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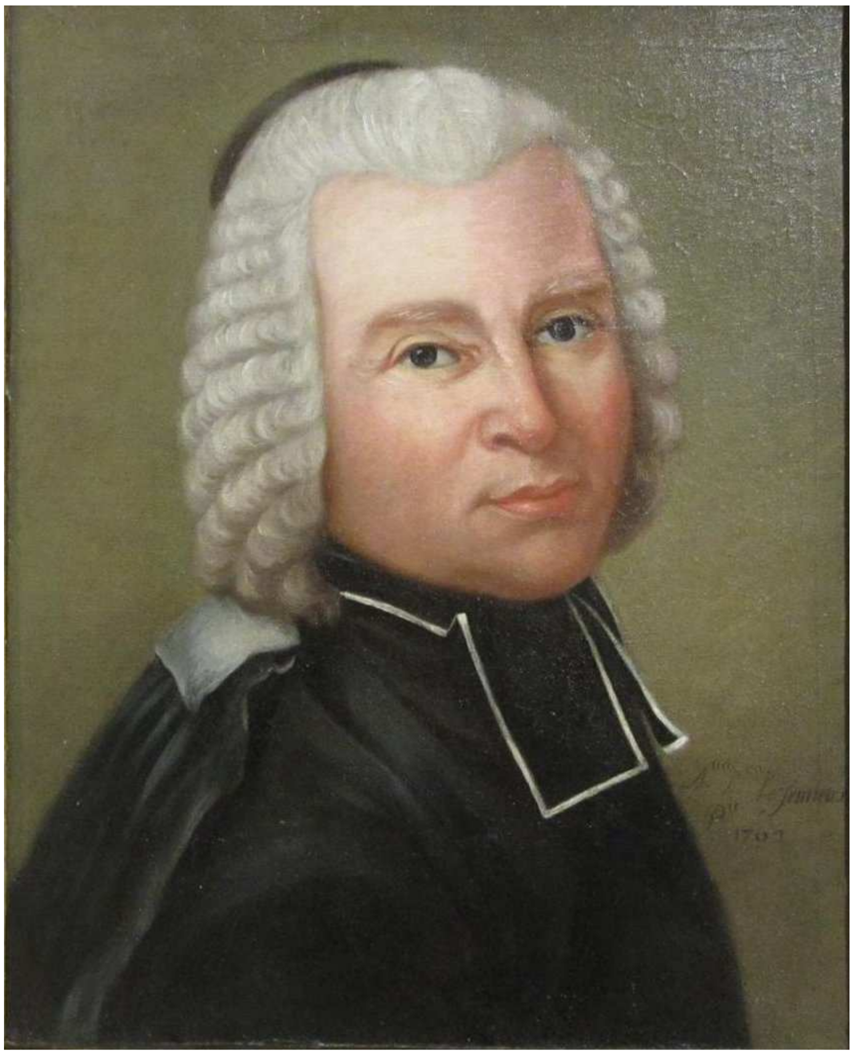

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Cover illustration: Portrait of Nicolas-Louis de La Caille by his friend Anne-Louise Le Jeuneux, dated in the year of his death, 1762.

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Tercentenary of Nicolas-Louis de La Caille

I.S. Glass (SAAO)

Nicolas-Louis de La Caille, the French astronomer who visited the Cape in 1751 to 1753 and made the first telescopic catalogue of the sky, was born just 300 years ago, on 28 December 1713. From September to December 2013 the Paris Observatory is holding an exhibition on his life and work.

La Caille came from a very religious family who hoped that he would become a priest. He did, in fact, study for the priesthood but balked at being ordained and instead became a deacon. He is often known as the Abbé de La Caille, but this was almost a courtesy title. During his student years he became more and more fascinated by astronomy and eventually landed a job at the Paris Observatory. Here his abilities became obvious and he learned to be an astronomer and also a mapmaker, specializing in large-scale surveying or geodesy.

He was appointed a professor of mathematics at the Mazarin College, a prestigious institution then part of the University of Paris. Here he had his own observatory and soon established himself as the most active French astronomer of his generation. He wrote textbooks extolling Newtonian physics, was an indefatigable calculator of all kinds of tables and, on a practical level, made very precise observations of the positions of stars and solar system objects.

To get the distances of the planets by trigonometry he decided to use the longest possible baseline, one that would stretch from Europe to Cape Town. He applied for a grant to mount an expedition and duly made the long sea voyage. He was well supported by Ryk Tulbagh, the Dutch East India Company Governor of the time and built a small observatory on the shoreline of Table Bay. Here he observed every possible night for a year and made a systematic survey of the sky south of the Tropic of Capricorn, getting the positions of about 10,000 stars.

He found it necessary to define 14 new constellations and one of these he called Mons Mensa or Table Mountain. His constellation names are still in use. He also found a number of nebulous objects but could not investigate them properly because his telescope had an aperture of only 12 mm.

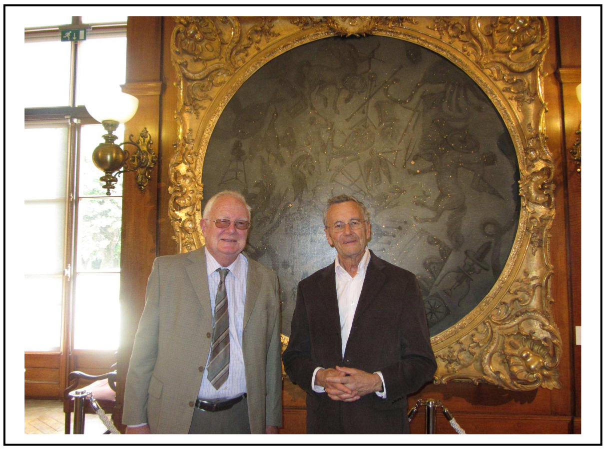
In his second year at the Cape, La Caille decided to measure the local radius of the earth. He needed to know its shape in connection with his triangulation of the planets. It had recently been found to be somewhat flattened towards the north pole and he wanted to find out if the same was true in the south, He carried out an elaborate survey from Cape Town to a spot near the Piketberg and, to his surprise, found that the earth seemed to be slightly pear shaped! [Later it was shown that the gravitational attraction of Table Mountain and the Piketberg had affected his latitude measurements].

La Caille, though a very shy man, found on his return to Paris that he had become famous. He carried on his observational programmes from his Mazarin College Observatory. His results were useful to the French mathematicians of the period who had realized that Kepler's laws were not followed exactly. The mutual interaction of the planets and the flattening of the earth were found to be causing many subtle effects that made their positions as well as that of the Moon very hard to predict with precision. Using the theories of his friend, the mathematician Clairaut, he managed to construct new tables of the Moon that were precise enough to make it a means for determining time at sea and so finding longitudes, a great boon to ships' captains.

La Caille had a number of brilliant pupils, including the chemist Lavoisier who paid tribute to the quantitative methods he had learned from his teacher. These led him to the discovery of the conservation of mass in chemical reactions. But La Caille influenced many others also including Lalande and Bailly.

The return of Halley's comet towards the end of his life was of great interest and the precise calculation of its reappearance by Clairaut was regarded as a great triumph of Newton's laws, which therefore applied to comets as well as to solid bodies like planets. It was in fact La Caille who gave Halley's Comet its name!

La Caille died relatively young, in 1762, and was given the unusual honour of burial in the vaults of the Mazarin College chapel.



Ian Glass with Prof James Lequeux, who has translated his biography of La Caille into French, in front of a giant painting of La Caille's southern hemisphere constellations made by Anne-Louise Le Jeuneux. This picture was taken at the exhibition in Paris Observatory.

Reference: Glass, I.S., 2012. Nicolas-Louis de La Caille, Astronomer and Geodesist, Oxford University Press.

The 2013 Eta Aquariids from Bredell

T P Cooper

Summary

Weather permitted continuous coverage of the eta Aquariids for the first time in many years. This fortunate occurrence allowed the author to observe the maximum activity, which peaked at around ZHR=135 $\pm$ 16 at about solar longitude ($\lambda_{\odot}$) = 45.6°, on the morning of 2013 May 6, and at about double the zenithal hourly rate observed in recent years. A total of 256 eta Aquariids were observed in 15.68 hours observation by the author. A summary of the observations and derived shower data is provided.

Background

After a period of many decades in which the eta Aquariids were characterised by few observations, this shower, the outbound debris stream from comet 1P Halley, has been better observed in more recent times. A number of articles have appeared in which the observed activity has been characterised. The author published a review paper (Cooper 1996) based largely on southern African observations during the period 1986-1995, which concluded the maximum during this period occurred at $\lambda_{\odot}$ = 43.5-44.0° and with ZHR = 60-70/hr, with the exception of 1993, when the ZHR increased to 110 on the morning of May 3 (at $\lambda_{\odot}$ ~ 43°). The paper concluded that a previous outburst above ZHR = 100 had similarly occurred in 1980. Dubietis (2003) analysed the long-term activity from both meteor showers related to comet 1P Halley, the eta Aquariids and the Orionids, and concluded the activity profiles might be cyclical, with a period of 12 years between ZHR maxima. He also drew attention to the filamentary structures present in both streams, and alluded to in the paper by Cooper. Jenniskens (2006) concluded the activity profile is asymmetric, and consists of a narrow component with maximum at $\lambda_{\odot}$ = 44.4° superimposed on a broader component, which no doubt results in the activity often observed for several days after the normal maximum, and the asymmetric nature of the overall rate profile. He concluded variations in the rate of the first component occurred depending on whether Jupiter was on the same side of the sun as earth in its orbit.

Historical rates of the eta Aquariids, and the 2013 Rate Profile

Figure 1 shows the ZHR at maximum derived from Cooper (1996) and Dubietis (2003), and from the IMO database since 2008. There is a wide scatter in peak rates, but there appears to be a general decrease in rates from the mid 1980s from ZHR ~80 down to ~50 by 2000, followed by a recovery in rates by 2010. Periods of enhanced activity can be seen superimposed on this slow cycle, for example from 1993 to 1995, and then again clearly in 2013. There is insufficient detail to enable confirmation of the aforementioned twelve year periodicity, but rather there seems to be a slow oscillation in rates with a period of perhaps several decades. Outside the years showing enhanced activity, the ZHR is normally within the limits of ZHR = ~40-80.

Similar to 1980 and 1993, the eta Aquariids again showed enhanced activity in 2013. In contrast to previous years, weather conditions allowed almost complete coverage of the rise and fall in activity, and the author logged 15.68 hours observations on all mornings from May 1 to May 8, seeing 256 eta Aquariids and 76 other meteors. The 256 shower members logged account for 20% of all eta Aquariids reported to the IMO by 57 observers globally during the 2013 apparition, and demonstrates the importance South African observations can contribute to the understanding of this important meteor shower. Alas no other South African observations were made during 2013, despite wide coverage in several daily newspapers, an ASSA Comet and Meteor Circular, and email exchanges when it was clear an outburst was underway.

The complete data set of the author is given in Appendix 1, correctly formatted as required for submission to the IMO Visual Database. Those who intend to submit observations in future should use the same format. The rate profile based on the global observations, which include those of the author, is shown as Figure 2. Rates remained low until about $\lambda_{\odot}$ = 44°, corresponding to 2013 May 4. On the morning of May 5 rates had started to increase more rapidly, and peaked about $\lambda_{\odot}$ = 45.6°, in the early hours of May 6. The shower was probably at about its peak rate as morning twilight broke, as rates remained near the same ZHR until 15h00 UT on May 6, as observed elsewhere on the globe. Rates dropped rapidly thereafter. Examination of Figure 2 shows clearly that the 2013 eta Aquariids peaked well above the historical ZHR~80, and indeed were above this level for two full days.

The findings are very close to the predictions of Sato (2013). Through orbital modelling he announced on May 4 that the earth would make a close approach to filaments of particles ejected from comet 1P Halley at its –910 and –1197 (that is 910BC and 1197BC) apparitions, resulting in two peaks or possibly one continuous peak from about 05h45 to 21h00 UT on May 6, and that enhanced activity was possible for two full days. Observations show these predictions to be very close to what happened in reality!

Meteor Characteristics

Analysis of the 256 eta Aquariids observed by the author gave an overall mean magnitude of 2.24. The mean magnitude by date is given in Table 1, along with n, the number of shower members used to determine the mean.

Date	Mean ETA magnitude	n
May 1	4.25	2
May 2	3.67	3
May 3	2.46	14
May 4	1.86	21
May 5	1.86	51
May 6	2.28	71
May 7	2.32	59
May 8	2.51	35
Mean	**2.24**	**256**

Table 1 Mean magnitude of observed eta Aquariids

While meteor rates were highest on the morning of May 6, the observed meteors were not brighter at maximum. There is a slightly lower mean magnitude on the mornings of May 4 and 5, when the mean eta Aquariid magnitude was 1.86, compared to May 6-8, when the mean was 2.34, possibly indicating slightly larger meteoroids were encountered just before the peak than after. Few fireballs were encountered during 2013, the only two magnitude –3 eta Aquariids being observed on the mornings of May 5 and May 7. These were the brightest meteors observed during the campaign. The percentage of observed eta Aquariids leaving trains was 48.8%, the percentage increasing for brighter members, which were often noticeably green.

Concomitant activity

Apart from the 256 eta Aquariids, a further 76 non-shower members were logged, including 22 May Capricornids (Wood), 1 April Lyrid, 3 alpha Scorpiids, and 50 meteors logged as sporadic. These sporadic meteors are the remainder which could not be assigned to any known radiants, or in a small number of cases there was some doubt as to their radiant assignment. However, a number of the meteors logged as sporadic were observed to emanate from specific regions of sky. Several meteors were noted to emanate from Aquila, and ten from the region of Grus or Piscis Austrinus. This latter activity may be significant, as on the morning of 2003 May 4 the author noted more than a dozen meteors in 2.0 hours emanating from a similar region, the plotted paths indicating a radiant at 335°, -28°. There is no previous activity noted from this radiant either in Jenniskens (2006) or Wood. The author intends to observe the region with low-light video in the future to confirm the presence of any radiants active around the time of the eta Aquariids.

Conclusions

The eta Aquariids underwent enhanced activity in 2013, with peak rates about double those of recent years, and peaking at $\lambda_{\odot}$ = 45.6°, a little later than the published date for Jenniskens first peak. Intensive observations are requested for 2014 with greater participation from ASSA members to confirm whether the 2013 activity continues at the enhanced rate. The moon will pose no hindrance, and conditions are excellent again to monitor the rise to and fall from maximum.

Acknowledgements

Data used in the preparation of Figures 1 and 2 was obtained from the web-site of the International Meteor Organisation at www.imo.org and is reproduced with kind

permission of Geert Barentsen. Comments from Peter Jenniskens are gratefully acknowledged.

