

NEWSLETTER

No. 116

January 1971

THE POLAR AURORA - PART 2

In 1833, after studying the accounts of Arctic Explorers, Muncke was the first to recognise the fact that the frequency of occurrence of the aurora does not go on increasing up to the pole, but that a maximum occurs in a zone well short of the pole. This zone was plotted by Loomis in 1860 and by Fritz who in 1881 pointed out a fact of great theoretical importance, namely, that the zone appears to lie at a distance of about 20-25 degrees from the earth's magnetic (rather than geographic) axis point*. A correlation of the occurrence of aurorae with magnetic disturbances (first noted by Celsius in 1741) and of the latter with the sunspot cycle, discovered in the 1840's were the only other fundamentally important facts known relating to the aurora before the time of Fritz's discovery.

The term aurora, then, by history and common usage, implicitly refers to a visual phenomenon, and naturally it was the 'visual aurora' which received initial attention. When spectroscopic studies were begun on the aurora by Angstrom the work was of necessity done visually. He was able to detect the characteristic

*Since the IGY it has been found that the precipitation curve for auroral particles at a given instant has an oval shape and that the auroral zone corresponds to this oval only at the midnight sector. It is thought that the behaviour of the oval, rather than the zone, represents the key to unravelling magnetospheric problems.

strong line in the yellow-green region, but unable to accurately obtain its wavelength or to positively identify it. In fact, it was not until 1925 after the production of this line in the laboratory by McLennon and Shrum that it was positively identified as a 'forbidden' line of neutral atomic oxygen. The description 'forbidden' refers to the fact that while the normal period required for an excited atom to radiate is 10^{-6} to 10^{-8} secs, some atoms can remain in a metastable excited state for up to hours in certain cases. However, these metastable states are usually de-excited by collisions. This makes their study difficult in the laboratory where the pressures and sizes of apparatus used cannot be easily adjusted to reduce collision rates to those experienced by the excited atom at auroral heights (100 km) where it has a larger probability of remaining undisturbed long enough to radiate a 'forbidden' quantum.

It happens that both of the two auroral spectral lines usually strongest in the visible region of the auroral spectrum are 'forbidden' neutral atomic oxygen lines. That described by Angstrom, the green line $\lambda 5577[\text{OI}]$, $^1\text{S} \rightarrow ^1\text{D}$ has an excited state lifetime of around one second and is generally the stronger of the two. In some situations, however, (such as low latitude auroras), the other emission, the red doublet $\lambda 6300-6364[\text{OI}]$, $^1\text{D} \rightarrow ^3\text{P}$ can be stronger. This has a lifetime of approximately two minutes and hence is subject to collisional de-excitation at low altitude. Why these lines are comparatively strong, and how they are produced is still uncertain.

The green $\lambda 5577$ line is near the maximum sensitivity of the human eye but usually the aurora is so faint, when the amount of incident illumination per unit steradian subtended at the observer is considered, that it is seen by the eye mainly in its scotopic mode, i.e. by the rods which are responsible for vision in dim light, but insensitive to colour. For this reason, unless an auroral form is exceptionally intense its appearance is usually white or greenish-white. This does not mean that when integrated over the whole sky the total illumination given by an auroral display cannot be quite high (at times comparable to moonlight) or that an active display, seen with fully dark adapted eyes, is not an exhilarating sight.

Other important auroral emissions in the visible regions are the molecular bands of N_2^+ in the blue and N_2 in the red regions of the spectrum.

The N_2^+ (1st negative) emissions were the first to be positively identified in the auroral spectrum by Vegard who began his work in 1912, using photographic techniques initiated around 1900 to open the violet and ultra-violet regions to exploration. Wavelength measurements and identifications of lines were made more certain but it can be fairly said that confusion almost reigned supreme right up

until the forties. (In the last twenty years however with the development of electro-optical devices such as photomultipliers, sensitive T.V. camera tubes, image intensifiers, etc. and the refinement of optical techniques, it has been possible to measure absolute intensities with greater accuracy, and obtain spectra in seconds instead of hours resulting in correspondingly greater progress). Vegard also succeeded in obtaining the first infra-red spectrum in 1932 and can be said to have truly begun the era of the study of the optical aurora which includes the visible aurora and the large number of emissions in the spectral region extending from the infra-red to the far ultra violet. The combined intensity of the non visible part of the optical aurora exceeds that of the visible part. The study of optical aurora has been greatly facilitated by the advent of rockets and satellites which enable spectra to be obtained beyond the limits of atmospheric cut-off. For example, a third oxygen forbidden line arising from the upper state of the $\lambda 5577(OI)$ transition at $\lambda 2972, {}^1S \rightarrow {}^3P$ would be a strong feature if observed above the ozone layer which cuts off all wavelengths less than $\lambda 3000$.

