LETTER TO THE EDITORS

Comments on an Inner Maximum of Magnetic Disturbance in the Antarctic

Following Alfvén's (1955) theoretical prediction of an inner auroral zone at 5° to 10° colatitude, other workers, Nikol'ski (1956, 1957) and Meek (1957), have reported the existence of such a zone in the northern hemisphere for both magnetic and auroral activity. Herein the possibility of an inner maximum in magnetic activity during summer in the Antarctic, using the K indices and hourly ranges, is investigated. It is found that the data does not warrant concluding that an inner maximum exists.

The K indices from four Russian magnetic observatories having similar K scales have been employed to rank each day of the month according to the degree of magnetic activity.

TABLE 1
DAILY ΣK ON LOCAL DISTURBED DAYS

1958	Vostok	Pionerskaya	Oasis	Mirny
13 January	37	29	37	38
20	36	30	28	41
21	36	28	35	37
22	37	28	38	36
5 February	36	32	40	43
6	37	30	39	42
11	47	38	54	52
12	42	33	48	46
5 March	33	26	40	36
17 April	27	22	30	38
18	26	21	28	36
14 May	23	22	30	33
15	24	21	26	34
29	26	24	28	33
31	22	19	26	28
7 June	25	21	30	33
21	24	21	23	33
8 July	49	39	49	55
9	28	23	30	37
21	28	25	29	36
17 August	41	34	43	48
22	27	24	30	34
24	36	27	37	43
27	35	26	35	39
3 September	25	23	28	31
4	31	28	35	36
9	27	25	31	34
16	29	27	35	35
25	30	25	32	33
22 October	27	25	34	35
23	28	24	30	32
24	31	27	35	37
28	30	27	34	37
11 November	30	26		33
28	32	27		36
4 December	35	33		40
13	37	27		42
18	43	30		39
Average	32	27	34	38

Ranking was performed in the same manner in which K_p is used to rank the five disturbed days internationally (Bartels et al, 1961), except that each station was ranked individually. The stations; Vostok ($\phi_m=90^\circ$), Pionerskaya (80.3°), Oasis (77.4°) and Mirny (77°) lie within the 146° to 172° geomagnetic longitude sector. In table 1, the daily sum of K for the 5 locally disturbed days in each month of 1958 is listed, selecting only those days which occurred at least at three of the four stations. Stations increase in geomagnetic latitude from right to left in the table. Mirny is seen to be the most disturbed of all stations in every season. Oasis is slightly less disturbed than Mirny, and Pionerskaya is the least active of the set. Vostok indicates an increase of disturbance over Pionerskaya. The averages at the bottom of table 1 yield the same distribution.

Another method, elucidating the maximum at Mirny, the minimum at Pionerskaya, and the secondary maximum at Vostok, is the frequency distribution of K indices shown in table 2. In December, K indices of degree

TABLE 2
FREQUENCY DISTRIBUTION OF K INDEX DURING DECEMBER AND JUNE 1958

Number of Occasions on Which K Has the Value											
Station	December										Total
	0	1	2	3	4	5	6	7	8	9	
Vostok			9	98	102	31	6	2			248
Pionerskaya		4	66	102	64	10	2				248
Mirny		1	24	52	65	77	24	4	1		248
June											
Vostok	9	62	89	65	14	1					240
Pionerskaya		85	117	32	6						240
Oasis	9	17	95	89	21	5	2				238
Mirny	7	24	74	63	43	24	5				240

5, 6, and 7 demonstrate the two maxima. June shows a similar distribution at a lower overall K value. Both halves of the table, while indicating an increase of disturbance at Vostok over Pionerskaya, show Mirny to be the most disturbed. This raises the question whether Pionerskaya should be considered an anomalous low and the inner station (Vostok) merely a decrease in activity over the auroral zone stations. Mayaud (1961) has shown the dissimilarity among stations in their manner of scaling K indices. The fact that Vostok, Pionerskaya, Oasis, and Mirny are all Russian stations should enhance the similarity among scaling techniques and reduce any errors. A contributing factor in the primary maximum occurring at Mirny might be the large Z values observed by Mansurov (1961). He concludes that the vertical component is affected by electric currents induced in the ocean, and that the interior part of the disturbance field is approximately twice as great as the exterior part.

Evans and Thomas (1959) have mentioned evidence reported by the Russian workers of an inner auroral zone at $\phi_m = 82.7^\circ$ near the location of Vostok I (different from Vostok; Vostok I is about 3° south of Pionerskaya). If the existence of the zone were real and necessarily nearer to Vostok than to Pionerskaya, this might explain the high level of magnetic activity at Vostok. It is noteworthy that reports concerning regions around Little America, Cape Hallett, Cape Evans, Discovery Bay, and Scott Base are the most difficult to interpret and oftentimes contradictory in light of northern-hemisphere knowledge.

Hourly ranges have been scaled to substantiate the deductions made from the K index statistics. Fig. 1 shows the diurnal variation of the most disturbed horizontal component for January 17–31, 1958 at Oasis, Pionerskaya, and Vostok. The numbers in parenthesis following the station name are the mean ak value for these days in units of 8γ . Fig. 2 similarly displays the vertical component variation.

One can readily see that the secondary maximum apparent in the K indices at Vostok is not present in the hourly ranges. The decline in activity with increasing distance from the auroral zone is what one would expect. This result indicates that some caution should be exercised in drawing conclusions from K indices for high latitude stations. Inspection of Vostok magnetograms suggests two possible areas for error in scaling the indices. First, the component traces are oftentimes out of focus and difficult to follow when they cross each other and second, the base lines frequently drift off scale and show considerable

Fig. 1. Diurnal variation of hourly ranges in the most disturbed horizontal components for January 17-31, 1958.

Fig. 2. Diurnal variation of hourly ranges in the vertical components for January 17-31, 1958.

variation in absolute magnitude. For the present, one must conclude the K index data does not warrant suggesting that an inner maximum exists at Vostok. Furthermore, the hourly range scalings indicate a latitudinal decrease in magnetic activity inside the auroral zone similar to the distribution shown by Whitham et al (1960) for Canada.

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