References

Cooper T.P., 1996, *A decade of visual eta Aquariid meteor observations*, WGN 24:5, pp157-161.
Dubietis A., 2003, *Long-term activity of meteor showers from Comet 1P/Halley*, WGN 31:2, pp43-48
Jenniskens, P., in *Meteor Showers and their Parent Comets*, Cambridge University Press, 2006.
Sato, M., communication posted to the '*meteorobs*' mailing list on 2013 May 4.
Wood J., private communication, *A list of Southern Hemisphere Meteor Streams prepared from observations made over the period 1970-1981*.

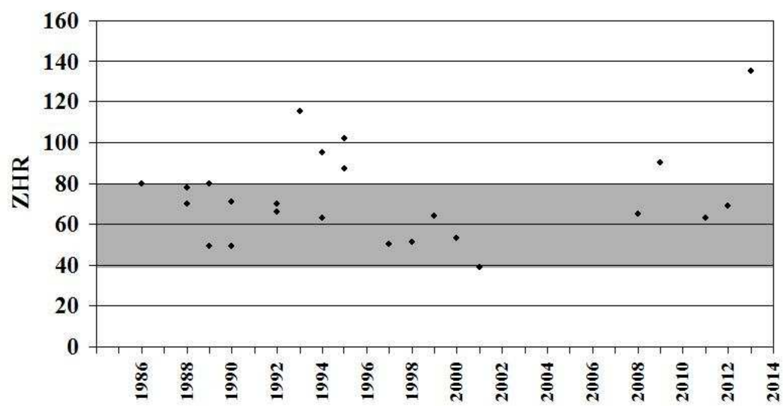


Fig 1. Variation in annual ZHR of the eta Aquariids. The normal annual range in ZHR is represented by the grey bar.

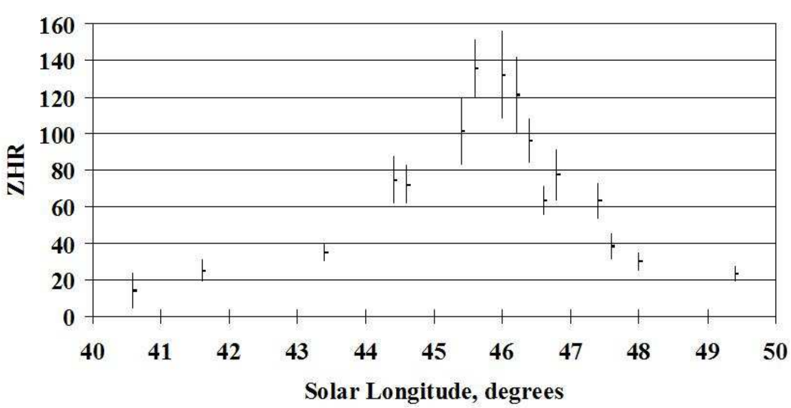


Fig 2. Rate profile of the 2013 eta Aquariids.

Appendix 1

SHOWERS OBSERVED :	ETA=eta Aquariids	SPO=sporadics
	MCP=May Capricornids	ASC=alpha Scorpiids
	LYR=Lyrids	

HOURLY RATES

Date 2013	Time UT	Field α,δ	T eff hours	F	LM	ETA	MCP	LYR	ASC	SPO	Total
Apr 30/May 1	0128-0228	322, -5	1.00	1.0	5.20	1	0	0	0	2	3
Apr 30/May 1	0228-0328	322, -5	1.00	1.0	5.30	1	2	0	0	4	7
May 1/2	0130-0230	330, -10	1.00	1.0	5.00	1	2	0	0	0	3
May 1/2	0230-0330	330, -10	1.00	1.0	5.15	2	0	0	1	2	5
May 2/3	0128-0228	330, -10	1.00	1.0	5.25	9	0	0	0	3	12
May 2/3	0228-0328	330, -10	1.00	1.0	5.40	5	1	0	0	5	11
May 3/4	0130-0230	320, +05	1.00	1.0	5.30	6	2	0	0	2	10
May 3/4	0236-0336	335, +10	1.00	1.0	5.50	15	0	0	0	3	18
May 4/5	0134-0204	327, +02	0.50	1.0	5.60	7	1	1	0	1	10
May 4/5	0204-0234	327, +02	0.50	1.0	5.65	15	1	0	0	0	16
May 4/5	0234-0304	327, +02	0.50	1.0	5.75	11	1	0	1	0	13
May 4/5	0304-0334	327, +02	0.50	1.0	5.80	18	1	0	0	1	20
May 5/6	0129-0159	322, -05	0.50	1.0	5.65	9	1	0	1	3	14
May 5/6	0159-0229	322, -05	0.50	1.0	5.65	18	3	0	0	1	22
May 5/6	0229-0244	322, -05	0.25	1.0	5.70	11	0	0	0	0	11
May 5/6	0244-0259	322, -05	0.25	1.0	5.70	10	0	0	0	1	11
May 5/6	0259-0314	322, -05	0.25	1.0	5.70	11	0	0	0	0	11
May 5/6	0314-0329	322, -05	0.25	1.0	5.75	13	1	0	0	0	14
May 6/7	0128-0200	322, -05	0.51	1.0	5.80	15	1	0	0	4	20
May 6/7	0200-0230	322, -05	0.50	1.0	5.80	15	1	0	0	2	18
May 6/7	0245-0315	322, -05	0.50	1.0	5.70	16	0	0	0	3	19
May 6/7	0315-0330	322, -05	0.25	1.0	5.70	12	0	0	0	0	12
May 7/8	0131-0201	322, -05	0.50	1.0	5.47	5	0	0	0	4	9
May 7/8	0201-0231	322, -05	0.50	1.0	5.55	8	1	0	0	3	12
May 7/8	0238-0308	322, -05	0.50	1.0	5.60	12	3	0	0	1	16
May 7/8	0308-0334	322, -05	0.42	1.0	5.65	10	0	0	0	5	15
Total			15.68			256	22	1	3	50	332

Lyrid May 5 maybe eta Lyrid, seen in peripheral vision
May Cap = combined alpha, gamma and omega Capricornids

MAGNITUDE DISTRIBUTIONS

SHOWER	DATE	LM	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
ETA	Apr 30/May 1	5.20	0	0	0	0	0	0	0	0.5	0.5	0	0
ETA	Apr 30/May 1	5.30	0	0	0	0	0	0	0	0	0	1	0
ETA	May 1/2	5.00	0	0	0	0	0	0	0	0	0.5	0.5	0
ETA	May 1/2	5.15	0	0	0	0	0	0	1	0	0.5	0.5	0
ETA	May 2/3	5.25	0	0	0	0	0	4	0	1.5	3	0.5	0
ETA	May 2/3	5.40	0	0	0	1	0	0	1	1.5	1.5	0	0
ETA	May 3/4	5.30	0	0	0	0	1	1	1	1	1.5	0.5	0
ETA	May 3/4	5.50	0	0	0	2	2	2	3.5	4.5	1	0	0
ETA	May 4/5	5.60	0	0	0	0	1	2	0	1	2	1	0
ETA	May 4/5	5.65	0	0	1	1	0	4	4.5	4	0.5	0	0
ETA	May 4/5	5.75	0	1	0	0	1	2	2.5	2.5	2	0	0
ETA	May 4/5	5.80	0	0	2	0	3	2	2	5.5	2.5	1	0
ETA	May 5/6	5.65	0	0	0	0	0	4	2	2	0	1	0
ETA	May 5/6	5.65	0	0	0	1	2	3	6	3	1.5	1.5	0
ETA	May 5/6	5.70	0	0	0	1	2.5	1.5	3.5	1.5	1	0	0
ETA	May 5/6	5.70	0	0	0	1	2	2	0	0	3.5	1.5	0
ETA	May 5/6	5.70	0	0	0	0	2	3	2	1.5	1	1.5	0
ETA	May 5/6	5.75	0	0	0	0	0	1	2	2.5	4	3.5	0

ETA	May 6/7	5.80	0	0	0	0	2	1	2.5	5	2.5	2	0
ETA	May 6/7	5.80	0	0	1	2	3	4	1.5	1	2.5	0	0
ETA	May 6/7	5.70	0	1	1	0	0	1	2	7.5	2.5	1	0
ETA	May 6/7	5.70	0	0	0	0	1	1	1.5	1.5	4.5	2.5	0
ETA	May 7/8	5.47	0	0	0	0	0	0.5	0.5	3.5	0.5	0	0
ETA	May 7/8	5.55	0	0	1	0	1	1	2	2	0	1	0
ETA	May 7/8	5.60	0	0	1	0	1	0	2	6	2	0	0
ETA	May 7/8	5.65	0	0	0	0	1	0	1.5	4	0.5	3	0
MCP	Apr 29/30	5.30	0	0	0	0	0	0	0	2	0	0	0
MCP	May 1/2	5.00	0	0	0	0	0	1	1	0	0	0	0
MCP	May 2/3	5.40	0	0	0	0	0	0	0	0	0	1	0
MCP	May 3/4	5.30	0	0	0	0	0	0	0	1	1	0	0
MCP	May 4/5	5.60	0	0	0	0	0	0	0	0	0	1	0
MCP	May 4/5	5.65	0	0	0	0	0	0	1	0	0	0	0
MCP	May 4/5	5.75	0	0	0	0	0	0	0	1	0	0	0
MCP	May 4/5	5.80	0	0	0	0	0	0	0	0	0	1	0
MCP	May 5/6	5.65	0	0	0	0	0	0	0	1	0	0	0
MCP	May 5/6	5.65	0	0	0	0	0	0	2	0	1	0	0
MCP	May 5/6	5.75	0	0	0	0	0	0	0	0	0.5	0.5	0
MCP	May 6/7	5.80	0	0	0	0	0	0	0	1	0	0	0
MCP	May 6/7	5.80	0	0	0	0	0	0	0	0	1	0	0
MCP	May 7/8	5.55	0	0	0	0	0	0	0	0	1	0	0
MCP	May 7/8	5.60	0	0	0	0	0	0	0	2	1	0	0
LYR	May 4/5	5.60	0	0	0	0	0	0	1	0	0	0	0
ASC	May 1/2	5.15	0	0	0	0	0	0	0	0.5	0.5	0	0
ASC	May 4/5	5.75	0	0	0	0	0	0	1	0	0	0	0
ASC	May 5/6	5.65	0	0	0	0	1	0	0	0	0	0	0
SPO	Apr 30/May 1	5.20	0	0	0	0	0	0	1	1	0	0	0
SPO	Apr 30/May 1	5.30	0	0	0	0	1	0	0.5	1	1.5	0	0
SPO	May 1/2	5.15	0	0	0	0	0	0	1.5	0.5	0	0	0
SPO	May 2/3	5.25	0	0	0	0	0	0	1.5	1.5	0	0	0
SPO	May 2/3	5.40	0	0	0	0	0	0	1	1.5	2.5	0	0
SPO	May 3/4	5.30	0	0	0	0	0	0	1	0.5	0.5	0	0
SPO	May 3/4	5.50	0	0	0	0	1	1	0	0	1	0	0
SPO	May 4/5	5.60	0	0	0	0	0	0	1	0	0	0	0
SPO	May 4/5	5.80	0	0	0	0	0	0	1	0	0	0	0
SPO	May 5/6	5.65	0	0	0	0	0	0	2	1	0	0	0
SPO	May 5/6	5.65	0	0	0	0	0	0	0	0	0	1	0
SPO	May 5/6	5.70	0	0	0	0	0	0	0	1	0	0	0
SPO	May 6/7	5.80	0	0	0	0	0	1	0	1	1	1	0
SPO	May 6/7	5.80	0	0	0	0	0	1	0	0	0	1	0
SPO	May 6/7	5.70	0	0	0	0	0	1	1	0	0	1	0
SPO	May 7/8	5.47	0	0	0	0	1	0	0	1	1	1	0
SPO	May 7/8	5.55	0	0	0	0	0	0	0	0	1.5	1.5	0
SPO	May 7/8	5.60	0	0	0	0	0	1	0	0	0	0	0
SPO	May 7/8	5.65	0	0	0	0	0	0	2	1	2	0	0

Observations of Comet C/2012 F6 (Lemmon)

T.P. Cooper

Summary

Comet C/2012 F6 Lemmon (hereinafter referred to simply as Comet Lemmon) peaked at around 4th magnitude in March 2013, and became an easy binocular object. This article summarises the observations and images made by several observers and sent to the author. Comet Lemmon was discovered on 2012 March 23. The first reported observation by ASSA members was by the author, who observed the comet visually on 2013 January 24, estimating the total cometary magnitude (m1) as 7.5. From then on the comet was reasonably well observed visually and photographically, though by only a few observers, until it became too close to the sun in mid March 2013. The comet was at perihelion on 2013 March 24, and was recovered in the morning sky on 2013 April 9, again by the author, and observed until May 7 when poor weather conditions prevented any further observations. The comet was placed too far north for observation thereafter. Note all dates in this article are in UT.

Visual Observations

Comet Lemmon was observed visually by Magda Streicher (ICQ Code STR03), Richard Ford (FORxx) and Tim Cooper (COO02). These observations included total cometary magnitude (m1) as well as coma size and degree of condensation (DC). Few visual observations were reported of the tail, which shows well in the images of this comet (see Plates 2 and 3). An examination of the images however indicates the presence of a bright ion tail, but the absence of a bright dust tail. While the tenuous ion tail shows up well in photographs, it is difficult to see visually and is generally rendered invisible by the light pollution suffered by all three visual observers, who reside nearby to large cities. Estimates of m1 are shown in Figure 1 based on 5-day bins. A curve has been added by the author that best fits the magnitude observations. These are generally in good agreement with the curve, except for the period around late February to early March 2013, when the comet was low above the evening horizon making brightness estimation difficult for the aforementioned reasons of light pollution. The curve indicates a general increase from about magnitude 8 in late January 2013, peaking at slightly fainter than magnitude 4 in late March, and then fading to magnitude 8 again by late May. Hence the comet was brighter than magnitude 8 for about four months, during which time it was a fine object in binoculars. More the pity that only three observers contributed any visual observations of this comet. There are also unfortunately too few visual observations to define the brightness parameters according to the standard formula with any accuracy. However, using the combined pre- and post-perihelion observations, I derive the general equation for the brightness behaviour as:

$$m1 = 5.6 + 5 \log \Delta + 15 \log R$$

and from which the absolute magnitude of the comet H_0 = 5.6 (Δ = R =1au), and the slope factor n = 15/2.5 = 6. This value of the slope factor is rather atypical of long period comets, which typically have n<4 (Green 1997), but the value has been determined from a rather small arc of the comets orbit. Note Δ is the geocentric distance of comet, and R is the heliocentric distance of the comet.

