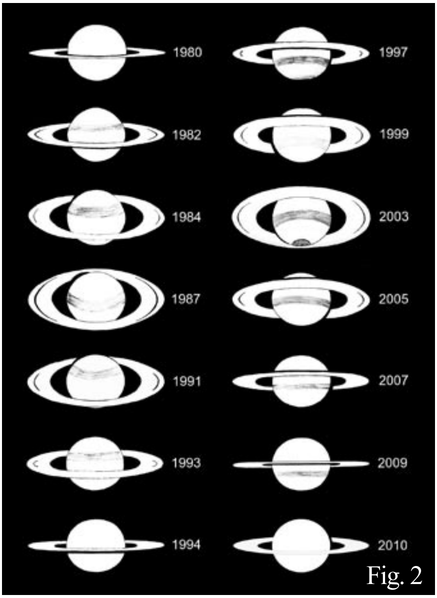

Fig. 2

4. Observing the seasons on Saturn

These Saturn observations cover a period of 30 years, ranging from 1 November 1980 until 3 November 2010. As discussed above, 30 years correspond to a full cycle of seasons on the planet, and Saturn was observed from shortly after the 1980 March equinox until shortly after the 2009 March equinox. Figure 2 shows the seasons on Saturn between 1980 and 2010. It can easily be seen how the rings opened and closed over the years, and how drastically the appearance of the rings changed during that time.

Figure 3 shows how the appearance of Saturn and its rings change from one Earth year to the next between a solstice and an equinox on Saturn. When the rings are wide open, there is not much change of the viewing angle within a year. When the viewing angle is small or intermediate however, the appearance of the rings changes significantly from one year to the next. Figure 3 also shows that the Cassini division can be observed when the viewing angle is large or intermediate. Around the

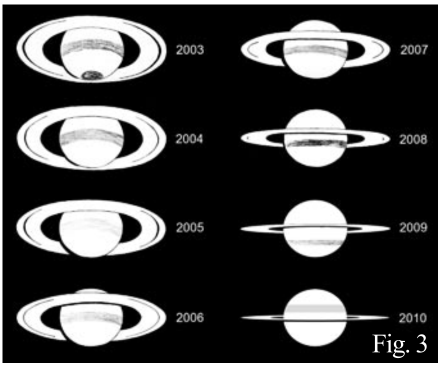

Fig. 3

Table 3. Series of events regarding the observations for Figure 4.

Date	Event
17 March 1996	Conjunction
11 July 1996	Viewing angle: 5°
26 September 1996	Opposition
1 December 1996	Viewing angle: 3°
30 March 1997	Conjunction
13 June 1997	Viewing angle: 11°
10 October 1997	Opposition
19 November 1997	Viewing angle: 9°
13 April 1998	Conjunction
28 August 1998	Viewing angle: 17°
23 October 1998	Opposition
4 December 1998	Viewing angle: 14°
27 April 1999	Conjunction

solstice on Saturn, the Cassini division is very prominent and easily visible in a small telescope. When Saturn is close to its equinox, the Cassini division cannot be seen.

Figure 4 shows the periodic changes of the viewing angle caused by the motion of the Earth between11 July 1996 and 4 December 1998 when the rings were opening as seen from the Sun. It can be seen how the viewing angle repeatedly increased and decreased. The effect is not dramatic, but it is clearly visible. Table 3 gives the series of events for Figure 4.

5. Visibility of shadows

Because of the fact that the phase angle of Saturn is not always 0, we are able to see shadows. We can see the shadow of the planet cast on the rings and the shadow of the rings cast on the planet. When Saturn is at opposition, no shadows are visible because our line of sight coincides with the direction of illumination from the Sun. The same applies when Saturn is in conjunction with the Sun. After conjunction and before opposition, when Saturn is found in the morning sky, the planet's shadow is visible next to the western limb of Saturn. After opposition, the planet's shadow is found next to the eastern limb. The shadow of the rings can be seen north or south of the edge of the rings in front of the planet. When the viewing angle from the Earth is smaller than the viewing angle from the Sun, the rings' shadow is visible next to the outer edge of the rings. When our viewing angle is larger than the viewing angle from the Sun, the rings' shadow is seen next to the inner edge of the rings. So during one visibility period of Saturn we can see the shadows moving from west to east and from either north to south (around the March equinox on Saturn) or south to north (around the September equinox).

