RSRS NEWSLETTER

No. 117 February 1971

THE POLAR AURORA - PART 3

As with all studies of geophysical phenomena which have depended on many independent individual observations of a transient occurrence, there have been several attempts in the past to produce a universally accepted classification system for aurorae. Such a system would produce a complete and precise identification, description and reporting of auroral forms. The latest attempt has been by the "International Union of Geodesy and Geophysics" who prepared, for use during the International Years of the Quiet Sun (1964-65), a photographic atlas and a classification system which is described in the table. It is useful to give this table at this point because, before describing the development of a typical auroral display, it forms a self-explanatory and concise catalogue of the great variation in visual appearance that the aurora can take.

To describe what one is seeing at any moment, this table is 'played' rather like a game of consequences, i.e. by selecting one or more symbols from the first two columns followed in order by one symbol (and any necessary subscripts) from each of the other columns, for example:

a_3 f R_3 B 3 c

which for many uses (and for reasons mentioned below) is usually limited to

R B 3 c

or even

R B

Although some combinations are more likely than others it is difficult to arrive at any that would be impossible.

TABLE : THE I.U.G.G. CLASSIFICATION SYSTEM FOR AURORAL CHARACTERISTICS

CONDITION	QUALIFICATION	STRUCTURE	FORM	BRIGHTNESS INDEX	COLOUR CLASS
If only slow changes in shape or position discernable: q = quiet If changes are occurring in the order of one second: $a_{(1,2,3,4)}$ = active The subscripts refer to type rather than degree of activity. a_1 folding a_2 shape changes a_3 ray movement } usually band-like forms a_4 whole display If there is a rythmical fluctuation in brightness: $p_{(1,2,3,4)}$ = pulsing Subscripts refer to type of pulsing: p_1 pulsating - variation in brightness uniform over form p_2 flaming - surges of light over form p_3 flickering - as if lit by flickering flames p_4 streaming - variations of brightness moving along horizontal extent of form	If there are two or more associated and roughly parallel forms: $m_{(2,3...)}$ =multiple Subscript refers to multiplicity. e g. m_2 = double If only remnants or small parts of form: f = fragmentary If form is in the direction of the magnetic zenith: c = coronal Called this because complex forms appear to form a fan or corona.	If no internal structure: H = homogeneous If fine filaments (~10 km long) appear within form usually parallel with lower border S = striated If there are rays aligned along magnetic field $R_{(1,2,3)}$ = rayed R_1 short (~10 km) R_2 long (up to few hundred km) R_3 very long (up to 1000 km) R_3 is often scattered or isolated rays.	If ribbon or sheet with continuous lower border and inclined in direction of magnetic field, it is one of two BAND-LIKE FORMS: A = arc - simple curving arch (due to perspective) usually q. B = band - kinks, folds and spirals, often developes from A usually a. A & B extend mainly E-W in auroral and along sun-earth line in auroral cap regions. DIFFUSE FORMS: P = patch - localized, typical angular width ~10°. V = veil - extensive, uniform luminosity. Sometimes background to other forms. Often colour class d at low latitudes R = rays - singly, in bundles, or scattered. (note: in this nomenclature can have R_3R etc.) N = not (completely) identifiable (includes forms partly below horizon - previously called glows)	0 1 2 3 4	a: red upper region due to OI λ6300/64. May be enhanced if upper region sunlit. Generally known as typeA. b: purple/red lower border, due to N_2 first positive bands. Conspicuous in very low altitude aurora (e.g. ~70 km, when λ5577 de-excited). Generally known as type B. c: white (from low levels of luminance - scotopic vision), green or yellow. 'Normal' aurora. d: red, due to OI λ6300/64. Often at great height and/or low latitude. e: red and green, due to OI lines irregularly distributed e.g. in a_3RB. f: blue or purple mainly from nitrogen bands. Associated with active displays or sunlit upper regions.

This very comprehensive system is derived from that produced for the second international Polar Year 1932-33 under Carl Störmer, to which it is similar in many ways. However,whilst its nomenclature is adhered to in the literature in principle, if not rigorously, much, such as the use of subscripts and the revised system of colour classes,is not universally used. This may of course be a symptom of the fact that with increasing understanding the need for the more general, regular, 'auroral weather' type of observation has fallen away now that the general global picture of auroral activity in space and time has been built up. Recently, a more direct and incisive experimental approach has become necessary with specific individual observations,for instance, by means of rockets, aimed at understanding particular areas of auroral detail.*

The type of aurora that one can expect to see is to a certain degree affected by one's geomagnetic latitude. It is convenient to consider, in each hemisphere of the earth, three regions in each of which some broad generalizations can be made as to the form of displays observed. The I.U.G.G. did this by dividing each hemisphere along lines $7\frac{1}{2}$ degrees distant from, and on each side of, the line of maximum zenithal auroral frequency (i.e. defining a width for the auroral zone) and called the area between these lines the auroral region. They called the region of lower latitude cis-auroral, a rather awkward term which I have not heard in general use (people preferring to refer simply to 'low latitude aurora'). The regions of higher latitude were called, again rather unsatisfactorily, to my way of thinking, the trans-auroral regions. These latter regions are more frequently referred to as the auroral caps, a term coined first, I think, by Chapman for one of the many, more complex divisions used before the I.G.Y. at which time it emerged that nothing more than the basic regions described above would be satisfactory for general visual type separation. With increasing subtlety of measurement it now appears that there could be several distinct origins for aurorae occurring within the auroral region and that this region does seem to form a separate domain from that of the polar cap but the relationship between the two is still not clear.