The visual descriptions reported in addition to the aforementioned observations are as follows:

2013 Jan 24.08, in 30cmT, f/10 x117, prominent, stands out from the star background, quite condensed, central coma punctuated by faint star-like point and surrounded by considerable wispy outer coma. Slightly hazy sky and optics dewed by 02h10UT [COO02].
2013 Feb 2.82, in 30cmT, f/10 x95, bright and easy shining with an overwhelming appearance, outer coma is very hazy with a misty and washed-out effect, small very bright core, but not quite star-like, size of the core estimated as 0.8’ perhaps slightly uneven in shape. Coma appears to be slightly greenish [STR03].
2013 Feb. 6.81, In 30cmL f/8 x75 coma moderately condensed, looks like an out of focus halo of soft light, measures 11x8’. Blesfontein Guest Farm, Sutherland, crystal clear sky, stars magnitude 6 and fainter visible to NE [FORxx].
2013 Feb 7.79, in 30cmL x75, hint of tail visible. Coma moderately condensed, DC=5. Blesfontein, Sutherland [FORxx].
2013 Feb 9.80, in 5.0B x10, coma more condensed, DC=7, fine details discernible in outer coma. In 30cmL x75, spurious outer coma, suddenly bright towards the centre, elongated, size 11x8’. Blesfontein, Sutherland [FORxx].
2013 Feb 15.78, outer coma considerably brighter and coma more condensed, DC=7, with bright stellar point in centre, tail visible but very difficult to discern. Perdeberg, Cape, fainter parts of the Milky Way barely visible, slight haze limited to the horizon did not interfere [FORxx].
2013 Feb 16.81, coma appears more condensed in 5.0B x10, DC=7. In 30cmL x75 outer coma very much brighter, oval shaped, 12x9’, DC=5 with central point almost stellar, tail visible but difficult to discern [FORxx].

2013 Feb 22.75, 5.0B x16, very prominent, stands out from the star background but clearly fainter than NGC 104 (47 Tuc), quite condensed, suddenly bright towards the centre, DC=6, hint of tail visible but difficult in light of bright gibbous moon [COO02].
2013 Mar 4.73, bright aspect and readily discernible despite low altitude of 16° though much less conspicuous than 47 Tuc. DC=6/. In 30cmT x117, very bright central coma punctuated by bright central point almost stellar in appearance, surrounded by considerable diffuse glow which fills the field. Poor conditions with a lot of low hazy cloud, especially towards west in the direction of the comet [COO02].
2013 Mar 8.73, becoming difficult in low haze, smaller than previous but appears slightly more condensed, DC=7, no extinction co-efficient applied as comparison stars selected at same altitude as comet [COO02].
2013 Apr 9.14, first observation in early morning after perihelion, comet remains bright and easy despite low altitude, and followed well into bright twilight, remains quite condensed, DC=7 [COO02].
2013 Apr 16.12, still easy in 5.0B x16 despite haze and some cloud after frontal system and heavy dew, and altitude only 25°. Quite condensed, DC=7.
2013 Apr 22.16, slightly less condensed than prev., DC=6, and smaller, 3.3' versus 4'. In 30cmT x117 very bright central condensation surrounded by conspicuous outer coma and slight hint of bright point in the centre [COO02].
2013 May 3.15, noticeably smaller (2.5') and fainter but still very evident, DC=6 [COO02].
2013 May 5.15, readily visible as a well-defined circular smudge, DC=6, appears larger than prev., ~6', but conditions also excellent with clear sky after passage of cold front, and no lights due to general power failure(!), and despite nearby 23% moon. A very satisfying observation [COO02].
2013 May 7.15, appears slightly brighter than prev., coma diameter 5.5', DC=6/, slight hint of tail visible in position angle (p.a.) 280°. Crescent moon nearby. Last observation [COO02].

Images

Photographic images were submitted by Kos Coronaios, Auke Slotegraaf and Mauritz Geyser. A selection of the images and cometary data derived from them by the author is given as follows:

Plate 1 is the first image received from Kos Coronaios, taken on 2013 Jan 30.77, when the comet was around visual magnitude 7, and circumpolar located in Chameleon. He used a 300mm lens on a Canon 60D camera set at ISO1600, 30 second exposures, stacking nineteen exposures to arrive at the final image. The three bright stars, starting just below the comet and moving clockwise are SAO257025 (mag 7.1), SAO257019 (mag 5.8) and SAO257011 (mag 6.4). Closer examination of the original image shows a faint extension in position angle (p.a.) 308°, probably the early development of the tail. This p.a. is consistent with the anti-solar vector of 300° on this date. The original image shows clearly the green colour characteristic of fluorescence of diatomic carbon (C_2) at a wavelength of 516.5nm, the so-called Swan Band.

Plate 2 is another image from Kos Coronaios, taken on 2013 Feb 17.75, ten 30 second exposures with the same camera set-up as Plate 1, but at prime focus of a 20cmT f/10 telescope. The image is oriented north towards the right, with east at the top. The comet was then about visual magnitude 6, having brightened one full magnitude in the eighteen days since Plate 1 was taken. More evident is the development of the ion tail, which I measure as 1.1° in length in p.a. 151°. Close inspection shows the ion tail to be split into two separate streams outward of 24' from the centre of the coma. The brightest star to the lower left of the comet is magnitude 6.9 SAO255567. The bright globular cluster 47 Tucanae is located just outside the frame at upper left, only 5° from the comet.

Plate 3 was taken by Mauritz Geyser on 2013 Mar 1.81, using a Canon EOS Rebel T1i (500D) camera set at ISO400, Sigma 70-300mm APO DG f/5.6 lens set at 300mm focal length. The final image is the combination of 3 one minute exposures, with the comet now about magnitude 5. North is to the right and east is at the top. From his image I measure the tail length as 1.3° in p.a. 156°. The tail is quite sharp for the first 10' where it appears twisted and broadens from here outwards. The green colour is again very evident.

Plate 4 was taken by Mauritz Geyser on 2013 Mar 9.77 to 9.79, using a Canon EOS 500D camera at prime focus of a 20cm f4.9 Newtonian (focal length 1000mm), and is a composite of 35 thirty second images at ISO1600. The resulting image was processed by applying an unsharp mask to bring out fine details in the tail. I measure the overall tail length as 0.6° in p.a. 162°, but several other sharp features are visible apart from this main tail.

Kos Coronaios was also able to secure a final image of the comet in the early morning sky after perihelion, on 2013 Apr 16. From his image I was able to determine a tail length of 0.5° in p.a. 222°.

Auke Slotegraaf used his image taken on 2013 Jan 26.09 to determine the brightness by aperture photometry. He used the 2-circle aperture photometry routine in IRIS to compare the brightness of the comet with globular clusters NGC 4833 and 4372. Using the V magnitudes for the clusters from Harris's list (7.8 and 9.8 respectively) he arrived at a magnitude of 7.5 for the comet, almost in exact agreement with the total magnitude at that date in Figure 1.

References

Green 1997, D.W, in Guide to Observing Comets, published as a Special Edition of the ICQ, p3

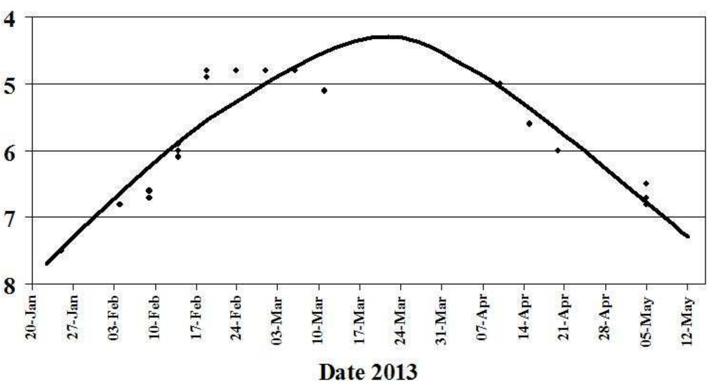


Fig. 1. Light curve of Comet Lemmon from visual Observations.

Plate 1. Image by Kos Coronaios taken on January 30.

Plate 2. Image by Kos Coronaios taken on February 17.

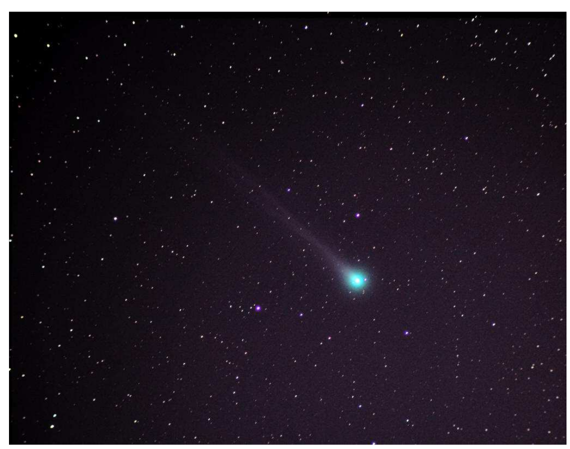


Plate 3. Image by Mauritz Geyser taken on March 1.

Plate 4. Image by Mauritz Geyser on March 9

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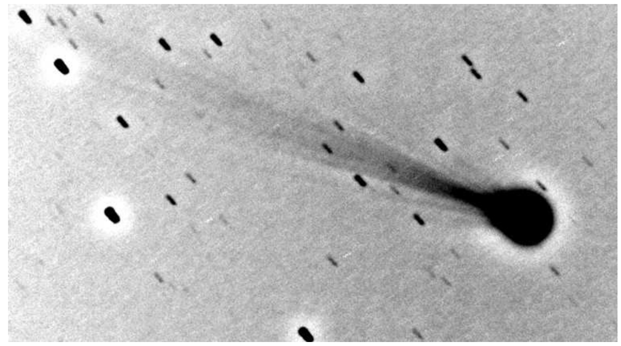

Amateur Optical Tracking in South Africa

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Abstract: This is the first of what is planned to be several articles covering the history of amateur satellite tracking in South Africa during the period 1957 to the present. It will concentrate almost exclusively on optical tracking rather than being a complete record of optical and radio tracking. Whilst it will mainly cover amateur activity some professional astronomers played leading roles for the first year or so.

Besides the **Moonwatch** organisation several other organisations were interested in satellite optical observations and they will also be discussed. Each of the various **Moonwatch** stations will be described, and illustrated where possible, in numerical order of their station identification by COSPAR which was established by the International Council of Scientific Unions in October 1958 to continue the cooperative programmes of rocket and satellite research undertaken during the International Geophysical Year (IGY) of 1957-58.

Introduction

Several books and articles have been written about the **Moonwatch** project, rated by many as one of the most successful collaborations between amateurs and professionals in the field of scientific research, but coverage of the South African contribution is rather limited. It was therefore felt necessary to detail as much as possible within the context that much has already been lost since the majority of the participants are now deceased. The author is possibly the youngest person from this era that is still alive so decided some years ago to start collecting material on the South African contribution. It is far from complete but it is hoped that sufficient information is provided so that if any future "follow-up" is done by a more qualified "historian" at least there is a foundation to work on. Unfortunately a great deal of what will be described covers the author's personal experiences and memories, but sometimes the memory is lacking on the dates of certain events.

If any readers can offer any additional information on any of the various aspects covered, particularly photographs, it would be greatly appreciated if they contact the author, so that, where possible, a more balanced report can be given. He is also open to correction in a few cases, but hopefully there are not too many errors! Some are no doubt due to the authors failing memory but some may come from incorrect information to start with. Relatively little was published by the respective satellite observing stations during their operating lifetime.

The Moonwatch Program

In 1955 the United States National Academy of Sciences and the National Science Foundation, acting for the U.S. National Committee of the IGY gave the Smithsonian Astrophysical Observatory (SAO), under director Dr. Fred L. Whipple, the responsibility for the optical tracking of U.S. artificial satellites launched during the period of the IGY. This ran from 1 July, 1957 to 31 December, 1958. Strangely no specific plans were made to continue after this date. It was felt that the tracking of such satellites was a task best suited for astronomers and no one knew the exact means by which mathematicians and astronomers would determine the orbit of a satellite nor prepare predictions, which meant that the optical satellite tracking program was not only a field operation but also a case of "feel as you go" in a program of scientific research involving many unknowns.

Whipple proposed a fast large-aperture Schmidt type optical system (based on his experiences with fast cameras for meteor research) for photographing the satellites that eventually resulted in the precision optical tracking camera known as the Baker-Nunn (BNC) camera (see MNASSA Vol.71 Nos 5 & 6. P104/5) but Whipple also realised that in order for the few cameras to be constructed (due to limited funds) to operate efficiently it was necessary to know where the satellite was and proposed that teams of amateur visual observers be set up to acquire the satellite in its first

few orbits. The problem was presented to Miss Grace G. Scholtz (later to be Mrs. Armand Spitz) of the United States Astronomical League and she organised a committee to recruit observers and work out some techniques and the equipment required.
The Astronomical League sent out a plea for volunteers interested in participating in the visual observing program and the response was immediate and rather overwhelming which presented a problem in administration - a problem which persisted for most of the IGY!

Although the program was to be operated on a volunteer basis, each individual member had to be selected for their skill and willingness to accept responsibility and to undertake what would prove to be a fairly arduous and time-consuming job with the only reward being the knowledge that their work would be of scientific value and that without their efforts, and hundreds like them, the satellite might become lost. In Feb 1956 the Smithsonian Observatory appointed Dr. Armand N. Spitz to coordinate these efforts.

Recruitment for the program began and in July 1956 the Smithsonian Astrophysical Observatory published its first **Bulletin for Visual Observers of Satellites** which appeared in the magazine **Sky and Telescope** and in which the title **Moonwatch** was officially adopted for the program.

The requirements for an individual to participate in the program were outlined. The Central Computing Bureau for receiving and evaluating optical observations would only accept observations despatched by the appointed **Moonwatch** team leader who would only accept and forward observations made at the site for his selected group. Thus no "lone-wolf" observer was welcome or provided for - each individual had to act in co-operation with his group if his observations were to have any value or even be considered.

All observations by a group must, in turn, be made from a stated geographical position, as predetermined and recorded in the central computing bureau in the memory system of the computing machine which had rather limited capacity and only had room for a limited number of stations.

These very rigid requirements were essential for several reasons:

1. The precise observation of a satellite's position in the sky is worthless unless the observer's geographical position was accurately known at the computing centre

for immediate use in computations. This still applies today - people reporting satellite observations have to state their geographical position unless they are recognized observers to the reporting centre.

2. The computing system could only deal with a limited number of such stations, so it would not be possible to investigate reports from isolated observers to determine their possible value.

3. The satellite program depended on volunteer observing groups setting up an "optical fence" to prevent any possibility that a satellite might slip through successive zones of observation without being seen. Even if it were possible to screen the scattered reports of isolated volunteers, the number of such observers would have to be impossibly large to guarantee that the satellite would be detected by their unorganised search.

Whipple recognised that "lone-wolf" observers probably had the experience and equipment to produce useful results but how was it possible to know what was useful and what was not. The program, he insisted, would function best using teams of amateurs - it was not for the lone wolf observer.

A total of 9 bulletins appeared in **Sky and Telescope** and covered such topics as organization, qualifications for observers and operational procedures. A basic **Moonwatch** telescope was defined which became known as the **Moonwatch Monoscope** - a name that fortunately did not survive for long! Under ideal conditions it was expected to be able to acquire a satellite as faint as magnitude +8 which was the expected brightness of the first US satellite to be launched. The satellite was subsequently made smaller which meant it was fainter - in fact too faint for the original telescope requirements.