Figure 5 shows Saturn on 28 August 1998, 26 October 1998 and 4 December 1998. The planet was at opposition on 23 October 1998. It can be seen that before opposition, the planet's shadow is west of the planet and the rings' shadow is south of the rings. Close to opposition, no shadows are visible, and after opposition, the shadows

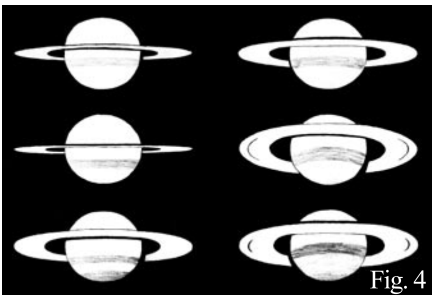

Fig. 4

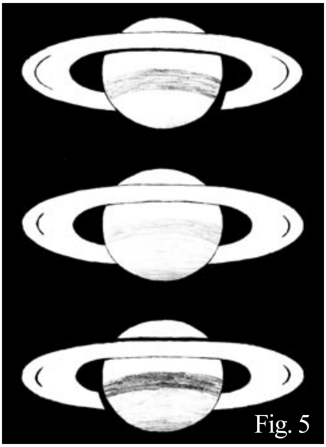

Fig. 5

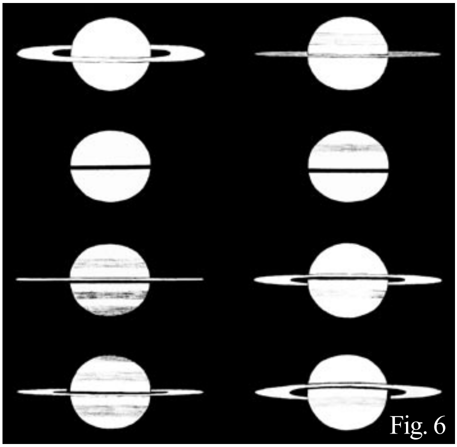

Fig. 6

are found east of the planet and north of the rings. These changes take place in only a few months, and they are easily observable in a small telescope. More examples of the shadows on Saturn are given in Cunow (2004).

6. Saturn's rings seen edge-on

When Saturn passes its equinox, the rings turn edge-on, something that is always fascinating to observe. As discussed above, the rings are so thin that when the Earth crosses the ring plane, the rings appear as a thin line or even disappear. Furthermore, there are often periods of time around the equinox when we look at the dark side of the rings, i.e., the side that is not illuminated by the Sun. When this happens the rings cannot be seen, but their silhouette is visible as a dark lane in front of the planet, often together with the rings' shadow. When the Sun is about to set on one side of the rings, we are able to see how the rings progressively darken until they disappear. In this section I will describe my Saturn observations in 1995/96 and 2009.

In 1995/96, the Earth crossed the ring plane three times, and we could see Saturn without rings for a few months. According to Tables 1 and 2, before 22 May 1995, the Sun illuminated the northern side of the rings, and we also looked at the northern side. On 22 May the Earth crossed the ring plane from north to south and the rings disappeared. On 11 August the Earth crossed the ring plane from south to north, so the rings reappeared. On 19 November 1995, the Sun set for the northern side of the rings, and the rings disappeared again. On 12 February 1996, the Earth crossed the ring plane again from north to south, and the rings reappeared.

Figure 6 shows Saturn in 1995/96. The 15 cm telescope was not available for the second half of 1995 and other

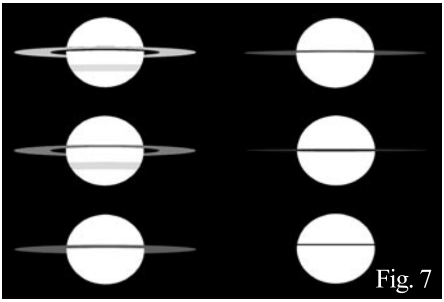

Fig. 7

telescopes were used during this time. The observation on 6 June 1995 was done with a 6 cm refractor, those on 1 September and 19 October 1995 with the 1.0 m telescope at the South African Astronomical Observatory at Sutherland, and the one on 6 November1995 with the C14 telescope at the University of South Africa. One can see how the rings repeatedly disappeared and reappeared, and the drawing from 6 November 1995 shows the darkening of the rings just before sunset.

In 2009 the conditions for observing Saturn without rings were less favourable than in 1995. Before 10 August 2009, the Sun illuminated the southern side of the rings and we also looked at the southern side. On August 10, the Sun set for the southern side, so the rings disappeared. The Earth crossed the ring plane from south to north on 4 September and the rings reappeared, but because Saturn was in conjunction with the Sun only 13 days later on 17 September, this event could not be observed. What we could observe however, was the darkening and the subsequent disappearance of the rings. Figure 7 shows Saturn between 10 May and 11 August 2009. The drawings show how the rings progressively darkened and finally disappeared.

7. Conclusions

This paper clearly shows how much can be seen on Saturn with a small telescope. Even though we have the spectacular images of the planet from the Hubble Space Telescope and the Voyager and Cassini space probes, there is nothing that beats the view of Saturn through a telescope just using an eyepiece.