Part 4 will contain (at last!) a description of the cycle of development of a typical auroral display as one could expect to see it in each of these three regions, plus an explanation of the brightness scale appearing in col. 5 of the table.

---

*An example of this would be the auroral particle observations by means of sounding rockets by the auroral particle group at the R.S.R.S. A typical recent experiment obtained the location of the modulating mechanism governing the particle precipitation by the selecting of a pulsating aurora in which the temporal-spatial structure of the precipitation could be resolved (a paper to be published by Bryant et al. in JATP describes how this was done). Only this type of approach (i.e. rather that just data gathering) will enable the fundamental processes of a 'difficult' geophysical phenomena to be finally understood.

THINGS!

There are things that go on things,
and things that come off things,
and things that go bump in the night.

There are things that go in things,
and things that fall out things,
and things that thrill with delight.

There are big things and small things,
and short things and tall things,
and things that roll under the bed.

There are thin things and flat things,
and thick things and fat things,
and things that get lost in the shed.

There are round things and square things,
odd shaped and pair things,
and things that go off in the freezer.

There are black things and white things,
dim things and bright things,
and things that crawl out of the geyser.

There are old things and new things,
'you haven't a clue' things,
and things that fit the old lock.

There are paint things and paste things
'too good to waste things'
and things from the Grandfather clock.

There are things that are bad things,
and things that are good things,
and things you can't throw away.

There are things that are somethings,
and things that are nothings,
and things that you really can't say.

There are too good to use things,
and never must lose things,
and things that are hairy on top.

There are things that are used things,
and heavily abused things,
and sadly just here I must stop.

Spring the season when winter's frozen cobwebs shrink from the early morning sunshine, when the thoughts of men are of liaison, la maitresse, et l'amour, the thoughts of women seem centered upon cleaning and redecoration.

Intimate reading of Jung and Freud is unnecessary in order to comprehend that burnt meal and extra cigarette. The lurking colour compatibility chart and last year's uncleaned paint brushes, sprouting from a desert of arid turps, suggest the season of decor and not d'amour is here. Man may try, but in vain: heredity and environment are a powerful enemy. Past failure is no alibi for the prisoner standing dazed in the dock, he is guilty before trial and the sentence begins.

Eventually all is done, the paint brushed, the paper stuck and the emulsion applied, und der Hausputz fängt an. In one drawer there is string, paper bags, last year's licence, keys to the old car, wrapping from a cube of sugar, in fact

things that go on things
and things that come off things - - - -

D. A. Lepine

STATION NEWS

Mr. Meadows attended a Senior Management Seminar entitled 'Appraisal of Research and Development' at the Civil Service College, Sunningdale, from 11th to 14th January.

Welcome to:-

A. S. Waite	Clerical Officer
P. T. Manning	AEO
H. F. Lovesey	Tech. II
J. Halley	Stores Supervisor Grade III
Miss W. Harrington	SA
E. P. Ward	TTO II on secondment from Met. Office for 3 year tour Falkland Islands
Mrs P. Vincent	P/T Cleaner

Resignations:-

A. Dagnall	EO
D. Roberts	Sandwich Course Student

Other Changes:-

Mrs J. M. Cobb	CA P/T transferred from Accounts Section to Div. 1 Group II
D. J. King	AEO transferred from Div. 3 to Div. 5
G. R. Kennedy	Arrived Falkland Islands

SPORTS AND SOCIAL CLUB

A Mad, Mad, March Masquerade will be held in the bar on Saturday, March 13th. Fancy dress is optional and tickets cost 20P each.

TABLE-TENNIS

The Table-tennis section has been fortunate in obtaining a grant from the Sports and Social Club funds for re-conditioning the table in the Old Building. The table is now virtually as new and everyone is asked to take care when using it and not hammer the surface in temper when missing a shot.

After last season's entry into the Slough Table-Tennis League the team achieved promotion from the 4th to the 3rd division. The start to this year's season was rather disastrous. At one time the record was - Played 5, Won 0, Drawn 1, Lost 4. However a recovery was made and team has not lost a match since. The record now reads: Played 13, Won 8, Drawn 1, Lost 4 and we are present lying third in the 3rd division League table.

P. Muzlish,Hon. Sec.

LETTER TO THE OUTSTATIONS

Dear Colleagues,

Dislike of writing, writing here full deep,
Deep roots from which concern for you doth spring -

These Tudor plays on the tele seem to creep in everywhere - What I mean is that for the most part, the postal strike provides a sort of grand indulgence, a blanket of general absolution and excuse for never written letters often promised. To such as I, who dislike writing,such a situation is more boon than bane, yet, for your sins, you are still subject to editorial epistle. This state of affairs argues:

a) Deep roots from which concern etc. etc.
b) In this the lack of post is no excuse
c) It's part of my job.

For others, too, at R.S.R.S. contact must be maintained with the four corners of the earth and to this end the tasks of conference and research call forth our staff like winged Mercuries - sorry, it's crept in again - anyway we've lots of chaps going to lots of places and for the last few weeks few have ventured above a mile from home without acting as voluntary postman.

In the libray is a list of countries showing a span which makes Finland to the Black Sea look a short hop. France, India, America, Scandinavia, Austria; all have received nuncios from Slough during the past month, not forgetting the near impenetrable fastness of such places as Didcot and Leamington Spa. Each foreign post office has groaned under our load, each courier juggled with payment of strange monies for innumerable strange stamps.

Strange monies skirts close to a subject I have striven to avoid, let therefore genuine Tudor close this note 'unpointed as it is thus shall it go'

from Yours sincerely

The Editor

FEBRUARY 1970

REPRINTS

NIL

INTERNAL MEMORANDA

NIL