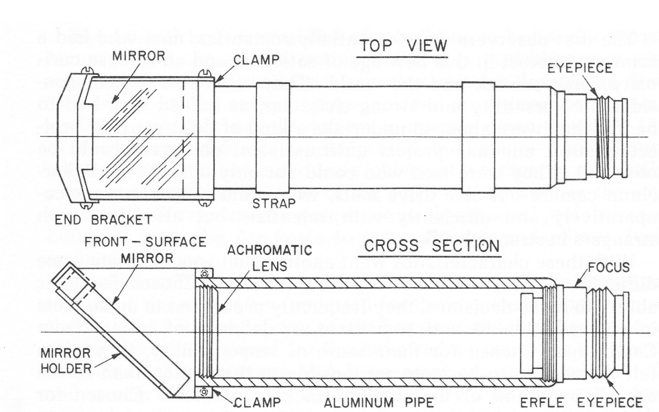


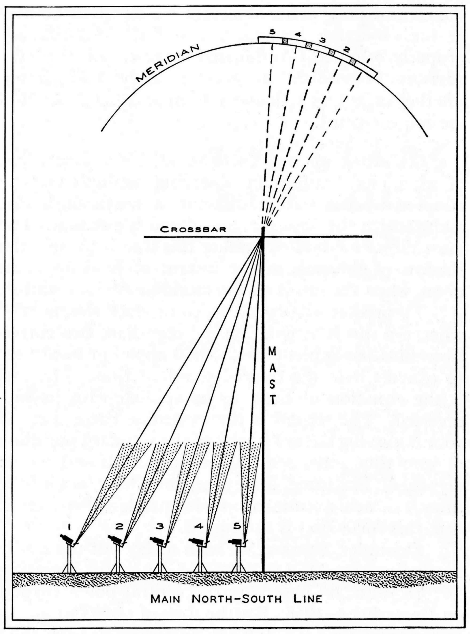
Figure 4. — Schematics of 50-mm. Moonwatch monoscope.

Fig. 1. Design of 50mm MOONWATCH 'scope.

The Smithsonian Observatory did not have the funds to provide instruments for the numerous teams so it was necessary for individual teams to make or purchase their own telescopes, or rely on the generosity of others to support the project.
Early in 1957 a **Moonwatch** steering committee under Dr. George van Biesbroek of the Yerkes Observatory was set up. Leon Campbell, Jr. had already been appointed supervisor of **Moonwatch**.

Moonwatch Station Requirements and how it should Operate

In "Bulletin No 2 for Visual Observers of Satellites" the layout and organization of a **Moonwatch** station was defined. The basic principle was that there would be a team of observers, each of whom maintained continuous watch during the observing session of a specified sky area lying on the celestial meridian. These areas had to overlap so that the satellite could not cross this meridian fence without hopefully being detected.



When the observing instruments are set up along the main north-south line of the station, each one will be oriented by means of the junction of the mast and the crossbar. The upper part of the diagram shows how the respective 12-degree fields overlap on the celestial meridian.

The team leader of each station had the responsibility of recruiting and selecting observers. Although it was expected that many people would volunteer to offer their services, the team leader had to select for his senior observers only those whose experience indicated both reliability and observing skill and they would man the main north-south, or meridian fence.

Fig. 2. (left) How a Meridian Fence is set up.

Each person on this fence would be assigned one specific area along the celestial meridian for which he was responsible. A vital requirement was that the observer not leave his post during the observing session for any reason in case the satellite should slip through during his absence. Alternate observers could be available, if there were suffcient observers, to act in the event of unavoidable absences of senior observers, or to spell them if their eyes become fatigued. It was strongly emphasized that looking for a satellite was a serious task and the usefulness to the professional optical tracking network might be seriously impaired if some visual observer failed to stay faithfully at his post. Since an observing spell could last as long as 90 minutes, or even longer, this could present problems for those with, say, a weak bladder!

Desmond King-Hele - a world expert on satellite theory as well as being an optical satellite tracker neatly summed up the objectives of **Moonwatch** in Technical report No 64087 released by the Royal Aircraft Establishment (UK) in 1964:
Moonwatch assignments are in three general categories: Routine, Pre-entry and Final entry, the accomplishment of which involves various observational techniques.

Routine observation requires a high degree of accuracy for useful results, but when predictions are generally very accurate, object acquisition is easy and high-power, small-field instruments can be used.

Although in most cases the best observations are made through utilization of star patterns and celestial co-ordinates, a few observers have successfully recorded positions in altazimuth by using carefully machined, mounted and calibrated instruments. Experienced **Moonwatch** observers generally follow some or all of the following procedures:

1. The satellite position is estimated within a recognizable star pattern; the pattern is located on a star chart and the position measured from chart grids.

2. Satellite transit of a reference reticle is compared with the transit of a known star; chart position of the star is measured, with subsequent determination of satellite position.

3. Satellite image is made to coincide with the optical axis; instruments altitude and azimuth are read for satellite position.

4. Events are timed by stopwatches compared with radio time signals, or even a two-channel magnetic tape recorder by recording simultaneously the observers voice and radio time signals.

Pre-Entry Observing and Final entry observations were also described in some detail but will not be repeated here.

Two teams of amateur astronomers were organised by the Union Observatory under the leadership of Dr. Charles Neil Williams in Johannesburg and Roy Smith in Pretoria. Together with a team in Hawaii these were the first teams registered outside the USA. This was followed by a team in Cape Town under Dr. David. S. Evans. Boyden also recruited a team under Dr. J. Stock.

The four teams were first equipped with the ordinary 2-in aperture "**Moonwatch**" telescopes, for which the optical components were presented by the South African Council for Scientific and Industrial Research (CSIR) as part of its contribution to the IGY. Teams of amateur observers with a stiffening of professionals from the observatories were organised. Communications facilities in the form of teleprinter machines connected to the Cable and Wireless Office in Cape Town were provided by the South African Post Office. A visual co-ordinator - Dr David S. Evans - was appointed by the South African National Committee of the IGY to concert the efforts of the teams.

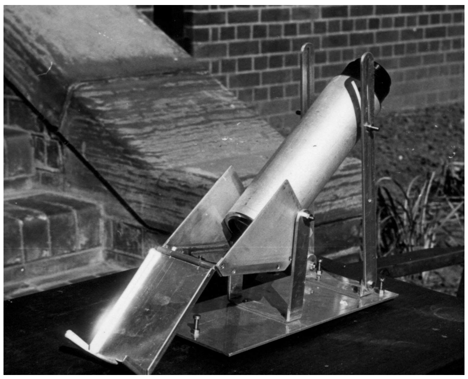


Fig. 3. Moonwatch 2-inch 'scope assembled by the Union Observatory.

The organization had to be modified when the first Russian earth satellites were launched, before the United States efforts, as this was basically totally unexpected and the teams were not even set up, organised or even had the required equipment, but a considerable number of observations of these were obtained, the Johannesburg team being particularly active.

In "The Bulletin for Visual Observers of Satellites" Number 9 July 1958 we find:

The need to detect satellites, which may be very high and faint, has led to the organisation of seven apogee Moonwatch stations, strategically located and equipped with batteries of special telescopes. Early in 1957 Naval Research Laboratory (NRL) calculations showed that some Vanguard IGY satellites might rise as high as 2500 miles, where a 21-inch sphere would be no brighter than 11th magnitude, well beyond the reach of the 5.5 power standard **Moonwatch** telescopes. The 5.5 power instrument could detect satellites as faint as 8th magnitude against a dark night-time sky; the Army M-17 8-power telescope would reach the 9th magnitude; so for very faint satellites a much larger instrument would be required.

Fig. 4 (above) The author's M17 today

Towards the end of 1957 it was arranged that the teams at Cape Town and Bloemfontein would be equipped with 5-in aperture so called "Apogee" telescopes designed to see the smaller US satellites when at maximum distance, ie at apogee. Forty-nine such telescopes, complete with mountings, were supplied to each of Cape Town and Bloemfontein.

FIG. 5. The author's Apogee telescope set up in Kenilworth

Installation of this equipment was in progress when the United States Explorer 1 satellite was launched on 1 February, 1958, and at all four **Moonwatch** stations there were heroic improvisation and efforts. An idea of the scale of the work involved may be gained from the log of the Cape Town team which recruited about 130 observers, and between 2 Feb and 22 Feb, mounted sixteen watches in the small hours of the mornings with an average compliment of 20-25 observers. These efforts were rewarded on the morning of 8 February, when the Cape Town team made the first sighting of Explorer 1 outside the United States. A second sighting was made on 20 February, and these two, together with nine other visual sightings, formed the basis of the first orbit deduced mainly from visual observations.

Through a decision made by the United States Naval Research Laboratory it was decided that "Johannesburg and Pretoria were too far north to observe the Vanguard satellite" so no Apogee telescopes were initially supplied to Johannesburg or Pretoria which meant that their punitive 2-inch aperture telescopes had no chance of seeing Explorer-1 although strenuous efforts were made so explains why Cape Town and Bloemfontein achieved the fame of the first observations because they had adequate optical equipment. Only later, after it was found that Bloemfontein could not man all the telescopes supplied were ten Apogee scopes despatched to Johannesburg and Pretoria.

So, in the case of South Africa during the period 1957 to early 1960s it meant that unless one lived in Cape Town, Bloemfontein, Johannesburg or Pretoria and belonged to a **Moonwatch** team – where the basic infra-structure already existed for rapid communication and professional observatories existed with the required astronomical expertise, the "lone-wolf" observer was not welcome and had no role to play. The writer found this out when he volunteered in early 1957 to offer his services from a small town in the middle of no-where (Glencoe, Northern Natal) and received a nice letter from Dr. David Evans saying "sorry - we cannot use you".

This limitation on "lone-wolf" observers was somewhat of a disappointment to many amateurs particularly interested in tracking and soon led to the establishment of other tracking organisations which encouraged participation by anyone interested. Projects such as **Phototrack, Moonbeam**, the **Volunteer SatelliteTracking Program**, the **Western Satellite Research Network** as well as the **British Prediction Service** are some of the better known ones and will be discussed later.

Consequently during the first few years of the Space Age many "lone-wolf" amateurs gave their attention and time to the other organisations and it was only around about the mid 60's that the restriction on **Moonwatch** observers was relaxed and the "lone-wolf" observer could now participate. When **Moonwatch** finally closed down in 1975 many of these "lone-wolf" observers continued and several are still active today.

Telescopes used in Moonwatch

Even today it is possible that telescopes used in the MOONWATCH program will still be found in various parts of the country etc so it might be useful to describe the various models that may be found.

The basic specifications for the first **Moonwatch** scopes were described in **"Bulletin No 2 for Visual Observers of Satellites"** that was an insert in **Sky and Telescope** Vol XV No 12 Oct 1956.

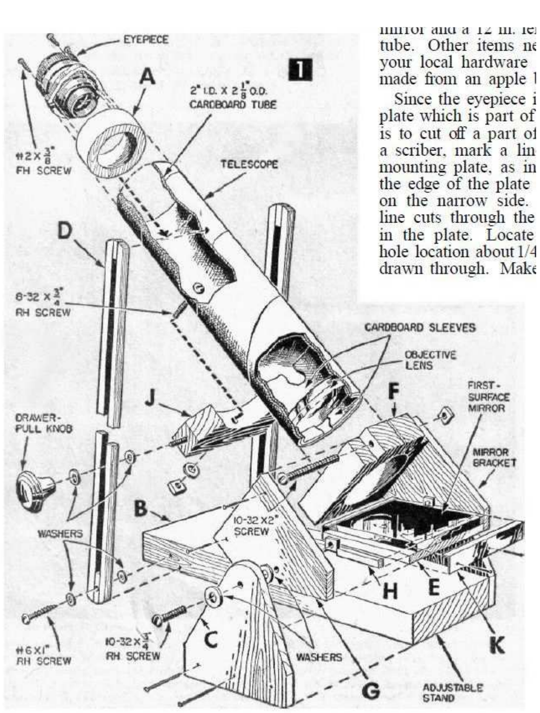
1. The telescope had to be capable of seeing a satellite as faint as magnitude +8 or +9 under good conditions.
2. It had to have a field of view of at least 10 to 12 degrees.

From this the basic specifications could be defined:

a) Objective diameter 45 to 55 millimetres
b) Magnifying power 6x to 7x
c) Field of view 10 to 12 degrees

Since observing sessions might be as long as 90 minutes or more it was essential that comfort over extended periods was possible for the efficiency of the **Moonwatch** team and it was recommended that the telescope be mounted in a rigid position in the plane of the meridian. Attached in front of the objective was a small plane mirror of high quality that was front surface aluminized and the telescope-mirror assembly was adjustable in elevation so that the desired portion of the sky could be brought into view with the net result that the observer was seated and looked down into the eyepiece.

An excellent description of how to assemble such an instrument was described by Art Youngquest in an article that appeared in **Science and Mechanics** Feb 1958. p122 - 126 with the title **"Making and using a $9 satellite 'scope"** which
may be found at www.scribd.com.doc/3210367/Satellite-Telescope



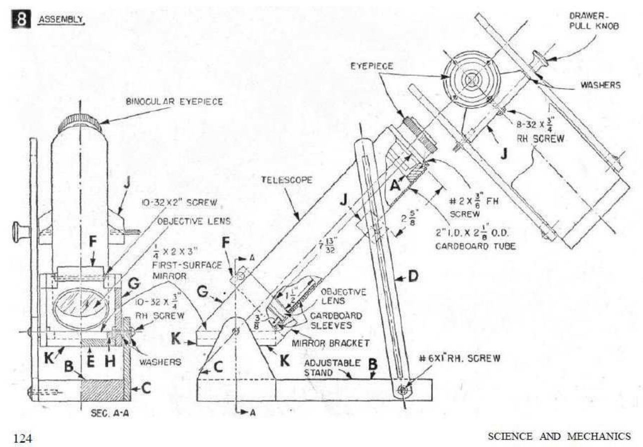


Fig. 6 (left) The Science and Mechanics drawings for the assembly of the $9 scope.

Fig 7. (above) Another view of the assembly in Science and Mechanics.

Since it's such an excellent description it deserves repeating here.

It is impossible to determine how many similar telescopes were assembled in South Africa. According to the article by Hers – published recently in MNASSA Vol 72 Nos 5 & 6 June 2013 - 60 kits were ordered from a supplier (Edmund Scientific?) in the United States and fifteen were provided to each of the four South African teams. In addition the then Union Observatory produced a cheaper model. How many of these have survived today is questionable - when the author left the Republic Observatory in about 1974, when it finally closed down, the "strong room" in the basement of the main building still had about a dozen and he was able to acquire one - what happened to the remainder is a mystery. The one acquired by the writer was subsequently lent to a "friend" and has long since "disappeared" along with the "friend".