Other electromagnetic emissions of the aurora are in the radio frequency regions, and in conjunction with auroral features that can only be detected by radar or sounding means these could be termed the radio aurora.

G. Webb

To my parents,

I had the strange hurry,
Of the flying saucers
And the spinning body
Of night ballet dancers.

At expected angles,
The sun was shimmering,
Like on golden spangles,
On the cells of my wing.

With infernal
Crazy cadence,
My recital
Of gold-ray-dance
Sprang up suspense
In British hearts.

Was it science
Or was it arts?

I was Ariel the third
Spreading over the world,
On a dancing music,
Data like by magic.

Alas, the die was cast.
Careless, till the last,
Of my wild spiral fall,
I was working for all,
Well up to the dead-line,
Over the Equator,
Hoping you will trace fine
My last vital hour.

From an unknown far site,
Has an unknown sailor
Seen an unknown bright light
With an unknown future?

In the breeze, with the stream,
Leaning on his elbow,
Very deep in his dream,
Very far from the crowd,
A Sailor was facing
The rapid and strange glow
And lulled by the rocking,
Has buried in his mind
The secret of your child.

Yes, I was Ariel 3;
Still I am Ariel 3;
I will be Ariel 3
For ever and ever
Since in every drawer,
From every computer,
My souvenirs, here and there,
Will expand everywhere.

Ariel

5 May 67-14 Dec 70 R.I.P.

FIRST AIDERS

Following the recent course in First Aid the Station now has fifteen persons qualified to give medical assistance.

Mr. I. Eyre	Stores
Mr. P. Allies	Workshop
Mr. C. MacFarlane	
Mrs. K. E. Shand	Library
Mr. F. D. G. Bennett	A Spur
Mr. R. J. Knight	B "
Mrs. E. Wright	C "
Mr. T. Edwards	D "
Mr. P. R. Eggett	E "
Mr. D. M. Kelley	Room 121a
Mrs. P. L. Elvins	Administration
Mrs. E. Thomas	
Miss L. Thomas	
Mr. P. Neirinck	Old Building
Miss A. Wasik	

A notice giving full details of the facilities available will be published in due course.

NO COMMENT!

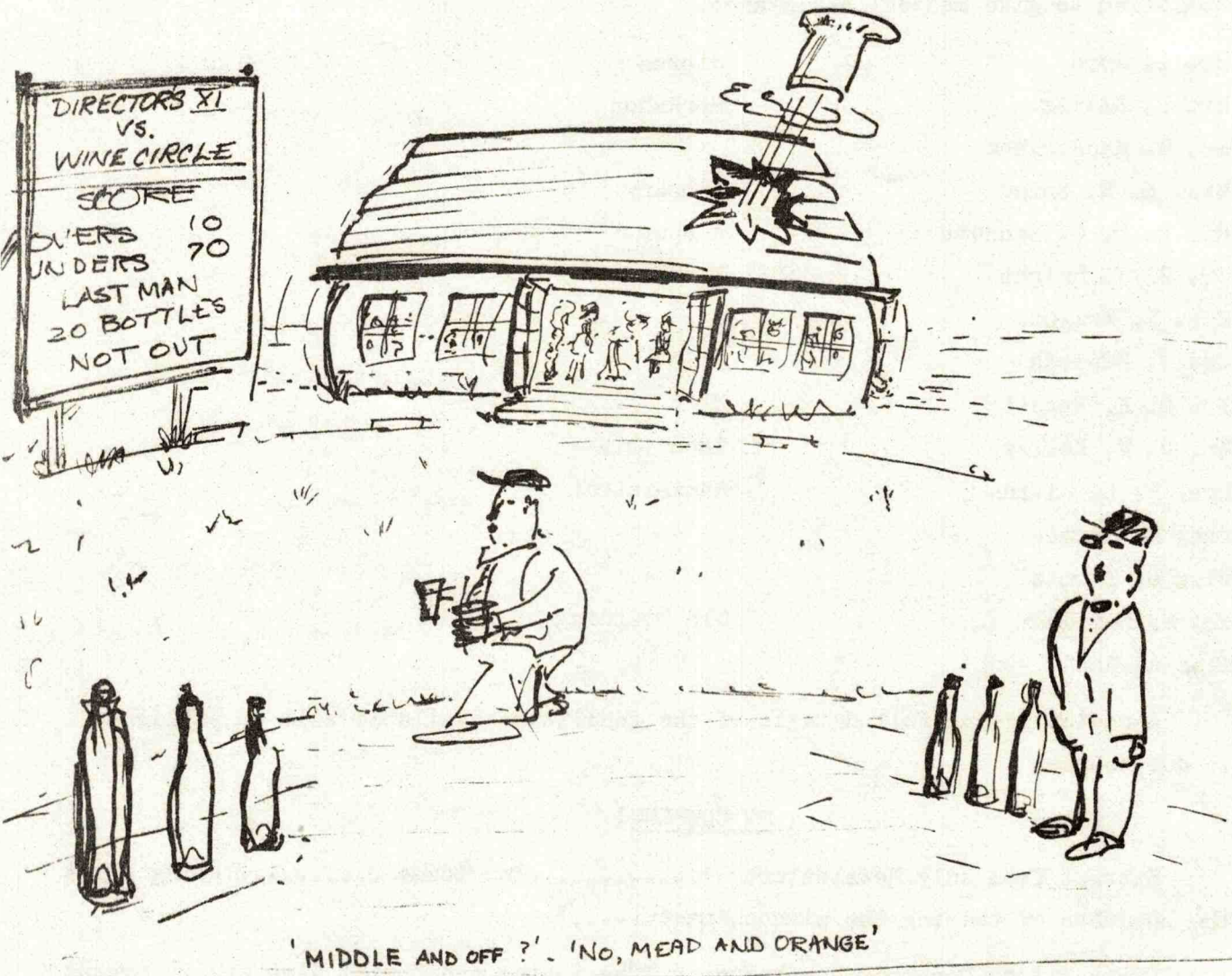
Extract from July Newsletter: '.....two teams going about the business of tearing the pianos apart.....'