The 2009 March equinox on Saturn is now behind us, and during the next years we will see the rings opening until the planet reaches its June solstice in 2017. As the viewing angle increases the Cassini division will become more and more prominent, and our view of the planet's higher latitudes will get increasingly better. So there are many exciting things to observe on Saturn in the near future and I am looking forward to the next 30 years of observation.

Acknowledgements

I would like to thank my parents for buying me the 15 cm Newtonian reflector in 1979. Furthermore I would like to thank the organizers of the 2010 ASSA Symposium for the opportunity to present my Saturn observations at this conference.

Reference

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Licensing Green Laser Pointers

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Background

Over the past decade the green laser pointer has become an invaluable and indispensable aid for both professional and amateur astronomers. Initially only 5mW units were available, and whilst these worked well, more powerful units, with an output exceeding 100mW, became available. This enhanced performance proved popular, but unfortunately their use was abused by members of the public: they were used to "flash" aircraft[1] and interfere with players at sport events.[2]

Legislation

Lasers are classified under the Hazardous Substances Act (Act No. 15 of 1973)[3]. Regulation No. R. 1302, 14 June 1991[4] (Schedule of listed electronic products) states the following:

> 3. Any electronic product emitting coherent electromagnetic radiation produced by stimulated emission, namely all laser products that emit radiation in excess of 0.8×10^{-9} watt in the wavelength region up to and including 400 nm or that emit radiation in excess of 0.39×10^{-6} watt in the wavelength region greater than 400 nm.

This means any green laser pointer with a power output of more than 0.39 μW is a scheduled product and the importer/manufacturer of such a device has to register/license the device at the Department of Health.[5] Licensing conditions demands from the importer/dealer as follows if the device is a Class 3b or Class 4 laser (any laser with output power more than 5mW):[6]

(i) If this model is a Class 3b or Class 4 laser device, the licence holder must provide the purchaser with a copy of the application form SBLN-1.[7]

(ii) Any unit of this model may only be supplied to the purchaser if the purchaser possess documentary proof that the required licence to use that unit has been issued by the Department of Health.

On the application form, the purchaser identifies who the 'Laser Safety Officer'[8] will be. If approved, the licence is issued under the following condition:[9]

The Laser Safety Officer must ensure that the requirements with regard to the safe use of this electronic product as outlined in the document "*REQUIREMENTS FOR THE SAFE USE OF LASER PRODUCTS*"[10] are adhered to at all times.[11]

Laser workshop at ASSA Symposium 2010

During 2009, the Department of Health contacted the author[12] for guidelines in approving applications for Class 3b and Class 4 green laser pointers. In this communication the Department of Health raised their concern about the easy access careless people have to these powerful lasers and requested guidance in the approval of applications for powerful laser pointers for astronomy purposes.

To prevent a total ban on the use of laser pointers above 5mW in South Africa, the author would require some input or suggestions from the Astronomical Society of Southern Africa, ASSA, on the use of higher power lasers in astronomy.

The 2010 ASSA symposium presented an ideal forum where this issue could be discussed and the organizing committee of the symposium subsequently included a workshop on this issue in the program. The outcome of the workshop is posted on the Pretoria branch website,[13] but the core recommendations are:

- 5mW laser pointers are suitable/ sufficient for general use
- Only astronomers who frequently perform astronomy outreach (and similar) presentations to large groups have a requirement for stronger laser pointers, 20mW being the norm and 50mW is seen as the maximum useful
- Applications to use powerful lasers (>5mW) should be accompanied by a recommendation from a legitimate organization (e.g. ASSA, ASSA branch, SANParks, SAASTA, etc.)

These recommendations are intended to provide guidelines to the Department of Health when they evaluate applications.

It should be noted, that these recommendations do not change the already existing requirement for:

- An importer to license the product at the Department of Health, even for models with output power less than 5mW
- A user/purchaser of laser pointers with a power output of more than 5mW to obtain a licence to use the product

In addition to the above recommendations regarding licensing of Green laser pointers, the delegates at the symposium also agreed that the following 'safe practices' are a good starting point when events are organised or presentations to groups are done with powerful laser pointers:

- Limit output power of lasers to 5mW at ASSA events (such as the Karoo Star Party, ScopeX, etc.) except for approved presenters. (Event organisers should be aware of their responsibilities for safety at the event in terms of the Occupational Health and Safety Act. (Act 85 of 1993))
- Lasers should be used by knowledgeable astronomers under controlled circumstances
- Do not point at people, aircraft or animals
- Keep a suitable distance from audience

- Warn the audience that a powerful laser pointer will be used during the presentation
- Area should be clean of obstacles
- Avoid pointing to surfaces that can give specular reflections
- Minimise use (do not play)
- Keep away from children
- Laser must switch off when switch is released
- Remove batteries when not in use
- Do not use mechanisms that keep the pointer switched on

ASSA members are encouraged to register their powerful laser pointers and to co-operate with the Department of Health to ensure that we can continue to use these useful instruments for years to come.