As **Moonwatch** developed and the technology for placing satellites into the correct orbit improved use was made of war-surplus M17 tank 8 power elbow telescopes that were sold by Edmund Scientific and other optical suppliers for about $13.50. These had a field of view of 6 degrees and superior performance to the original **Moonwatch** scope. Apparently 36 such telescopes were supplied to South Africa, along with the APOGEE telescopes, and since the latter had superior performance it would appear that the M-17 telescope was not used to any great extent. What happened to all of them is a mystery. The writer still has the one supplied to him in later years and did locate another one beyond repair years later in a Cape Town scrap-yard.

Fig. 8. The M17 8-power telescope.

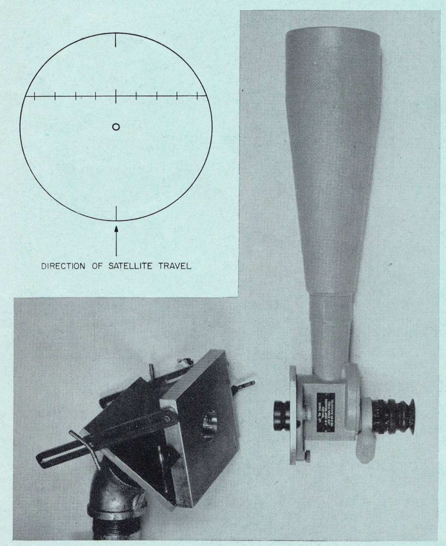
Some were apparently for sale in a local Cape Town garage that may have been M-17 scopes according to a communication from Cliff Turk and purchased by Peter Mack- founder of the Cedarberg observatory before he left South Africa.

"The 2" scopes which Peter got hold of were probably the ones I saw in a big cardboard box in a garage in Buitengracht Street (I think) in about the mid 70's. They were too small for what I was looking for at the time and I don't know how I got to find them, but I did go back a couple of years later to be told they had all been taken by one person and there were none left. I think this would have been before Peter came to the Cape as he was only here for 6 years and left in 1988. One of those 2" scopes was used as a finder on the 2nd version of the Ron Atkins Telescope (RAT) which replaced the original at the suggestion of Peter to the Cape Centre. Maybe that "finder" is still in the junk held by the Centre - or by Chris Forder who rebuilt the RAT into its 3rd version."

The possibility does exist that most of the M-17 telescopes were sent from South Africa to other countries - particularly Japan which had a large number of **Moonwatch** stations.

In "The Bulletin for Visual Observers of Satellites" Number 9 JULY 1958 the APOGEE telescope was illustrated and described :

The high-powered elbow telescope provided for the stations was the APOGEE telescope. It had a magnification of 21.5, with an aperture of 120mm, and its real field of view was 2.25 degrees and combined the objective of U.S. NAVY MARK-I ship's binoculars with the prism and eyepiece unit of the M-17. NRL designed a special offset reticule to assist the observation for time and position that was illuminated by a controllable faint red light which did not impair dark adaption.



Special MOONWATCH stations established for observing distant and faint satellites use this high-power telescope designed at the Naval Research Laboratory. The inset diagram shows how the reticle has a reference line that is offset to give the observer more time to recognize a very faint object. The 21½-power instrument can be easily removed from its simple mounting and replaced by an M-17 elbow telescope when low, bright satellites are to be observed. Naval Research Laboratory pictures.

Fig. 9 (right) The Apogee telescope and offset reticle.

Since the 21.5x telescope had 2.7 times the aperture of the M-17, it makes equally visible a satellite 2.7 squared times fainter This corresponds to an object 2.7 times farther away, but this is the same factor by which the 21.5x field is narrower than that of the M-17. Hence the 21.5x had about the same lateral coverage in miles as the M-17 had for a satellite 2.7 times closer.

Other Telescopes

Obviously many companies took the opportunity to try and make some money out of providing telescopes suitable for **Moonwatch** or optical satellite tracking and a variety of adverts appeared in **Sky and Telescope**, for example, during the first year or two and a few made their way to South Africa. For example I purchased the UNITRON model from a camera shop in Durban in the early 60's but found its optical performance rather poor until I changed the arrangement of the objective - I think the two lens components had been installed back to front which was very easy to do! I still have it but it’s now pretty battered. In original condition it is apparently worth quite a small fortune as not many were made and it’s a much sort after item by people who collect UNITRON products. Unfortunately, for Unitron, they entered the market a little too late by which time the excitement about satellites had already diminished. It was also relatively expensive.

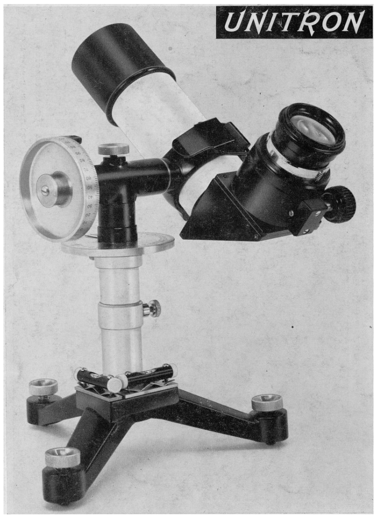


Fig 10. The Unitron telescope.

Next article will describe the tracking organizations set up for the "lone-wolf" observer and, depending on how long this will be, leave space to describe the first **Moonwatch** station in South Africa. Subsequent articles will describe each station, depending on how much information is available.

Colloquia and Seminars

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

Also included in this section are the colloquia/seminars at the SAAO, NASSP, UWC and the Astrophysics, Cosmology and Gravity Centre at UCT, ACGC. Also included are the SAAO Astro-coffees which are 15-20min informal discussions on just about any topic including but not limited to: recent astro-ph papers, seminal/classic publications, education/outreach ideas and initiatives, preliminary results, student progress reports, conference/workshop feedback and skills-transfer (Editor).

SAAO

Title: Spherical Grating Spectrographs
Speaker: Darragh O'Donoghue (SAAO)
Venue: SAAO Auditorium
Date: 29 August
Time: 16h00
Abstract: Since the mid 1800s when the "spectroscope" of Bunsen and Kirchhoff solved the resolution problem in spectra of the Sun and laboratory element discovery, the basic form of the optical spectrometer has remained the same: light to be analyzed illuminates a slit, is collimated, incident on a flat grating, and imaged by a camera. Spectrometers using spherical dispersers were suggested in the late 1970s but have thus far been employed on space platforms, both looking down at the Earth and outward at the Cosmos. Ground-based optical/NIR astronomical spectrometers are the most challenging of the traditional instruments, because of the demands of efficient processing of light at low intensity levels and high resolution. In this talk I will review ground-based astronomical spectrometers and describe new forms of spectrometer built around curved Volume Phase Holographic diffraction gratings. I'll also show how these novel designs can solve problems in the various forms of the instrument, enabling, in particular, massively multiplexed spectroscopy to be realised at minimal cost. These innovations may be useful to South Africa's growing appetite for spectroscopic follow-up of surveys originating from the new generation of radio telescopes and LSST.

Title: ComPADRE Digital Library Resources for Teaching Physics and Astronomy
Speaker: Prof. Wolfgang Christian (Davidson College, USA)
Venue: SAAO Auditorium
Date: 6 September
Time: 11:00

Abstract: Although there are many computer-based resources for teaching physics and astronomy, few are designed to be adoptable, adaptable and extensible. What is needed by the physics and astronomy education community is not another computer program (although programs are essential), but a synthesis of curriculum development, computational physics, computer science, and physics education research that will be useful for students and for teachers wishing to write their own simulations and to develop their own curricular material. The Open Source Physics (OSP) project was established to meet this need. OSP is an NSF-funded curriculum development project that is developing and distributing a code library, programs, and examples of computer-based interactive curricular material. This talk will describe OSP material hosted in the ComPADRE National Science Digital Library for teaching physics and astronomy.

Title: Planet formation in dense star clusters
Speaker: Henry Throop (Planetary Science Institute, Pretoria)
Venue: SAAO Auditorium
Date: 2 September
Time: 11h00

Abstract: Our Solar System's closest stellar neighbors are several light years away, and most models of the Solar System's formation assume that we have been isolated from other stars. But a growing body of evidence suggests that most stars and planets form in star clusters far more dense, where tens of thousands of young stars are initially packed into the same volume of space as between us and our closest stellar neighbors. The Orion region is one such nearby dense stellar cluster, where UV radiation, clouds of gas, and encounters with other stars can shape the future of planetary systems. I will discuss our recent observations and modeling of the formation of stars, disks, and planets in dense star clusters such as Orion, and what this says about the formation of stars and planets throughout the galaxy.

Title: The SH0ES project: H0 to 3% and beyond
Speaker: Lucas Macri
Venue: SAAO Auditorium
Date: 12 September
Time: 16h00

Abstract: The SH0ES project (P.I.: Adam Riess) aims to obtain increasingly more precise and accurate determinations of the Hubble constant using type Ia supernovae, calibrated via near-infrared observations of Cepheid variables. We minimize sources of systematic uncertainty by building a robust, differential distance ladder that uses the same telescope and camera (HST and WFC3) for all observations. The ladder is anchored on the "maser galaxy" NGC 4258, the Milky Way and the Large Magellanic Cloud. Our most recent determination of H0 has an uncertainty of 3.3% (Riess, Macri et al. 2011, ApJ 730, 119).
I will review our progress to date and present results from the current phase of the project, designed to yield a 1.9% determination of H0. This will be achieved by doubling the SN calibrator sample and by obtaining high-quality parallaxes to an additional 11 Milky Way Cepheids.

Title: Detecting and confirming planets with eclipse time and transit time variations
Speaker: Stefan Dreizler
Venue: SAAO Auditorium
Date: 19 September
Time: 16h00
Abstract: While the timing method was the first to successfully detect exoplanets, the radial velocity method has quickly developed as a standard method for exoplanet detection. The timing method has received more interest in recent years due to two different areas of exoplanet reserach. On the one hand, eclipse time variations have shown that planets exist in exotic environments like in post common envelope binaries. This raises the questions whether or not these planets have survived the significant mass loss of the binary system or if there is a second phase of planet formation. On the other hand, the transit timing variation offers the possibility to detect and confirm exoplanets from photometric data alone. With the large number of multi-transiting planetary systems the Kepler satellite detected, this method can now be applied to several systems. In the talk, I summarize our contributions to the eclipse time and transit timing method.

Title: Chemical abundances in the atmospheres of the symbiotic giants
Speaker: Cezary Galan
Venue: 1896 Building
Date: 20 September
Time: 11h00
Abstract: Symbiotic stars are known to be strongly interacting long period binary systems at the final stages of the stellar evolution which can be very useful tool to understand of the chemical evolution of the Galaxy and formation of the stellar

populations. The knowledge of the chemical composition of the symbiotic giants is essential to address these issues but unfortunately reliably determined are only in a few cases. We have started a chemical composition analysis for a sample of over 30 symbiotic systems based on high-resolution, near-IR spectra obtained with Phoenix/Gemini South spectrometer, using the methods of standard LTE
analysis, and atmosphere models for spectral synthesis. Here we present results obtained for two objects: RW Hya and SY Mus. Our analysis revealed a significantly subsolar metallicity (Me/H ~ -0.5) for RW Hya confirming its belonging to the Galactic halo population, a near solar metallicity in SY Mus, and a low 12C/13C isotopic ratios ~6 and ~10, for both objects.

Title: A Thermometer for Goldilocks: Accurate Temperatures of Kepler M Dwarfs and Their Planets
Speaker: Eric Gaidos
Venue: SAAO Auditorium
Date: 26 September
Time: 16h00
Abstract: M dwarf stars are especially attractive targets in the search for Earth-like planets because small planets are easier to detect around such stars, and the "habitable zone" is closer to the star where planets are more readily detected. The Kepler mission has discovered Earth-size planets transiting M dwarfs, including some that may orbit in the habitable zone. But the properties of these stars, and hence those of their planets, are poorly constrained. We have refined the temperatures of nearby M dwarfs whose angular diameters have been measured by interferometry. We find excellent agreement between certain model spectra and the observed spectra of these stars and use "spectrothermometry" to estimate the temperatures of distant Kepler M dwarfs with a precision of 60K. We then apply model-independent empirical relations to estimate stellar radius, luminosity, and mass, and use these in turn to revise the radii and stellar irradiances of M dwarf planets. We find that a recent estimate of the occurrence of Earth-size planets in the habitable zone of M dwarfs may need to be revised downwards by a factor of four.

Title: Extragalactic X-ray Binaries
Venue: SAAO Auditorium
Speaker: Tana Joseph
Date: 17 October
Time: 11h00
Abstract: In this talk I will present my research into extragalactic X-ray binaries (XRBs) in the Local Universe carried out during my PhD. This work consisted of a study of the

XRB population of the elliptical galaxy NGC4472 as well as the discovery of two new XRBs in M82 and NGC1399. I will then discuss my current project. This research entails searching for low mass X-ray binaries (LMXBs) in the Small Magellanic Cloud (SMC) using X-ray, radio and optical data. Previous studies of the SMC revealed objects like accreting pulsars and supernova remnants within the SMC. These studies have mainly been sensitive to pulsating systems, like high mass X-ray binaries, leaving the galaxy's other populations of compact objects unstudied. The identification of LMXBs in the SMC would make it the first full external galaxy in which a clearly understood sample of quiescent XRBs had been discovered.

Title: The Asteroid Grand Challenge
Speaker: James Adams (Deputy Chief Technologist at NASA)
Venue: SAAO Auditorium
Date: 7 November
Time: 15h00
Abstract: A key new element of the NASA mission was established earlier this year in the form of a Grand Challenge: "Find all asteroid threats to human populations and know what to do about them." The NASA "Asteroid Grand Challenge," an element of President Obama's Strategy for American Innovation is a large-scale effort focused on detecting and characterizing asteroids and learning how to deal with potential threats. The Asteroid Grand Challenge (AGC), led by NASA's Office of the Chief Technologist, will require multi-disciplinary collaborations and a variety of partnerships with other government agencies, international partners, industry, academia, and citizen scientists. The AGC complements NASA's recently announced Asteroid Initiative, which includes a mission to rendezvous with and redirect an asteroid to a lunar orbit, followed by a mission to send humans to explore the asteroid.
NASA is interested in engaging other nations to help with this important work, with a particular interest in filling a gap within the Southern Hemisphere for night sky survey coverage. We feel that the sophisticated astronomy and science communities within South Africa, coupled with your geographic location, make South Africa an ideal early partner in this initiative, particularly with regard to asteroid detection and characterization. We feel that the US-South Africa Joint Commission Meeting (JCM) presents a great opportunity to advance cooperation with South Africa in this area.

