Introduction

Although auroral and upper-atmosphere research is carried out mainly in polar regions by professional scientists, it is still worthwhile for the amateur to observe this beautiful and sometimes spectacular phenomenon for its own sake. Occasionally, however, the BAA Aurora Section is called upon to supply information on displays to a variety of professional organisations, and so it has become important to receive reports, to log them in a standardised method and to maintain a continuous archive which can be consulted by interested persons. Through the kindness and foresight of the late Dr Michael Gadsden this has been done – all our auroral and noctilucent cloud data from the time of Director James Paton in the 1940s up to the present is preserved in the special Balfour Stewart Archive at the Library of Aberdeen University.

It used to be thought that the aurora was a feature of the polar regions, or at least the far north of Scotland. Not at all! The last few years, especially the months of 2003 October and November, have witnessed some of the most awesome displays ever seen, visible in the South of England and photographed by many, as demonstrated in our own Journal, Astronomy Now and other magazines. These huge displays, the result of coronal mass ejections hurling matter Earthwards and seriously disturbing our magnetic field, are still comparatively uncommon compared to the small, quiet so-called ‘Scottish’ aurorae associated with coronal holes and smaller disturbances in the solar wind. Details of the physics of these can be found in the extensive literature.

Where can the aurora be seen? In general the further north the better, up to the Auroral Maximum zone which is an oval of almost perpetual light through Northern Norway, Iceland, Hudson’s Bay and Alaska. As this oval comes further south into the American continent the best places to go are Alberta, Saskatchewan, and North Dakota, where at about 48ºN Jay Brausche sees far more aurorae than Inverness at 57º. Iceland and Shetland suffer from cloud – many a hopeful observer has gone there and seen nothing. The best skies for aurorae in Britain are probably along the Moray Firth coast.

For continuity, the aurora is best described according to simple instructions worked out during the International Geophysical Year 1957–58 and set forth in the International Auroral Atlas.

Preliminaries

The geographical latitude and longitude of the observer should be given, with the year and the month, and the date is always rendered as the ‘double-date’ to identify a night, that is, Nov 16/17 means the evening of the 16th and the morning of the 17th. Time is always recorded in UT but if an observer outside the British Isles gives the local time the time zone must be made clear, being careful also to allow for summer time shifts. It is not necessary to give a minute-by-minute account of an aurora, just the salient times when there is a change, onset or cessation of activity or major brightenings.

Measurement of the maximum elevation of a display above the northern true horizon, (indicated like this: 722º) and of the base of an auroral arc, (indicated h.12º) can be done by a simple cloud alidade or a similar device made from a protractor and a ruler (Figure 1), or by using the human hand – the fully extended thumb and fingers subtend about 17º at arm’s length, and three knuckles of the fist make about 6º. A protractor can be used to estimate rough azimuths of the limits of the display from true north. Since the base of a homogeneous arc (q.v.) is nearly always 100km above the Earth’s surface, its elevation in degrees enables an investigator studying the development of an individual display to fix it in geomagnetic latitude. It is best not to describe auroral forms with respect to stars or constellations as this involves unnecessary and tedious calculations, as the stellar background differs from each location.

Simple ‘jamjar’ or more elaborate ‘fluxgate’ magnetometers can, in experienced hands, act as an early-warning system and this is well explained in the literature, although sometimes a magnetic disturbance does not produce a visible aurora, or an aurora may appear when the field is relatively quiet. Some astronomical societies have set up a warning system by phoning around. Some warning of auroral conditions is given on the internet but those sites of North American origin tend to apply mostly to that continent, which is at a higher geomagnetic latitude relative to the geographical equivalent in Europe.

Finally, dress as warmly as possible, especially the feet, keep the head covered (most heat is lost this way), get away from street or artificial light, use a clipboard, and a red torch to preserve your dark adaptation. Hot drinks are fine but avoid alcohol except to celebrate with afterwards!