References

1 http://www.iol.co.za/sport/laser-at-fan-park-helicopter-pilot-sees-red-1.490640

2 http://communities.canada.com/theprovince/blogs/gobig/archive/2010/01/11/five-sporting events-where-the-green-laser-pointer-was-a-factor.aspx

3 http://www.doh.gov.za/docs/legislation/acts/1973/act15.html

4 http://www.doh.gov.za/docs/regulations/1991/reg1302.pdf

5 http://www.doh.gov.za/department/radiation/licensing/electronicproducts/import/41bn-1.pdf

6 Licence condition 4b

7 http://www.doh.gov.za/department/radiation/licensing/electronicproducts/use/sbln-1.pdf

8 The Laser Safety Officer (LSO) will in most cases be the purchaser. However, an organisation such SANParks or a planetarium, may have several powerful laser pointers and a single LSO. The LSO is then responsible to ensure that all operators/users employ safe practices when using these devices.

9 Licence condition 1

10 http://www.doh.za/department/radiation/.codeofpractice/electronicproducts/nonioinising/sblas-%20.pdf

11 See also:http://www.doh.gov.za/department/radiation/codeofpractice/electronicproducts/nonionising/sblas-2.pdf

12 Eridanus Optics CC is one of only three dealers who were licensed to import/manufacture green laser pointers at the Department of Health on 14 October 2010 and the only one who deals (is involved) in astronomy. The other two entities are Comidt Lasers (Port Elizabeth) and Eloptro (A division of Denel in Benoni)

12 http://www.pretoria-astronomy.co.za/laser.htm ☆

A Misty Cloud on our Doorstep

by Magda Streicher
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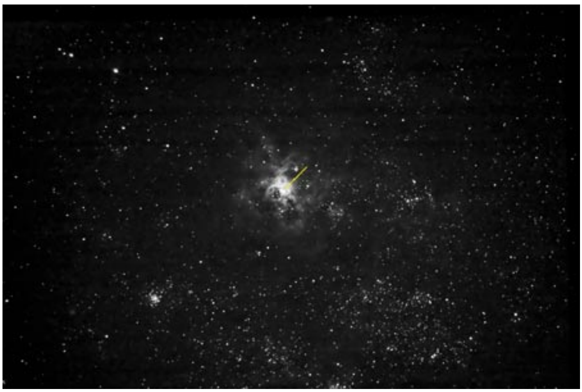
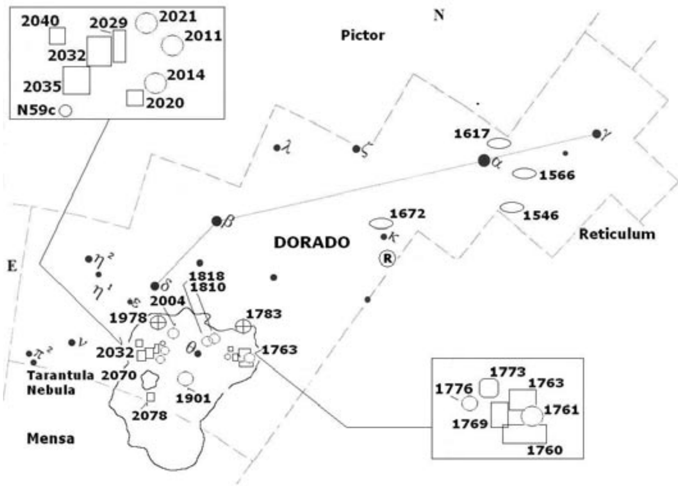
Earth is a mere speck in the Milky Way and to try and imagine and represent it in perspective is all but impossible. The soft band of the Milky Way is a reality that leaves one standing in amazement but understanding little. Gazing southwards here in favourable dark conditions close to the end of the year we are able to see the two Magellan satellite galaxies that revolve around our Milky Way. Observing them so closely provides an opportunity to try and bring the privilege of seeing them and grasping the reality of them a little closer together.

The explorer Amerigo Vespucci noted the Clouds as early as 1503, but it was Ferdinand Magellan, the Portuguese explorer, who documented the Magellanic Clouds in the 16th century and named them after himself in his report. Imagine for a moment the amazement and wonder such a sight would have produced in those early seafarers.

