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I-4-P5. Mid Latitude Auroras

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Recently interest has grown in the upper atmosphere radiation [OI] 6300Å. During both magnetically quiet and disturbed times it shows characteristic changes which have been the subject of recent investigations. Its behavior depends markedly on the latitude of the observer, from the auroral zone where it is a conspicuous component of visible auroras to the tropics where the activity suggests the existence of arcs directly associated with ionospheric changes.

During times of magnetic activity a stable arc, due chiefly to 6300, often occurs. The arc occurs typically at a geomagnetic latitude of about 50°. It is located in the 400 km region. An observer as much as 12° from such an are could detect photometric evidence of its existence near the horizon (at a zenith distance of 80°). Actually they have been reported from stations varying in geomagnetic latitude from 42° to 53°. Observers in the vicinity of the auroral zone ($\Phi \approx 67°$) should frequently be able to detect such arcs on the extreme equator-ward horizon but it is difficult to disentangle them from the general auroral activity.

The discovery of the phenomenon is due to D. Barbier working at the Haute Provence Observatory. Since the discovery there have been a number of publications describing many of the features which are here tabulated.

1. The only radiation which is observed to be significantly present in the arc is 6300 Å[1)-4)].

2. The arc may be physically intense but is usually subvisible (intensity less than 10 kR). The absolute intensity is proportional to the vigor of the magnetic activity[1)].

3. It extends in longitude at least 2700 km and probably farther (in one case from Europe to America)[4)].

4. It is oriented approximately along lines of constant magnetic dip[5)].

5. The height of the optical "center of gravity" is about 400 km. Its vertical extent is not known[6),7)].

6. Its geographical width is about 600 km[4)].

7. It is relatively stable in position, moving sluggishly, if at all, in a direction north to south (in the northern hemisphere)[4),5)].

8. Its observable lifetime is usually about one day; onlyrarely is it observed on two successive days.

9. Its most equator-ward position observed to date is 48° geomagnetic latitude. On a few occasions it has been south of Fritz Peak ($\Phi = 49°$) but never in the zenith of Haute Provence ($\Phi = 46°$). The zone of maximum occurrence seems to be near $\Phi = 50°$[1),2),6)].

10. On one occasion a satellite passing over an arc recorded a significant increase in the counting rate of high energy particles[9)].

11. A correlation[8)] with ionospheric parameters suggests that the origin of the optical radiation may be a pair of photochemical reactions

$$O^+ + N_2 \longrightarrow NO^+ + N$$
$$NO^+ + e \longrightarrow N + O^*$$

Table I. Coordinates of Stations from which 6300 A arcs have been observed.

Station	Geographic		Geomagnetic	DIP	B	I	L
	Latitude	Longitude	Latitude	Latitude	$h=400$ km	$h=400$ km	$h=400$ km
Haute Provence	43°55′	E5°43′	45.8°	41°	0.379	2.128	1.794
Rapid City	44°02′	W103°03′	53.1°	57°	0.483	5.513	2.978
Fritz Peak	39°54′	W105°29′	48.7°	51°	0.466	3.949	2.412
Cactus Peak	36°05′	W117°49′	43.1°	43°	0.433	2.533	1.905
Sacramento Peak	32°43′	W105°45′	41.6°	42°	0.433	2.372	1.844
Camden	−34°04′	E150°38′	−42.6°	−46°	0.487	2.771	1.958

B = intensity of the magnetic field in gauss,
I = magnetic invariant

$$I = \int_M^{M^*} \sqrt{1 - \frac{B}{B_M}}\, ds$$

where M and M^* are the conjugate mirror points in the two hemispheres, B_M is the magnetic field strength at the mirror point and the integration is along the path s.

L = the so-called shell parameter, which is analogous to the equatorial radius of a magnetic shell in a dipole field.

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Discussion

Knecht, R. W.: The connection of the low latitude red arcs to variations in the ionosphere *F* region has been rather conclusively shown by you and Dr. Barbier. Have you found any such association with your mid-latitude arcs?

Roach, F. E.: No, but we intend to look at this very shortly.