Figure 1. A simple alidade constructed from a protractor and ruler may be used to measure the height of a display above the horizon.
Gavine: Observing the aurora

The auroral forms

Rather than give a wordy description I recommend the observer uses a standard shorthand code based on the International Auroral Atlas. See also Figure 7.

N: Auroral light of unspecified or uncertain form, usually seen in cloud breaks, or a glow on the northern horizon, the top of a display further north over the horizon.

A: Arc, like a curving arch or a low rainbow which follows the curvature of the Earth, usually pale green or white.

B: Band. Like an arc but with one or more kinks or folds.

P: Patch, a diffuse cloud of light without sharp edges.

V: Veil, an extensive diffuse luminosity, fainter than Patch, usually as a background to other forms, normally white but may be pink or red.

R: Ray, a vertical shaft of light like a searchlight beam.

Symbols which qualify or describe the forms

m: Multiple, e.g. m3P means three patches.

f: Fragmentary, a part only of an arc or band sometimes after it breaks up, e.g. fA

c: Coronal: rays or patches converge like spokes of a wheel during very big displays, in the magnetic zenith which is several degrees (in UK) southeast of the true zenith.

Structure of forms

H: Homogeneous, lack of internal structure, usually uniform in brightness.

S: Striated, horizontal banding or filaments often at high altitude, uncommon in UK.

R: Rayed, addition of rays to other forms, such as RA rayed arc, RB rayed band, RP rayed patch. Rays alone are denoted RR. Lengths of rays may be indicated by R1, R2 & R3 for short, (up to 20º), medium, and long (60º+). E.g. R3B is a rayed band with long rays.

Condition of forms

Q: Quiet, no appreciable variations in brightness.

a: ‘Active’: forms move position or change shape quickly, in the order of a few seconds; this is subdivided as

a1: folding of boundaries of bands;

a2: rapid changes in lower borders of individual forms;

n: A: Arc, like a curving arch or a low rainbow which follows the curvature of the Earth, usually pale green or white.

B: Band. Like an arc but with one or more kinks or folds.

P: Patch, a diffuse cloud of light without sharp edges.

V: Veil, an extensive diffuse luminosity, fainter than Patch, usually as a background to other forms, normally white but may be pink or red.

R: Ray, a vertical shaft of light like a searchlight beam.

Figure 1. Quiet homogeneous arc with red veil above (QHA2c + V1d). D. Gavine, Edinburgh, 1999 Jan 13/14.

Figure 2. Long red and white rays, slow pulsations (p1R3R3e). D. Gavine, Edinburgh, 2001 Nov 5/6.

Figure 3. Pulsating green homogeneous patch (p1HP2c). D. Gavine, Fort Augustus, 1978 Aug 29/30.

Figure 4. Rayed band with blue sunlit tops, horizontal movement of fold along base (a1R2B2f). Lorna McCalman, Edinburgh, 2001 Apr 11/12.

Figure 5. Rayed band with blue sunlit tops, horizontal movement of fold along base (a1R2B2f). Lorna McCalman, Edinburgh, 2001 Apr 11/12.

Figure 6. Red flaming coronal rays (p2mcR3R2d). Lorna McCalman, Soutra, Midlothian, 2003 Oct 30/31.
Gavine: Observing the aurora

Reporting

Report forms are available from the Section Director but you can make up your own, like the example by one of our best observers given in Figure 8. If you are unhappy with the above coding system a sensible description in words will do. It is of particular value to include sketches showing the main auroral structures with their times of appearance.

Photographing the aurora

With modern lenses and emulsions it is not difficult to photograph the aurora, but if the display is very active and fast-moving like the huge event of 1989 March 13/14, the result can often be just a blur of light. The trick is to match the length of exposure with the movements of the auroral forms.