The Large Magellanic Cloud (LMC) forms an oval of approximately 6 by 4 degrees and astronomers classify it as a nearly face-on barred spiral galaxy, approximately 160 000 light years distant. The larger part is situated in the constellation Dorado, with some overflow into the constellation Mensa. The Small Magellanic Cloud (SMC) apparently consists of two separate galaxies in nearly the same line of vision, with the Mini Magellanic Cloud (MMC) at the back. Despite the LMC's irregular shape it displays a bar and one spiral arm, though somewhat distorted. The SMC is nearly 200 000 light years from Earth and 10 times smaller than the LMC. According to the Mount Stromolo and Siding Spring Observatories there are actu-



The Tarantula Nebula by Lucas Ferreira taken with a Sky-Watcher 203mm Newtonian Reflector (f/6); 2x1 minute exposures @ ISO 1600 and Pentax K110D DSLR.



ally three Magellanic Clouds. The Clouds may end up colliding with us or leave our Milky Way surroundings never to return.

Edmond Halley, who arrived at the island of St Helena off the west coast of Africa in 1677, wrote that the Magellanic Clouds have the look of galaxies, and he observed small pieces of clouds and stars through his telescope. Halley also noted three nebulae, which were probably the two dusty Magellanic Clouds and the dark Coal Sack in the constellation Crux.

The constellation Dorado, named after the Goldfish, contains no stars brighter than magnitude 3. The typical goldfish is a colourful creature and a fast swimmer. Dorado is one of the constellations invented by Pieter Keyser and Frederick de Houtman during the years 1595-1597 and was included in the 1603 catalogue of Johan Bayer. In 1598 the Dutch astronomer Petrus Plancius inscribed the constellation on the first globe, according to Auke Slotegraaf. The constellation is situated just north-west of the constellation Volans, the Flying Fish. The South ecliptic pole (RA: 4h, Dec: -66^{o}) lies within the constellation between eta and epsilon Doradus.

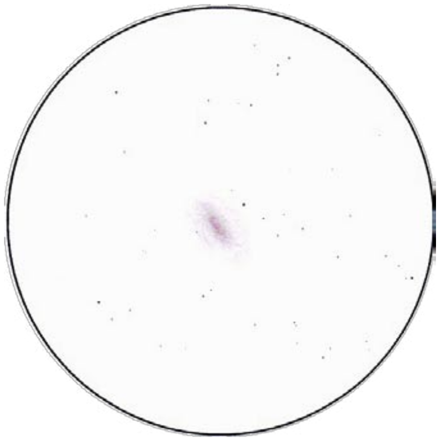
The tail part of this tropical marine fish is projected through the magnitude 3.2 alpha and 4.2 gamma Doradus, which are located in the far north-western area of the constellation. The stars in the constellation give the impression of a slender figure about 179 square degrees long.

The star alpha Doradus is situated just 35 arc minutes south of the galaxy **NGC 1617** in the same field of view. NGC 1617 is not that difficult to explore – you just need some patience and a few tricks. Move alpha Doradus to just outside your field of vision, use high magnification and concentrate! The galaxy displays a soft, elongated east to west oval which gradually brightens to a star-like nucleus surrounded by an outer envelope. The eastern edge of the galaxy appears very misty and high power treated me to some visible surface character in the form of a few knotty areas. IC 2085 is situated 11 arc minutes to the north with a magnitude of 14, not confirmed at the time, but suspected.

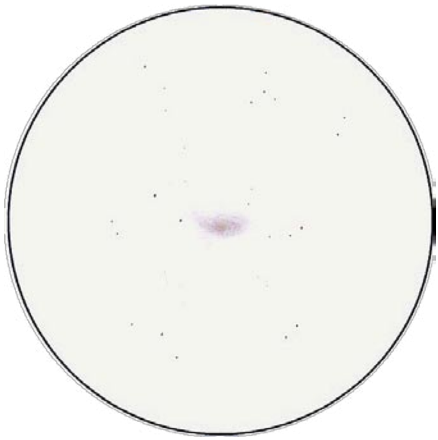
One of the most beautiful open spiral galaxies, **NGC 1566**, also known as Bennett 25, can be found among a number of other galaxies, also known as the Dorado Group, just 2 degrees north-west of alpha Doradus. The galaxy displays a large oval in a north-south direction with a really hazy fringe. The north-eastern and south-western parts are very flimsy and look like extended spiral arms (see sketch). The large bright core displays a dense nucleus surrounded by a soft envelope. A few faint stars and dusty knots can be seen on the surface.

Another galaxy which is also part of the Dorado group is **NGC 1546**, situated barely 1 degree further south-west, close to the boundary with the constellation Reticulum. The galaxy displays a lovely, large, elongated oval in a north-west to south-east direction. The author's study of the galaxy showed a lot of detail on its surface. The middle brighter area is large, with a soft outer halo that displays a good amount of nebulosity on the fringes. A short string of stars runs from the galaxy's western side into the field of view and ends with a magnitude 7.7 star. The magnitude 10 star closest to the galaxy's western side has a very faint magnitude 11 companion. The star field truly complements the galaxy.