Title: The polluted atmosphere of white dwarfs and the demise of planetary systems

Speaker: Stephane Vennes, Astronomical Institute, Acad. Sci. of the Czech Republic
Venue: SAAO Auditorium
Date: 14 November
Time: 11h00

Abstract: Planet host stars are common. If, as indicated by the Kepler mission, at least 20% of FGK stars harbour a planetary system, we should expect that the remnants of ancient systems should pollute the environment of their present-day post-AGB descendants, the white dwarfs. In fact, infrared data reveal the presence of debris material around a substantial fraction of white dwarfs. Moreover, white dwarf abundance analyses also show that this material is eventually accreted onto their surface. I will present our recent investigation of this phenomenon with the VLT/X-shooter spectrograph and our model atmosphere analysis of these accreting white dwarfs.

Title: Torque-Limited Growth of Massive Black Holes in Galaxies

Speaker: Daniel Angles-Alcazar (University of Arizona)
Venue: 1896 Building
Date: 21 November
Time: 11h00

Abstract: Current observations suggest that there is a close connection between the formation and evolution of supermassive black holes and their host galaxies. Most models that attempt to explain this connection assume that black hole growth is self-regulated by feedback from the accretion process itself. In this talk, I will describe an alternative scenario consistent with available observations in which the transport of angular momentum in the galaxy by gravitational instabilities regulates the long-term co-evolution of black holes andstar-forming galaxies. I will show that torque-limited growth yields black holes and host galaxies evolving on average towards the observed scaling relations, with no need for mass averaging through mergers or additional self-regulation processes, and I will discuss the main implications of torque-limited growth in the context of current observations and theoretical models.

Title: The PBL: a new instrument for atmospheric turbulence profiles

Speaker: Laure Catala
Venue: SAAO Auditorium
Date: 5 December
Time: 11h00

Abstract: Early 2010 we set up and started operating a MASS-DIMM (multi aperture scintillation sensor – differential image motion monitor) at the Sutherland site. The instrument has produced a valuable statistical sample of data allowing to extract general trends and low altitude resolution profiles of the atmospheric turbulence in addition to provide all observers on the plateau with the current seeing conditions.
In addition to the continuous monitoring done with the MASS-DIMM instrument, we started a collaboration with the University of Nice (France) who developed a new instrument (PBL). The main goal of the PBL is to provide high altitude resolution profiles of both the turbulence strength and the outer scale. This will be the first instrument providing the outer scale profile which is a critical parameter for the upcoming ELTs. In this talk I will explain the importance of characterizing the outer-scale profile. Then I will present the general working principle of the PBL, the work done in order to obtain atmospheric profiles from it and the first results from observations done at Sutherland in August 2011.

ACGC

Title: **xPand: An algorithm for perturbing homogeneous cosmologies**
Speaker: Obinna Umeh, UCT/UWC
Venue: M111, Maths Building, UCT
Date: 20 August
Time: 12h00
Abstract: I will describe in detail a package we developed recently that uses a fully geometrical method to derive perturbation equations about a spatially homogeneous background. The package uses the capabilities of the tensor algebra package xTensor in the xAct distribution along with its extension for perturbations xPert. The package is extremely user friendly especially for the UCT cosmology group since it relies on 1+3 decomposition technique. With xPand, deriving perturbation equations up to any order in perturbation theory and for any metric theory of gravity become very simple.

Title: Gravitational Lensing and Time Delay in Chameleon Gravity
Speaker: Robert Poltis (UCT)
Venue: room M111 Maths building
Date: 27 August
Time: 12h00
Abstract: Light scalar fields are well motivated and expected to arise in various models of cosmology and high energy physics, but as of yet remain unobserved. Either these light fields do not exist, or they possess some mechanism that so far has

allowed them to evade experimental detection. Scalar tensor theories are appealing in that they can lead to light scalars fields that manage to evade experimental detection, such as in the chameleon mechanism and symmetron mechanism. In this paper we calculate the gravitational lensing and time delay signatures for chameleon gravity. We find that while there is no detectable effect on image distortions in gravitational lensing, the Shapiro time delay may be significantly different from the prediction of general relativity for chameleon-matter couplings of order unity.

Title: Cosmology through galaxy motions
Speaker**:** Prof. Adi Nusser (Technion - Israel Institute of Technology, Haifa, Israel)
Venue: Room M111, Maths Building
Date: 10 September
Time: 12h00
Abstract: Observational data yield a consistent paradigm for the formation of structure in the Universe. This is the standard cosmological paradigm with cold dark matter and dark energy as the main contributors to the cosmological energy density. The talk will describe how peculiar motions (deviations from a pure Hubble flow) of galaxies can further constrain the cosmological models and offer clues to the nature of dark energy.

Title: Galaxy Redshift Surveys: How Distortions Can Yield a Sharper View of the Universe
Speaker: Prof. Enzo Branchini (Università degli Studi Roma Tre, Italy)
Venue: RW James Building Lecture Theatre D
Date: 17 September
Time: 12h00
Abstract: Large surveys of galaxy redshifts, both photometric and spectroscopic, have long been a powerful tool to investigate the structure of the nearby Universe, reveal its content and constrain fundamental cosmological parameters. The possibility to extend these surveys to the epoch in which the Universe started its accelerated expansion gives us the unique opportunity to investigate the origin of this acceleration: whether it is due to some form of Dark Energy or whether we need to revise Einstein's theory of gravity. Observational tests able to address this fundamental question typically exploit gravitational lensing or galaxy clustering, or a combination of both. In this talk I shall focus on the second aspect, stressing the importance of redshift distortions to discriminate between Dark Energy and modified gravity.
I will review existing observational constraints, present those from currently ongoing observational campaigns like VIPERS, and from future surveys like Euclid.

Title: The metric inside the past light-cone: a numerical scheme to test the Copernican principle

Speaker: Landman Bester (Rhodes University)

Venue: Room 111 Maths building

Date: 22 October

Time: 12h00

Abstract: This talk will present an algorithm that uses real observations on the past null-cone (PNC) as initial data to reconstruct the geometry of space-time in its interior. The algorithm is designed to reconstruct the metric of space=time within the class of spherically symmetric dust universes with or without a cosmological constant. Assuming that gravity is well described by General Relativity it is demonstrated how the algorithm can be employed to test the Copernican principle based on currently available observations. The intrinsic noise present in realistic data presents a challenge for the smoothing algorithm employed. It is shown that currently available model independent distance/redshift and age/redshift data has not reached the required precision for a conclusive result.

Title: Testing dark energy as a function of scale

Speaker: Ignacy Sawicki

Venue: Room 111 Maths building

Date: 19 November

Time: 12h00

Note: This was also presented at AIMS 0n 15 November.

Abstract: The difference between various models of dark energy or modifications of gravity becomes apparent at the level of growth of large-scale structure in the universe. In addition to measuring the background expansion, we are now beginning to probe this aspect. I will discuss a model-ignorant approach to interpreting these observations and show the full set of late-universe observables that we might have in principle in the absence of a theory of dark energy. I will then show how we can construct null tests using these observables which constrain classes of dark-energy models and are uniquely capable of, for example, excluding the general scalar field as a mechanism for acceleration.

Title: Far-Infrared -- radio correlation for AKARI galaxies

Speaker: Agata Pepiak (Astronomical Observatory of the Jagiellonian University, Krakow, Poland)

Venue: Room 111 Maths building

Date: 20 November

Time: 16h00

Abstract: We probe radio-infrared correlation for two samples of extragalactic sources from the local Universe from the AKARI All-Sky Catalogue. The first, smaller sample (1 053 objects) was constructed by the cross-correlation of the AKARI/FIS All-Sky Survey Bright Source Catalogue, the AKARI IRC All-Sky Survey Point Source Catalogue and the NRAO VLA Sky Survey, i.e. it consists of sources observed in the mid- and far-infrared by AKARI, and at the 1.4 GHz radio frequency by NRAO. The second, larger sample (13 324 objects) was constructed by the cross-correlation of only the AKARI/FIS All-Sky Survey Bright Source Catalogue and the NRAO VLA Sky Survey, i.e. it consists of sources observed in the far-infrared and radio, without a condition to be observed in the mid-infrared. Additionally, all objects in both samples were identified as galaxies in the NED and/or SIMBAD databases, and a part of them is known to host active galactic nuclei (AGNs). For the present analysis, we have restricted our samples only to sources with known redshift. We analyse the far-infrared-radio correlation for both of these samples. We compare the ratio of infrared and radio emission from normal star-forming dusty galaxies and AGNs in both samples. For the smaller sample we obtained <q(AGN)>=2.14 for AGNs and <q(n)>=2.27 for normal galaxies, while for the larger sample <q(AGN)>=2.15 for AGNs and <q_n>=2.22 for normal galaxies. An average value of the slope in both samples is <q>=2.2, which is consistent with previous measurements from the literature.

Title: Galaxy clustering seen by the VIMOS-VLT deep survey

Speaker: Agnieszka Swieton (Astronomical Observatory of the Jagiellonian University, Krakow, Poland and Kepler Institute of Astronomy, University of Zielona Gora, Poland)

Venue: Room 111Maths building

Date: 20 November

Time: 16h00

Abstract: Investigation of galaxy clustering is an essential element to understand the development of the large-scale structure of the Universe. The local Universe is relatively well known, and thanks to the large surveys like the 2dF Galaxy Redshift Survey (2dFGRS) or the Sloan Digital Sky Survey (SDSS) we know that clustering properties of galaxies depend on their colour, spectral type, luminosity and environment. One of the biggest questions of modern cosmology is how these dependencies evolved and what conditions determined them. So, it is important to study how galaxy clustering depends on galaxy properties in the Universe up to z~1 and further. The VIMOS-VLT Deep Survey was prepared to study the formation and evolution of galaxies and the large scale structure of the Universe. Spectroscopic observations were obtained by the VIsible Multi-Object Spectograph (VIMOS) at the European Southern Observatory's Very Large Telescope. I want to present the results concerning dependencies of the galaxy clustering obtained from the VVDS survey, including my own recent measurements.

Title: Dark energy inspired singularities
Speaker: Mariam Bouhmadi Lopez (Department of Theoretical Physics, University of the Basque Country, Spain)
Venue: Room M111, Maths Building
Date: 3 December
Time: 12h00
Abstract: In this talk, we will review some kind of cosmological singularities that have appeared over the last few years, motivated initially from the possible presence of an exotic dark energy component. Then we will show how these singularities could be removed or appeased either on a semi-classical setup or using a quantum approach within the framework of quantum geometrodynamics.

NASSP

Title: Do we have robust tests of the Cold Dark Matter model?
Speaker: Associate Professor Christopher Power from the University of Western Australia.
Venue: RW James Lecture Hall C
Date: 21 August
Time: 16h00
Abstract: The Lambda Cold Dark Matter model is well established as the framework within which we study the origin and growth of structure in the Universe from the earliest cosmic epoch to the present day. Yet a recurring theme for the LCDM model over the last two decades has been that it faces a crisis on small-scales, predicting an overabundance of low-mass galaxies whereas comparatively few are observed. Can this tension be explained by appealing to known astrophysical processes, or does it signal the need for a fundamental overhaul of the dark matter model itself? I will review the current state of affairs, highlighting where our theoretical understanding needs to be improved, and I will discuss the kind of observations that might help us test dark matter models in the most robust fashion.

Title: Exploring the Early Universe with the Cosmic Microwave Background
Speaker: Dr. H. Cynthia Chiang from The UKZN. See below for more details.
Venue: RW James Lecture Hall C
Date: 28 August
Time: 16h00

Abstract: Cosmology, the study of the origins and evolution of the universe, is an exciting area of research that has made astounding progress with the recent flood of observational data and development of precision instrumentation. One of the most valuable tools for studying the universe is the cosmic microwave background (CMB), which is the "afterglow" of the big bang and a direct snapshot of the universe in its infancy. The CMB contains a wealth of information, encoding the universe's history from moments after the big bang up to the era of structure formation. I will discuss our current knowledge of the CMB, what it has taught us about the universe, and some of the science goals of upcoming microwave telescopes. In particular, I will describe SPIDER and SPTpol, two experiments operating from Antarctica, that are searching for the signatures of inflationary gravitational waves and neutrino mass in the CMB.

Title: Periodic masers in massive star formation regions: Can KAT-7 shed light on their nature?

Speaker: Dr. Sharmila Goedhart from SKA office in Cape Town.

Venue: RW James Lecture Hall C

Date: 11 September 2013

Time: 16h00

Abstract: An intensive long-term monitoring programme of 6.7 GHz methanol masers using the HartRAO 26m telescope led to the discovery of periodic variability in seven sources. 6.7 GHz methanol masers are an exclusive tracer of an early stage of massive star formation but their exact location in the circumstellar environment is still a matter of much debate. Hydroxyl masers are often found in close proximity to the methanol masers and are believed to be pumped by the same mechanism as the methanol masers. One of the KAT-7 science verification programmes is to monitor hydroxyl masers associated with periodic methanol masers in an attempt to detect correlated variability. I shall give background on masers in starforming regions, present the light curves of the periodic methanol masers and early results from the KAT-7 monitoring programme.

Title: A Second Life for The Dwingeloo Radio Telescope

Speaker: André van Es, project manager at ASTRON and is the chairman of the CAMRAS foundation

Venue: RW James Lecture Hall C

Date: 18 September

Time: 16h00

Abstract: The Dwingeloo Radio Telescope came into operation in 1956 and at that time it was the largest Radio telescope in the world. After over 40 productive years

ASTRON decided to stop operations in 1997. Then it was not used for ten years. In 2007 a group radio amateurs approached ASTRON with a request to start using the telescope. For this purpose a foundation, named CAMRAS, was started with radio amateurs and amateur astronomers. This foundation succeeded in obtaining a monument status for this iconic instrument and raising funds for a complete restoration of the telescope.

The talk will address the history of radio astronomy that lead to the building of the radio telescope. Starting with the science case from Oort, the discovery of radio waves coming from the Universe by Jansky followed by the work of Grote Reber and Van de Hulst. The hypotheses of HI in the universe that was the direct reason for the building and construction of the Dwingeloo Radio Telescope short after World War II. A short overview of the operational life, including the Dwingeloo map and the discovery of Dwingeloo I and II. The founding of the volunteers foundation that started using the telescope, the restoration process and its planned future use. The future will use will be a joint program by radio amateurs, citizen scientist involving retro-science, niche science and art.

Title: Low frequency radio astronomy and the search for primordial HI

Speaker: Gianni Bernardi from the SKA office

Venue: RW James Lecture Hall C

Date: 2 October

Time: 16h00

Abstract: I will give an overview of low frequency (< 200 MHz) radio astronomy, its problems and peculiarity with respect to cm-wavelength radio astronomy. I will also describe the implications of low frequency radio astronomy for cosmology, by looking for the highly redshifted 21cm line from neutral Hydrogen.

Title: Cosmos (from Chaos): A Personal Voyage of how the Galaxy and Mass Assembly Survey (GAMA) plugs into my research

Speaker: Michelle Cluver UCT Astronomy Dept.