You will need a tripod, a cable release and a ball and socket head enabling the 35mm camera to point to the zenith. Get well away from street lights, especially sodium. A wide-angle lens, say 28mm focal length, working at f2.8 or better will enable a large section of a display to be captured, but an all-sky lens such as 16mm or even 8mm will give spectacular pictures of an entire auroral scene. Favourite slide films are 400 ISO Fuji or Ektachrome which are sensitive to the red and green auroral emissions and render them in the truest colours. In general 5 or 10 seconds will do for bright aurorae, 20 to 60 seconds for faint structures. Jim Henderson of Aberdeenshire, a professional photographer with many years’ experience of the aurora, gives the best advice. The huge displays of 2003 were also captured by observers with digital cameras, with very pleasing results, so it is worth experimenting. Always make a note of the times and lengths of your exposures, and if possible the azimuth in which the camera is pointing; this is particularly useful for analysis of photographs of noctilucent clouds, for which 3–5 seconds at f2.8 on ISO 400 has been found to give the best results.

Useful sources of information

The internet

The BAA Aurora Section maintains a website: [www.baa-aurora.fsnet.co.uk](http://www.baa-aurora.fsnet.co.uk) which has full instructions with illustrations on how to observe aurora and noctilucent cloud, a selection of recent photographs, a
Gavine: Observing the aurora

bibliography and links to other auroral and geomagnetic sites. One of the best is the site maintained by Aurorawatch UK at the University of Lancaster, which gives magnetograms from the University of York: www.des.lancs.ac.uk.

A select bibliography

Bone N., 'Lights in the sky', Astronomy Now, June 2000
Bone N., 'Two weeks that shook space', ibid. January 2004
Burtnyk K., Eather R. H. & Odenwald S., 'Fire in the sky', Sky & Tel., March 2000
Smillie D. J., 'Magnetic and radio detection of aurorae', ibid. 102, 16–20 (1992)

Acknowledgments

The author thanks Ron Livesey, Aurora Section Director, for useful discussions, and Tom McEwan for managing the Section's Aurora and NLC website.

Address: 29 Collesdene Crescent, Edinburgh EH15 2JL. [david@mylesgavine.fsnet.co.uk]

BAA Membership

The subscription rates for the 2004–2005 session are as follows:

Junior Members (under 18 years of age on 1st August) .................. £13.50
Intermediate Members (over 18 and under 22) ............................ £16.50
Ordinary Members (over 22 and under 65) ...................... £35.00
Senior Members (over 65) ........................................ £23.75
Affiliated Societies .................. £35.00
Members of 50 or more years’ standing no charge
Family Membership:
Where both Members are under 65 on 1st August .................... £83.00
Where one or both Members are over 65 ................................ £25.75
Family Membership is available for couples living at the same address. Only one Journal and Handbook will be sent although both may use the Library, attend meetings and have a vote.

Associate Membership ................... £9.25
Associate Membership is open to all, including societies, but especially to educators and those under 18. Associate Members will receive the BAA Handbook, and may use the Library and attend meetings. They do not have a vote.

Circulars (if required):
UK and Europe .......................... £4.00
Outside Europe ........................... £9.00

Postage:
Overseas postage by surface mail for the Journals and Handbook is included in the above rates. To avoid postal delays and losses use of airmail is strongly recommended. If airmail is required, please add the following:

Europe (including the Canary Islands and Turkey) ....................... £9.25
Near and Middle East, the Americas, Africa, India, Malaysia, Singapore and Hong Kong .................. £16.00

Australia, China, Japan, New Zealand, Taiwan and the Pacific Islands .... £17.70
It would be greatly appreciated if overseas members and members from the Republic of Ireland would arrange payment in Sterling on a UK Bank.

New members joining between August and January will be sent the publications of the current session. New members (regardless of age) joining between February and June may pay the reduced rate of either £21.00 for the February, April and June Journals plus the current Handbook or £14.00 for the above Journals without the Handbook.

Gift Aid

Regular UK Income Tax payers are encouraged to complete a Gift Aid certificate for their subscriptions and other donations. Please request a Gift Aid form from the Office if you have not previously completed one. The BAA can claim a tax refund at any time during the year.