Between the fins of the heavenly fish, the galaxy **NGC 1672** can be seen, just 30 arc minutes north of magnitude 5.2 kappa Doradus in the middle area of the constellation. The galaxy is an excellent example of a bar shape with a very elongated middle part in an east to west direction (see sketch). With high power the true character of the galaxy comes to the fore, with a well-defined bar showing off the bright pinpoint nucleus. Towards the eastern end of the bar a faint spiral arm can be glimpsed extending northwards. This



NGC 1566 or Bennett 25



NGC 1672 or Bennett 26

large bright galaxy displays a very misty washed-out outer halo, more so towards the northern and southern ends.

An outstanding red Carbon Mira star, **R Doradus**, which the author strongly recommends observing, is situated 2.5 degrees south of kappa Doradus and 2.5 degrees east of alpha Doradus.

The variable-magnitude 3.8 beta Doradus, situated on the northern edge of the LMC, represents the watchful eye of the goldfish and is easy to see.

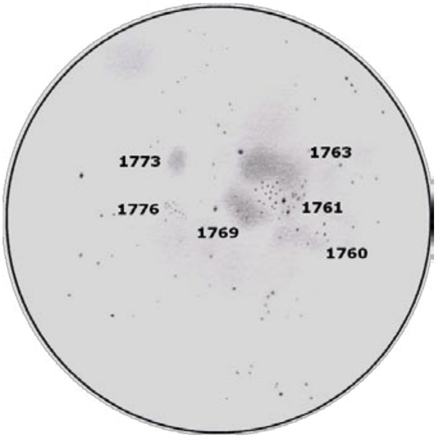
To explore the LMC imagine a scene with the goldfish taking a breath of fresh air above the cloudy waters. On the far northern edge of the cloud a globular cluster pokes its nose up into the air out of the stormy sea. **NGC 1783**, also known as Bennett 28, is an outstanding object, slightly oblong in a north-south direction. This globular has all the parameters, becoming denser towards a compact centre with stars resolved over the surface and particularly with short star spikes on the outer edges. A few references classify it as an open cluster.

The name Bennett used in some of the descriptions in this article and elsewhere refers to Jack Caister Bennett, an accomplished amateur astronomer born on 6 April 1914 in Escort, KwaZulu-Natal, South Africa. He passed away on 30 May 1990. Bennett was a dedicated South African comet-hunter who patrolled the skies in the late 1960s. He picked up a magnitude 9 supernova in NGC 5236 (M83), becoming the first person ever to visually discover a supernova since the invention of the telescope. He compiled the Bennett Catalogue, a list of 152 objects to help observers eliminate them in comet searches. The constellation Dorado contains no fewer than eleven Bennett objects: NGC 1549 = Ben 23, NGC = 1553 = Ben24, NGC 1566 = Ben 25, NGC 1617 = 25a, NGC 1672 = Ben 26, NGC 1763 = Ben 27, NGC 1783 = Ben 28, NGC 1818 = Ben 30, NGC 1866 = Ben 33, NGC 2070 = Ben 35 and NGC 2214 = Ben 36.

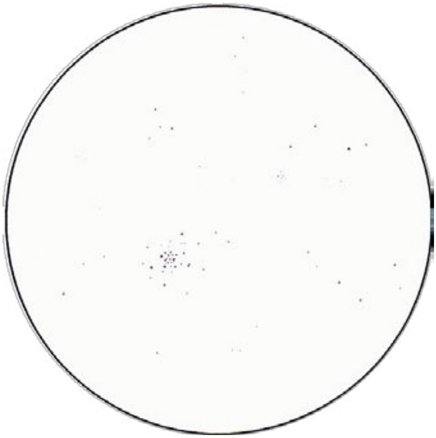
A lovely, complex area permeated with clusters and nebulosity is situated just 30 arc minutes to the south of the globular. The first impression is of three very bright irregular gas clouds that fill a field of nearly 20 arc minutes. The focus of the complex area is **NGC 1763**, also known as Bennett 27, which resembles a cocoon enveloped within a gas cloud, also the largest and brightest object in this field of view (see sketch). Careful and accurate viewing will reveal a handful of stars within the nebulosity. The cluster **NGC 1761**, situated just south of NGC 1763, displays approximately 20 faint stars well resolved. Against the very uneven flimsy nebulous complex **NGC 1760** an emission nebula situated further south displays a soft, hazy, elongated “inverted bowl” with quite a few faint stars embedded in the hazy extensions. The quite impressive dusty field can be observed through binoculars. Situated to the south-west of NGC 1763, the oblong emission nebula **NGC 1769** is part of the larger complex and impresses the observer with its bright, dense appearance, quite outstanding against the background nebulosity. The much smaller **NGC 1773** displays a round, quite bright patch of nebulosity to the north of NGC 1769, with just a few pinpoint stars in its midst. Bear in mind that the size and magnitude of the emission and diffuse nebulae are very difficult to determine. Most of the index data differs largely.