Venue: RW James Lecture Hall C

Date: 9 October

Time: 16h00

Abstract: Within the realm of astrophysics we explore extremes of scales. From the formation of our Solar System and molecular clouds within our galaxy to colliding clusters of galaxies, we explore 30 orders of magnitude of mass across 15 orders of wavelength. We accumulate mind-boggling amounts of data and knowledge, but they remain pieces of a vast and complex puzzle governed by intricate physics and chemistry. I will discuss my work on gas-rich star formation, galaxy groups and the

Galaxy and Mass Assembly (GAMA) Survey and how I see physical processes on very different scales being analogous. Exploiting these parallel connections when combining extremely large datasets and the mega-simulations of the future should bolster the unification of currently parallel studies.

UWC

Title: The IAU Office of Astronomy for Development
Speaker: Dr. J C Mauduit
Venue: Room 1.35 of the Physics Department, UWC
Date: 23 August
Time: 13h00
Abstract: The International Astronomical Union (IAU) is the largest body of professional astronomers in the world and has set up the Office of Astronomy for Development (OAD) in partnership with the South African National Research Foundation (NRF). The OAD is located at the South African Astronomical Observatory (SAAO) in Cape Town. Its mission is to realise the IAU's Strategic Plan, which aims to use astronomy as a tool for development. In 2012 the first open Call for Proposals was launched, focusing on three main areas: "Universities and Research", "Children and Schools" and "Public Outreach". Eighteen projects worldwide have been approved for 2013 and are currently under way. The OAD is also setting up regional nodes and language expertise centres around the world. This presentation will describe the ongoing activities of the OAD and plans for the future

Title: How Flat is our Universe Really?
Speaker: Patrice Okouma
Venue: Room 1.35 Physics building
Date: 28 August
Time: 13h00
Abstract: In this talk, we will highlight again the point that distance measurement provides no constraints on curvature independent of assumptions about the dark energy, raising the question, how flat is our Universe if we make no such assumptions? Allowing for general evolution of the dark energy equation of state with 20 free parameters that are allowed to cross the phantom divide, $w(z)=-1$, we show that while it is indeed possible to match the first peak in the Cosmic Microwave Background with non-flat models and arbitrary Hubble constant, H0, the full WMAP7 and supernova data alone imply $-0.12 < \Omega_k < 0.01$ (2σ). If we add an H0 prior, this tightens significantly to $\Omega_k = 0.002 \pm 0.009$. These constitute the most conservative and model-independent constraints on curvature available today,

and illustrate that the curvature-dynamics degeneracy is broken by current data, with a key role played by the Integrated Sachs Wolfe effect rather than the distance to the surface of last scattering. We also highlight the potential of growth information in breaking this degeneracy, hence the future addition of probes such as Euclid would be an advantage in this endeavour.

Title : Dr Sidelobes: How I learned to stop worrying and love simulations
Speaker: Prof Oleg Smirnov (SKA/KAT office)
Venue: Room 1.35 of the Physics building
Date: 23 October
Time: 14h00
Abstract: Radio interferometers are complex --and above all counter-intuitive - instruments, and we are constantly pushing the envelope of their performance with increasingly sophisticated science experiments. The combination of these two circumstances can produce some real surprises-- most of them of the unpleasant variety. I will present some examples of surprising observational limitations, both in real-world and simulated data (DDEs, calibration ghosts, sidelobe confusion, calibration noise) and discuss their possible impact on future radio surveys.

Title: Bipolar models of nova outbursts at radio frequencies
Speaker: Dr Valerio Ribeiro, UCT
Venue: Room 1.35 Physcis
Date: 15 November
Time: 13h00
Abstract: Novae outbursts occur on the surface of a white dwarf following extensive accretion from a less evolved star. Developments of our understanding of the nova ejecta in the optical and recent data from the upgraded VLA have shown that, in the latter case, the ejecta morphology do not fit the standard simple spherical thermal free-free process. Here, I will outline our efforts to answer some of the questions that the VLA observations as put forward to us, by building bipolar morpho-kinematical models of the progress of a nova outburst. I will then present future efforts to understand the relevance of these nova systems as progenitors of type Ia supernova.

Title: Modeling multi-phase gas and sub-mm lines emission in galaxies
Speaker: Gergö Popping (Groningen)
Venue: Room 1.35 Physics
Date: 18 November
Time: 14h00

Abstract: The star-formation activity of the Universe has gone through strong changes from redshifts of z~3 until present day. Information about the gas content of typical star-forming galaxies responsible for these changes has so far largely been missing. In this talk I present two theoretical a pproaches to make predictions for and support upcoming observations of the gas content of high redshift galaxies with ALMA and SKA. First, I present a new model in which I explicitly track the formation of molecular hydrogen and implement a physically-motivated H2-based star formation recipe within a semi-analytic cosmological galaxy formation model. I discuss our predictions for the atomic and molecular content of galaxies, how they evolve and how they constrain our understanding of galaxy formation and evolution. Second, I present a combination of this model of galaxy formation with a three-dimensional radiative transfer code. I discuss the CO, HCN, C, [CII], and [OI] emission from galaxies and use this tool to study how the detailed gas properties of galaxies during cosmic noon compares to galaxies in the local Universe and make direct predictions for ALMA observations.

Title: Letting the Data Speak for Themselves: What Observations Tell Us About Galaxy Formation

Speaker: Neal Katz (University of Massachusetts)

Venue: R00m 1.35 Physics

Date: 2 December

Time: 14h00

Abstract: We infer the star formation rates in dark matter halos at different redshifts from halo merger histories expected in a Lambda CDM cosmology constrained to match the observed stellar mass/luminosity functions of galaxies at different redshifts and the local cluster galaxy luminosity function, which has a steeper faint end than that of field galaxies. The only other assumptions that we make are that the star formation rate of central galaxies depends on the halo mass and redshift and that when a galaxy becomes a satellite its star formation rate is quenched exponentially and it can eventually merge with the central galaxy on a dynami cal friction timescale. We find that 1) the star formation in the central galaxies of high mass halos (>10e12) has to be boosted at high redshift beyond what is expected from a simple scaling of the dynamical time; 2) below z=2 the star formation in halos below 1e11 must be quenched, which is not directly expected in standard stellar feedback models and is most easily explained by some form of preheating, and implies that there is a significant old stellar population in present-day dwarf galaxies with M_star < 10e8 and steep slopes for the high redshift stellar mass and star formation rate functions 3) the stellar mass of galaxies assembles in one of three ways depending on halo mass: > 1e12 the galaxies assemble through mergers and

should hence have a spheroidal morphology and between 1e11 and 1e12 (e.g MW) it assembles slowly and at z>2 has less than 5% of its mass in place, which has extreme observational consequences

Title: Detecting planets around evolved pulsating stars using the timing method
Speaker: Enrico Olivier (UWC)
Venue: Room 1.35 Physics
Date: 6 December
Time: 14h00
Abstract: I met up with the EXOTIME group at the Osservatorio Astrofisico di Torino during October this year to learn more about their data analysis method. The primary goal of the EXOTIME project is to use the timing method to detect exoplanets around evolved pulsating stars such as subdwarf B (sdB) stars and white dwarfs. This talk will cover the timing method, the EXOTIME project itself and the wider context of the project in exoplanet and stellar research. I will also discuss one of the project's southern targets, the sdB star EC09582-1137 originally discovered by Dave Kilkenny

AIMS

Title: Filters vs Solvers for radio interferometry
Speaker: Cyril Tasse (SKA,SA).
Venue: The Hall, AIMS research centre
Date: 25 October
Time: 12h00
Abstract: Imaging problems in the presence of the direction-dependent effects are mostly solved, but the calibration of these effects remains open in many cases. For example, in the case of LOFAR and SKA-low we will need to estimate an ionospheric calibration solution every ~ 30 seconds, in low signal to noise ratio regime. Moreover, the largenumber of degrees of freedom of calibration problems associated with a limited number of measurement often leads to "ill-conditioned" problems driving intrinsic instability of the solutions to these large inverse problems. We have started working on modern filtering techniques to improve robustness of calibration solutions. For example, we can take into account the fact that ionospheric solutions are spatially and temporally correlated, etc... Contrarily to traditional iterative least-squares solver, Non-Linear Kalman filters are fundamentally recursive and opens the way to use radio interferometers "streaming" mode.

Title: Testing dark energy as a function of scale

Speaker: Ignacy Sawicki
Venue: The Hall, AIMS research centre
Date: 15 November
Time: 12h00

Abstract: The difference between various models of dark energy or modifications of gravity becomes apparent at the level of growth of large-scale structure in the universe. In addition to measuring the background expansion, we are now beginning to probe this aspect. I will discuss a model-ignorant approach to interpreting these observations and show the full set of late-universe observables that we might have in principle in the absence of a theory of dark energy. I will then show how we can construct null tests using these observables which constrain classes of dark-energy models and are uniquely capable of, for example, excluding the general scalar field as a mechanism for acceleration.

Astro-coffee

Title: The Ones in the Middle
Speaker: Kaustubh Vaghmare (IUCAA)
Date: 26 August
Venue: 1896 Building
Time: 11h00

Abstract: The "middle" here refers to the middle of the Hubble tuning fork of galaxy classification, where the S0 galaxies were originally placed. Work done in recent decades has disputed the status of S0 galaxies. I will cite a few examples which will serve the purpose of establishing a motivation to study them in detail. Then, I shall describe my own work based on mid-infrared data from Spitzer.

Sky Delights: The Painter's World

Magda Streicher

The Painter's Easel is a constellation which Louis de La Caille named Equuleus Pictoris in 1752, simplified to just Pictor by Benjamin Apthorp Gould in 1877. Most of the constellations named by La Caille represent instruments of science or the arts.

Pictor is situated just south of Columba, with Carina to the east and the Large Magellanic Cloud to the south. The French called it The Palette, and in Italian it is known as The Pittore.

But by whichever name one might call it, being able to paint is surely a wonderful gift, and finding a reference to that activity in the name of a constellation is hardly surprising or strange. Just as the painter represents images on a canvas using feeling and colours, so the objects in the night sky leave a lasting impression on the eye and mind.

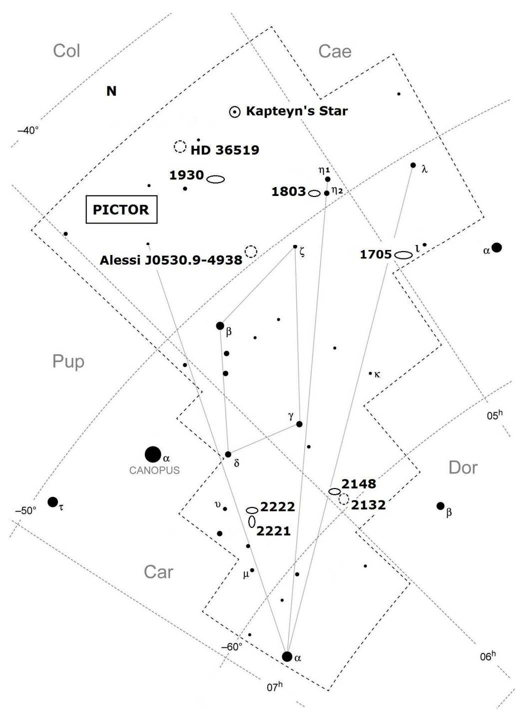


Fig 1 Map of the constellation Pictor

Pictor stretches across 27 degrees, with fairly faint stars making it extremely difficult to draw the constellation's outline with any precision, but this difficulty is abundantly compensated for by the opportunity to study some exceptional objects along the way.

The bright star Canopus in Carina is perhaps the best place to start in an attempt to find this constellation, a few degrees to the west.

Come and explore some of the colourful objects painted on the canvas of the night skies. To group stars into all kinds of shapes stretches and enriches the imagination and mind. One such grouping can be found a mere one degree south of the boundary with Columba. The handful of stars, clad mostly in a rich-yellow to orange colour, is well outstanding against the background star field. In the middle of the cluster, which is about 18' in extent, we find the most outstanding deep-orange magnitude 7.7 star **HD 3651**, which can also serve as reference. In a way the group can be seen as a half-moon opening up towards the west, with fainter stars nestling inside.

One of the most exceptional stars located within Pictor can be found 3.5 degrees further west. **Hipparcos 24186** is perhaps better known as Kapteyn's Star, a lovely, ruddy-hued type M1 magnitude 8.8 sub-dwarf only 12.8 light years away. The proper motion of 8".7 in a south-eastern direction per year earned it the apt name The Flying Star. A pair of prominent, wide double stars can be seen north of Kapteyn's Star, which should help you spot its position. The Dutch astronomer Jacobus Cornelius Kapteyn was born in Barneveld in the Netherlands on 19 January 1851 and died in 1922. In his late twenties he became professor of astronomy at Groningen, a post he held until retirement at the age of seventy.

Fig. 2 (right) Jacobus Kapteyn. Painting by Jan Veth (Wikipedia).

The Isaac Newton Telescope group on the cliffs of the island of La Palma probably sounds like a group of sentinels on the edge of a volcano, but it is, in fact, situated more towards the middle and eastern part of the island. At the southern end lies the volcano Cumbre Vieja, whose western flanks may someday collapse into the Atlantic, triggering a mega-tsunami. However, part of the group of telescopes is the 1-metre-mirror Jacobus Kapteyn Telescope, the naming of which was such a wonderful gesture to this special man.

The galaxy **NGC 1930**, situated another 2.7 degrees further south from Kapteyn's Star, is a somewhat faint object. A few magnitude 11 stars situated towards the west of the galaxy easily point the way. Although this star city is faint, the small bright nucleus is what first catches the eye. Closer investigation reveals the core surrounded by a roundish halo. The author's notes indicate a small round piece of haze towards the south-western side, but she is not quite sure of that and of what it is. Larger scopes will be needed for a proper investigation and some feedback would be much appreciated.

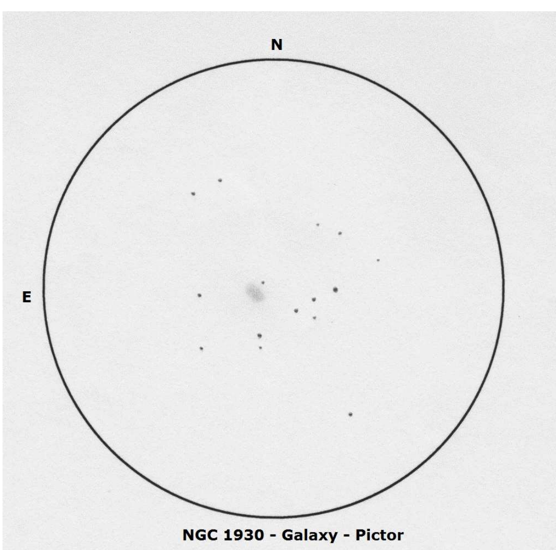


Fig. 3. The galaxy NGC 1930 in Pictor.