Extract from December Newsletter: 'The Sports and Social Club are in urgent need of a piano'

SPORTS AND SOCIAL CLUB NEWS

A large selection of books is available at half-price, in room A12.

The Wine Circle will show a film, 'The Golden Bridge', on February 15th, at 1 p.m., in the Board Room.



STATION NEWS

Special meetings of the CCIR will be held from February 3rd to March 3rd. The meetings are being held to prepare technical information which will be used at the World Radio Conference on Space. This will take place during June and July.

The Director, Mr. Lane and Mr. Luscombe will be present at all of the meetings; Dr. Horner will attend part of the time.

STAFF NEWS

Congratulations to:-

Veronica Lovell and Chris Boulton, who were married on December 19th, at Datchet.

Mike Quigley, who has become a member of the I.E.E.

Welcome to:-

G. R. Kennedy	Exp. Off.	1.12.70
L. C. McClure	Craftsman I	14.12.70

Resignations

Mrs. J. L. Prescott	C.O.	11.12.70
C. R. Boulton	S.O.	31.12.70
Miss L. M. Norwood	C.O. (Winkfield)	31.12.70

News of former staff

We are glad to learn that Mr. Robert Naismith, a member of staff here for many years, has been appointed a Fellow of the Institute of Physics.

LETTER TO THE OUTSTATIONS

Dear Colleagues,

We at Ditton Park have been looking at the snow; all very charming it seemed when viewed from within a warm room. Enthusiasm abated somewhat after exposure to the elements for a short time, then fell sharply to zero on finding - guess what? - the boiler'd bust and RSRS was on the short list for the award of heat-sink of the year. Nevertheless none despaired; Works etc. were consulted, various outside oracles cajoled, bullied and abused, and a jury rig repair to the rift in the pipe, or whatever, enabled us to generate enough thermal noise for it to sound like work. Once again reason triumphs over cosmic cussedness and science marches ahead.

There are, they say, more people who know a fool than he is aware of. The same would seem to apply to peers of the realm, television personalities, ladies of easy virtue, and, in some measure at least, to editors. An editor, unless he or she be at the controls of some great engine of public information, has another point in common with the street walker; both must perforce solicit somewhat and both on occasion are approached with varied and interesting suggestions.

Such hints to editors are usually welcome, that they are not always acted upon may be for a variety of reasons. Thus:- Not of much general interest; Too

personal; Would place the editor in a curious and difficult position; and FAR TOO INTERESTING. The last category usually evoking such responses as, 'Does she really?' or 'Ha Ha - too bad we can't use it'.

Still from time to time we can use it, for instance the boiler episode, for which I am most grateful. For one thing suggestions generate further ideas, thus saving mental effort, for another it shows that an interested clientele has been built up in a modest way, which is all that is sought. After all, power without responsibility or the journalistic equivalent of the Shady Side of Jermyn Street has never been the wish of,

Yours sincerely,

The Editor

January 1971

List of Reprints

R. Dalziel, B. N. Harden,
D. E. Page, G. R. Thomas
and D. G. Thorpe

Satellite equipment for the measurement of
high energy electrons and protons.
J.A.T.P. 1971, Vol. 33, 71-87

E. Golton and
G. O. Walker

Observations of ionospheric electron
content across the equatorial anomaly at
sunspot minimum.
J.A.T.P. 1971, Vol. 33, 1-11

Internal Memoranda

Nil