The open cluster **NGC 1818**, situated only 50 arc minutes to the east, is rather impressive and resembles a small, bright, round hazy patch with a compact middle (see sketch). With higher power a few stars of varying magnitudes form short strings within the outer regions of the cluster can be seen. I could spot the very faint glow of the unresolved smaller cluster **NGC 1810** about 6 arc minutes to the north-west. NGC 1810 shows up as a faint, roundish glow with a half-moon of faint stars towards its western side.

One of the easier and larger globular clusters to spot in the LMC can be found in the north-eastern extreme of the constellation. **NGC 1978** displays an oval that is quite bright with a very hazy impression. It could easily be mistaken for a galaxy; however, with careful observation a few extremely faint stars can be detected on its surface. What makes observation a little difficult is that the object is embedded in the flimsy haziness of the cloud. Further south-west and in the mist of the cloud one of the author's favourite small open clusters, **NGC 2004**. The group is situated 1.5 degrees north-east of the magnitude 4.8 gold-coloured theta Doradus. This cluster gives the impression of a comet flying away from a swarm of faint stars to its north-eastern side. The group displays short strings of stars with less activity towards the southern part. These are very good example of where the field of view plays a role in the characterising an object's impression.



NGC 1763, etc.



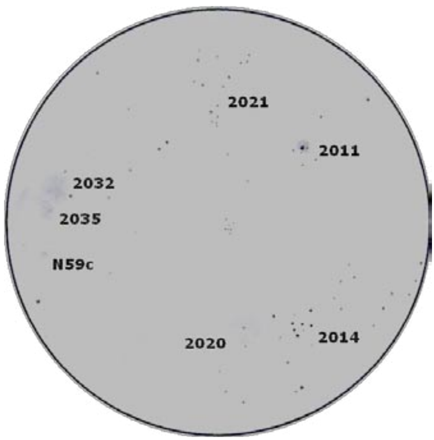
NGC 1818 and 1810

Around 8 arc minutes to the south there is a very small knot that could be an unresolved triple star. Drifting through the mists of the LMC brings to the fore many knots of faint stars interspersed with nebulosity. Using telescopes, binoculars or the naked eye, the LMC is a truly wonderful object to share with others.

NGC 2032, the larger and brighter, north-western, uneven nebula appears to move away from NGC 2035, giving it a slightly elongated appearance (see sketch). NGC 2035 is rounder, slightly fainter, with a few very faint stars embedded on the dusty surface. The two objects barely touch each other (almost like a pair of parted lips) and form the most outstanding figure in the field of view. Around the above observation was a small round patch of nebulosity just 2.7 arc minutes south of NGC 2035. All the nebulae in this area were brilliantly enhanced with an UHC Filter. The author was unable to find any data about this nebular patch, and a query was forwarded to Brian Skiff, an astronomer at Lowell Observatory. He said the object was catalogued by Karl Henize[1] in 1956 as **LHA 120-N59c**. It is centred on a 14.5-magnitude star that is obviously the star that fluoresces the circular nebula. The position of the star is: RA: 05h35.39.7, Dec: -67^{o}37'04".8 (J2000). Interestingly, the nebula is not easily found in reference data.

In the same field of view the misty NGC 2020 is situated 20 arc minutes south-east of NGC 2035. The emission nebula displays a soft, even, round glow, very smooth, that fades away into the field. The ignited star that florescence the nebula is relatively easily to see, and gives the impression of riding along on top of this glow. The magnitude 12.2 star on the southern end of the nebula is a distracting factor drawing the eye away. Nebulosity very much interweaves the lovely star grouping NGC 2014, about 5 arc minutes north-west. And although small, the relatively compact group NGC 2011 just to the north is relatively bright. NGC 2021 displays an elongated scattering of faint stars in the northern part of the complex, somewhat triangular in shape, with the triangle pointing south. A flimsy peace of nebulosity NGC 2029 is situated just east of NGC 2021 and close to the north-west edge of NGC 2035.

A very large, loose group of about 50 clearly visible stars and a handful of fainter ones are situated more or less in the middle area



NGC 2032, etc.

of the LMC. **NGC 1901** spans an area of more than 30 arc minutes. It is a very nice object to study through binoculars.

