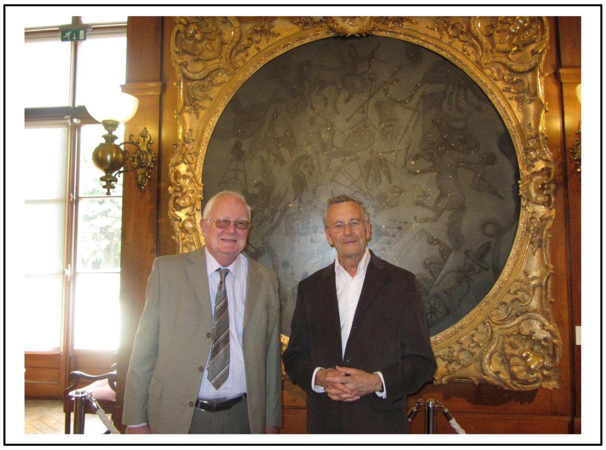
La Caille died relatively young, in 1762, and was given the unusual honour of burial in the vaults of the Mazarin College chapel.



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 ± 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*.

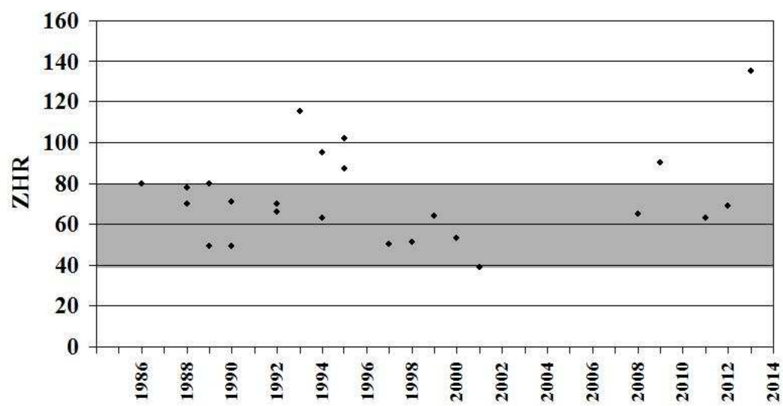


Fig 1. Variation in annual ZHR of the eta Aquariids. The normal annual range in ZHR is represented by the grey bar.

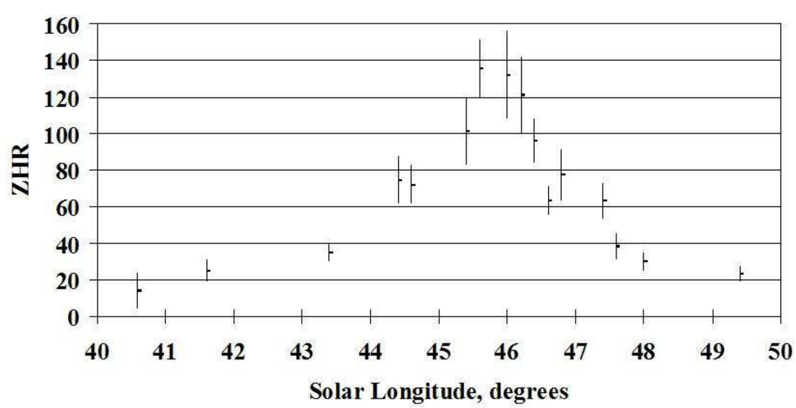


Fig 2. Rate profile of the 2013 eta Aquariids.

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	Tota l
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