The outstanding double star eta Pictoris is situated in the far western part of the constellation – two beautiful magnitude 5 stars dressed up in rich yellow and orange colours. What makes the orange-coloured eta 2 Pictoris and the field of view special is the galaxy **NGC 1803** situated only 4.5' towards the east of the star. The object is pretty faint and quite a challenge to see, but take up the challenge! Use high magnification and move eta 2 Pictoris to just outside the eyepiece field, use averted vision and concentrate. Closer investigation shows the galaxy as a soft haze just slightly brighter towards the middle.

About 2 degrees east of NGC 1803 there is a grouping that is not particularly substantial, but nevertheless worth a visit. **ALESSI J0530.9-4938** is known as an asterism consisting of three magnitude 9 stars slightly more outstanding in a line from north to south. Three more stars towards the western field of view complete a sort of half-moon appearance opening towards the south as seen in a wider field of view. It is categorized as a "Milky Way Field".

Move across to the eastern part of the constellation to pin-point beta Pictoris. An intensive study around the magnitude 3.8 white-coloured type A3 star, 63 light years away, is being undertaken of late. An object with a radius 2–3 times that of Jupiter was found as it occulted beta Pictoris. A team led by Anne-Marie Lagrange (Grenoble Observatory, France) announced a possible planet orbiting the youth star beta Pictoris's dust disk, at a projected distance of only 8 a.u., putting it comfortably within the realm of the giant planets as in our solar system.

The lovely double star iota Pictoris is situated in the far western part of the constellation, which could be seen as representing the steady stay of the painter's drawing board, barely 30' west of the galaxy **NGC 1705**. The two members of this attractive pair are very similar in appearance, with a 5.6 magnitude primary displaying a yellow-white colour and the 6.4 magnitude secondary appearing to be slightly yellow-grey and, therefore, darker in shade. The separation is 12.3", which is quite easy to split in amateur telescopes. However, the galaxy gives a very soft oval impression in the company of two magnitude 11 field stars. From a hazy edge it rises slowly to a brighter middle part.

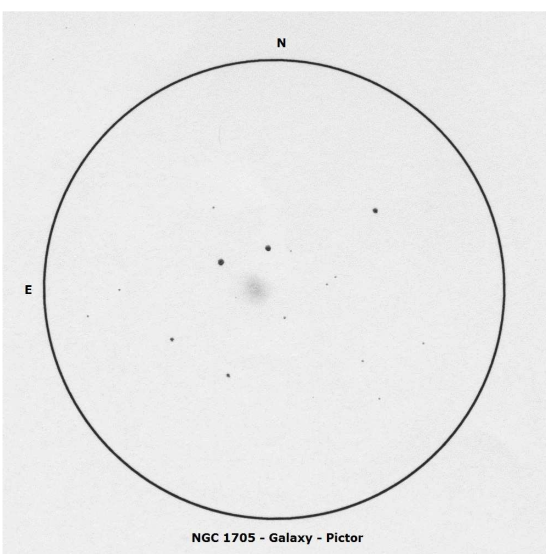


Fig. 4. The galaxy NGC1705 in Pictor

More towards the central eastern part of Pictor we find a special pair of galaxies forming an imaginary triangle of 1.5 degrees to the west with magnitude 5.8 nu Pictoris and magnitude 5.6 mu Pictoris. This is the nearly identical twin system **NGC 2221** and **NGC 2222** – I cannot think of them in any other terms: two very faint dust flecks, the one just like the other. If you have not been able to spot them, don't be concerned – this is a very difficult pair of galaxies to glimpse even with bigger amateur telescopes. Although it's a challenge, I spotted these two with averted vision from my very dark observation site. Higher magnification and care are needed to reveal that both grow a little brighter towards the middle area. The direction of NGC 2221 is north to south and seems to be slightly slimmer. A few very faint stars can be glimpsed around the immediate field of view. The northern companion galaxy NGC 2222 is slightly tilted in a north-west to south-east direction barely 1.5' towards the north of NGC 2221. In the west, between the two galaxies, a visible double star forms a triangle with the two galaxies. I have not dared to suggest searching for the very faint galaxy PGC 18839, which has a magnitude of just 15, just 2.5' further north, but if the opportunity arises, go for it.

Two objects, **NGC 2148**, a galaxy, and **NGC 2132**, a star cluster, can be found within a one-degree area about 3 degrees west of the Pictoris twin galaxies. NGC 2148 is no brighter than the above-mentioned two galaxies and displays only an extremely faint, roundish glow. The star cluster NGC 2132, about 52' south-west, comprises only a few stars, of various magnitudes, that are slightly more outstanding against the background star field. What is however, more notable, is the fact that the stars vary from yellow to deep orange in colour. Closer investigation reveals many fainter stars accompanying this group of stars. But this group of stars is a surprise package. Its southern member, HD 40307, which is situated only 42 light years away, has been studied in detail lately and has been found to house a few super-Earths orbiting the orange dwarf star. The exoplanet-hunting HARPS spectrograph in Chile discovered that HD 4037g lies in the system's habitable zone with a mass of that of between 4 and 10 Earths. The exoplanet's orbital period is 198 days, meaning HD 4037g receives about 62% of the heat Earth receives from the Sun (John Bochanski).

Fig. 5. NGC2221 and NGC2222, a pair of galaxies in Pictor

In the normal course of events the heavens may sometimes come across as uninteresting when one merely glances at them, just in passing, as it were – but the next time you decide to wander around outside under the starry skies, take a telescope along and observe the deep-sky objects through different eyes – it will definitely colour your perspective on some of these objects.

OBJECT	TYPE	RA	DEC	MAG	SIZE
NGC 1704	Galaxy	04h54m.2	-53°22'.2	11.8	1.8'x1.4'
NGC 1803	Galaxy	05h05m.5	-49°34'.5	13.4	1.3'x0.8'
Hipparcos 24186 Kapteyn's Star	Star	05h11m.8	-45°02'.4	8.8	*
NGC 1930	Galaxy	05h25m.9	-46°44'.5	12.5	1.9'x1.2'
HD 36519 Star Group	Asterism	05h29m.8	-43°38'.7	8	16'
ALESSI J0530.9-4938	Asterism	05h30m.8	-49°38'.8	9.5	12'
NGC 2132	Open Cluster	05h54m.5	-59°50'.8	8	25'
NGC 2148	Galaxy	05h58m.7	-59°07'.6	14	1.1'x0.8'
NGC 2221	Galaxy	06h20m.3	-57°34'.8	13.6	2.0'x0.5'
NGC 2222	Galaxy	06h20m.4	-57°32'.2	13.9	1.5'x0.3'

Stop Press – Nova Centaurus 2013!

On Monday, December 02, Australian amateur astronomer John Seach (Chatsworth Island, NSW) discovered a nova in Centaurus, not far from beta Centauri.

A nova is a massive nuclear explosion on a dying star. These stars - white dwarves - are the final evolutionary stage of Sun-like stars. A typical white dwarf has a mass similar to the Sun but its size is similar to the Earth: a teaspoonful weighs a ton. The nearest known white dwarf is Sirius B.

About 40 stars go nova each year in our Milky Way, but only about 10 of these are actually observed. Once a nova is observed, a light curve can be compiled, and based on the curve, it is classified as either a fast, slow, very slow, or recurrent nova. A fast nova drops by 3 magnitudes from maximum within 100 days, while it takes 150 days or more for a slow nova to dim by the same 3 magnitudes. Very slow novae remain at maximum light for a decade or more! Recurrent novae have at least two observed outbursts, separated by decades.

The brightest recent nova was Nova Cygni 1975, which reached mag 2.0. Recently (2013 August) Nova Delphini reached mag 4.3, making Nova Cen 2013 (so far) the brightest nova this century.

2013 December 07

This morning, the nova was still a naked-eye spot just to the left of beta Centauri, despite the terrible light pollution (and the onset of day). From an 8-second photo of the region (50-mm, f/5.6), the nova is slightly fainter than Upsilon-1 Cen (HR 5249, HD 121790, V=3.87) but brighter than Upsilon-2 Cen (HR 5260, HD 122223, V=4.34). Using Iris's aperture photometry routine, the nova has V=4.1 +/- 0.2.

Distance to Nova Cen 2013

The brightness of a nova can be used to gauge approximate distance. The distribution of their absolute magnitudes shows twin peaks, one at -8.8 and a second at -7.5. Buscombe and de Vaucouleurs showed in 1955 that the mean magnitude of novae 15 days after maximum light was a constant; more recent work (1995) shows that the absolute magnitude 15 days post-max is -5.60 ± 0.14. There are, however, exceptional objects that suggest this method be used with caution.

Assume the V magnitude at maximium is 3.7, guessed from the AAVSO light curve.

The relationship between absolute (M) and apparent (m) magnitude depends on the distance (d, in parsecs):for M = -7.5, m = +3.7: d = 1738 parsecs.

So, with enthusiastic hand-waving, we can say the nova lies between 5,700 and 10,000 light years from Earth.

Thanks to Auke Slotegraaf for this item.

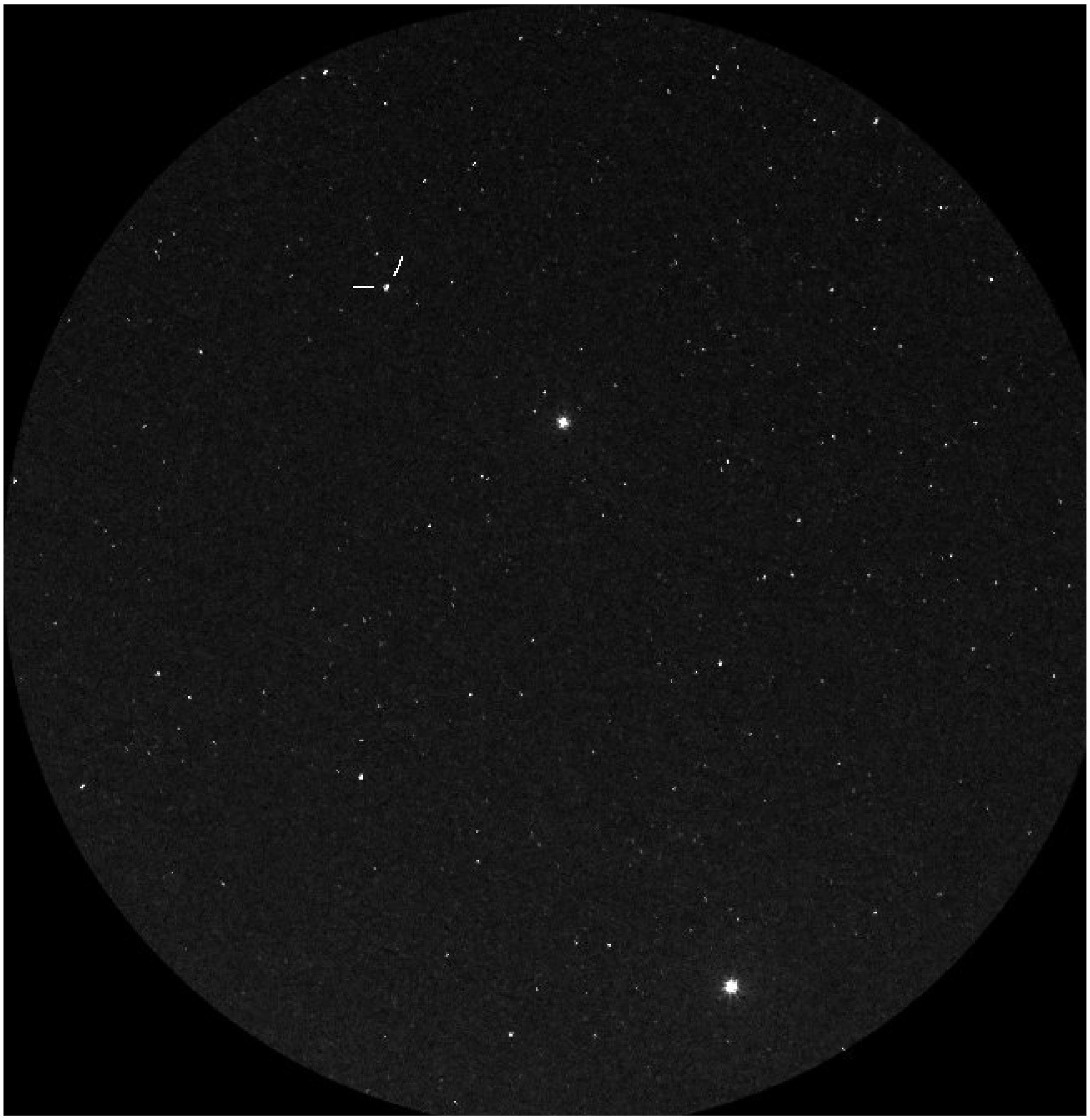


Photo taken 2013 December 07 by Auke Slotegraaf. The Nova is marked. At the bottom is Alpha Cen and the other bright star is Beta Cen

ASSA on-line Announcements

If you want to receive notifications of when issues are ready for download, then you need to register with the "*assa-info*" yahoogroup **NOW**. This forum will also be used to communicate ASSA-related matters, general ASSA news and information.

- To join, simply send a blank email (no subject needed) to assa_info-subscribe@yahoogroups.com and follow the instructions received.
- To unsubscribe (e.g. to remove a redundant email address), send mail to: assa_info-unsubscribe@yahoogroups.com

To post a message, email: assa_info@yahoogroups.com

You can also join a second yahoo group, "*assa_discussion*". This mail list will be used to distribute news and discuss queries of general astronomical related matters.

- To join, send a blank email (no subject needed) to assa_discussion-subscribe@yahoogroups.com and follow the instructions received.
- To post a message, send email to: assa_discussion@yahoogroups.com
- To unsubscribe (eg to remove a redundant email address), send mail to: assa_discussion-unsubscribe@yahoogroups.comASSA has also created a new format for their **Website** (http://assa.saao.ac.za). This is at present being populated with more content to allow better communication among the amateur astronomical community.

You can also now find ASSA on social media: On **Facebook** at https://www.facebook.com/Astrosocsa and on **Twitter:** @AstroSocSA

Ask an Astronomer: A link to this is provided on the website http://assa.saao.ac.za/contact-us/ask-an-astronomer/ Queries will be routed to Case Rijsdijk (Communications Director) who will take care of the query and if anything of general interest emerges, posts it on ASSA Mail lists, etc.

Report a sighting: A link to this is provided on the website http://assa.saao.ac.za/contact-us/report-a-sighting/ The report will be routed in the first instance to Kos Coronaios (Observing Director) who will make the decision of re-routing it as appropriate to someone who can answer the question.

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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 electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly as well as its annual *Sky Guide Africa South.*

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

Local Centres: Local Centres of the Society exist at Bloemfontein, Cape Town, Durban, Harare, Hermanus, Johannesburg, Pretoria and Sedgefield district (Garden Route Centre). Membership of any of these Centres automatically confers membership of the Society.

Sky & Telescope: Members may subscribe to Sky & Telescope at a significant discount (proof of membership is required). Please contact the Membership Secretary for details.

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