The Magellanic Cloud is home to **NGC 2070**, also known as Bennett 35, the great looped nebula situated in the south-eastern part of the Cloud and probably one of the most amazing objects in the southern night sky. Known as the **Tarantula nebula** due to the striking similarity it shows to the tarantula spider of Australia, the largest arachnid of its kind in the world, and easily spotted with the naked eye, with NGC 2070 as the Tarantula's heart. Also known as 30 Doradus, it is situated approximately 190 000 light years from earth, and is almost 600 to 700 light years in diameter. Some astronomers believe that 30 Doradus is the nucleus of this neighbourhood galaxy, but on the other hand it is not very centrally placed. The inner core consists of stars that are very hot and large, their combined radiation being responsible for its brightness, especially the brilliant cluster R136, home to the recently discovered super massive stars, several of which have masses well in excess of 200 solar masses. R136a1 starting off at 320 solar masses! See *MNASSA* Vol 69 Nos 11&12.

The very large gas nebula unfolds in long, soft, cloud-like arms, gently enfolded with dark, stripy inlays from a soft but strong inner part. With higher power the inner part displays a tight, bright overwhelming core (see sketch). Soft, nebulous gas trails and filaments extend beautifully in soft streaks of light that fade away and mingle with

NGC 2070, the Tarantula Nabula

the dark of night. The southern part of the nebula is more complex, unfolding in a veil of misty haziness. The northern part appears tighter and more defined, and with a bit of imagination a large starry spider can be seen lurking in the nebulosity. Star splinters dot the surface of this outstanding object like dewdrops on frosted glass.

Another complex group of objects is situated only 35 arc minutes south of the great Tarantula nebula in the LMC. No fewer than eight objects can be seen in a field spanning only 10 arc minutes. **NGC 2078**, a diffuse nebula, is the northern focus of four combined objects forming a clear S shape. The nebulosity around the other three – NGC 2083, NGC 2084 and NGC 2079 – is quite strongly defined, although the dusty surroundings are clearly seen.

Supernova 1987A, the titanic supernova explosion, was first observed on 23 February 1987 just to the south-east of the

Tarantula nebula. The star Sanduleak -69°202 was a magnitude 11.7 star before the outburst. It blazed with the power of 100 million suns and brightened up more than 2 000 times than it was before. Although the supernova itself is now a million times fainter than 23 years ago, light echoes are just beginning to show in the space surrounding it. Supernova 1987A was a blue super giant, with a core collapse that should have left behind a neutron star, but no evidence of that has yet turned up.

This supernova was discovered by Albert Jones of New Zealand, who has made over half a million variable observations in his lifetime. He also discovered two comets, the first in August 1946 and the second in 2000. The Minor Planet (9171) was named in his honour, but he decided to name it Carlyndiane after his wife, using her first two names. What a wonderful way to gift your wife with a piece of heaven.

References

[1] *MNASSA* Vol. 69 Nos. 9 & 10. Oct. 2010

Object	Type	RA (J2000.0)	Dec	Mag	Size
NGC 1546	Galaxy	04^h14.6	-56º04′	10.9	3.0′x1.7′
NGC 1566	Galaxy	04 20.0	--54 56	9.7	8.3′x6.6′
NGC 1617	Galaxy	04 31.7	-54 36	10.4	4.3′x2.1′
R Doradus	Mira Variable	04 36.8	-62 05	4.8-6.6	Per. 338 d
NGC 1672	Galaxy	04 45.7	-59 15	9.7	6.6′x5.5′
NGC 1763	Open Cluster/Neb	04 56.8	-66 25	8	5′x3′
NGC 1761	Open Cluster	04 56.6	-66 28	9	1.2′
NGC 1760	Emission Nebula	04 56.6	-66 32	11	2.5′
NGC 1769	Emission Nebula	04 57.7	-66 28	10	2.5′
NGC 1773	Open Cluster/Neb	04 58.2	-66 22	10	2.5′
NGC 1776	Open Cluster	04 58.7	-67 26	12	1.2′
NGC 1783	Globular Cluster	04 59.0	-65 59	11	3′
NGC 1810	Open Cluster	05 03.4	-66 23	11.9	1.2′
NGC 1818	Open Cluster	05 04.2	-66 26	9.7	3.4′
NGC 1901	Open Cluster	05 17.8	-68 26	7	40′
NGC 1978	Globular Cluster	05 28.8	-66 14	9	3.9′
NGC 2004	Open Cluster	05 30.7	-67 17	9.6	2.7′
NGC 2032	Emission Nebula	05 35.3	-67 34	10	3′
LHA120-N59c	Reflecting Nebula	05 35.6	-67 37	14	1′
NGC 2070	Emission Nebula	05 38.6	-69 05	5	30′x20′
NGC 2078	Diffuse Nebula	05 39.6	-69 45	10	1.5′

astronomical society of southern africa

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