

of the Es configuration do not appear to change significantly. very recently, Batista and Abdu<sup>5</sup> reported evidence of a significant enhancement of E<sub>s</sub> layer parameters: f<sub>0</sub>E<sub>s</sub> and f<sub>1</sub>E<sub>s</sub> at Cachocira Paulista (22.6° S, 45.0° W), located near the center of the Brazilian Geomagnetic Anomaly, within 1-3 days after the initiation of geomagnetic storms of moderate intensity. It is known from satellite observations that protons in the energy range 10-1000 keV exist in the equatorial region above 400 km and that their flux gets enhanced significantly during geomagnetic storms<sup>6-7</sup>. Recent calculations have shown that the extra ionization due to the precipitation of these energetic protons in the equatorial region will be significant at E-region altitudes during geomagnetic storm conditions<sup>8</sup>. The results obtained here therefore suggest a possible role of charged particle precipitation in the behaviour of night Es at equatorial latitudes, following geo-magnetic disturbances. The present investigation also suggests the need for further studies of this type at stations in other longitude zones (American and African) to obtain a detailed picture of the behaviour of night Es during geomagnetic storms.

Indian Institute of Astrophysics, J. HANUMATH SASTRI.  
Kodaikanal 624 103, B. S. MURTHY.  
February 11, 1978. K. SASIDHARAN.

1. Bandopadhyay, P. and Montes, H., *J. Geophys. Res.*, 1963, 68, 2453.
2. Awe, O., *J. Atmos. Terr. Phys.*, 1971, 33, 1209.
3. Chandra, H. and Rastogi, R. G., *Curr. Sci.*, 1974, 43, 583.
4. Sastri, J. H. and Murthy, B. S., *Ind. J. Radio and Space Phys.*, 1975, 4, 168.
5. Batista, I. S. and Abdu, M. A., *J. Geophys Res.*, 1977, 82, 4777.
6. Mizeva, P. P. and Blake, J. B., *Ibid.*, 1973, 78, 1058.
7. Moritz J. K., *Z. Geophysik*, 1972, 38, 701.
8. Rao, M. N. M., Rao, B. C. N., Geoshiv, M., Kutiev, I., Serafimov, K. and Karadimov, M., *Compt rend. Acad. Bulg. Sci.*, 1976, 29, 143.

### CRYSTAL STRUCTURE OF ZnSc<sub>2</sub>O<sub>4</sub>

A SURVEY of literature on binary spinels showed that no work has been done on this compound. The ionic radii<sup>1</sup> of both cations lie well within the range<sup>2</sup> of spinel formation. Thus it could be expected that the compound would crystallize in a spinel structure.

ZnSc<sub>2</sub>O<sub>4</sub> was prepared by intimately mixing the composite oxides of AR grade in equimolecular proportions. The mixture was heated in a platinum boat in an electrical furnace at 1200°C for 80 hours. The compound was cooled slowly at the rate of 100°C per hour.

The formation of the above compound was checked by X-ray diffractometer using filtered copper radia-

tion. Absence of lines due to the parent oxides showed the formation of a new compound. All the lines could be indexed for single phase. The crystallographic results are shown in Table I.

TABLE I  
X-ray crystallographic data of ZnSc<sub>2</sub>O<sub>4</sub>

'd' observed (in Å)	'd' calculated (in Å)	h	k	l
1.945	1.946	4	2	0
1.548	1.538	4	4	0
1.456	1.453	4	4	2
1.344	1.339	3	3	5
1.321	1.313	6	2	2
1.208	1.219	7	1	1
1.135	1.136	5	5	3
1.105	1.105	0	0	8
0.9717	0.9731	8	4	0
0.9663	0.9640	5	3	7
0.9475	0.9505	8	4	2
0.9511	0.9337	6	4	6

The crystallographic data show that the unit cell is tetragonal with a and c equal to 8.70 ± 0.01 and 8.84 ± 0.01 Å respectively. All the observed reflections show that the compound has Hausmanite structure<sup>3</sup> (distorted spinel space group I4<sub>1</sub>/amd.) In the present case both the cations Zn<sup>2+</sup> and Sc<sup>3+</sup> have spherical symmetry, i.e., they are non-Jahn Teller ions. The observed non-cubic symmetry is difficult to understand because the compound does not contain any distortive ion.

The observed symmetry (c > a) may be due to slightly greater electronegativity difference<sup>5,6</sup> between Sc<sup>3+</sup> and O<sup>2-</sup> ions and this causes localized small distortions in the coordination polyhedra, which in effect reflects in the bulk symmetry of the compound. For this reason the degree of distortion (c/a - 1) is very small (0.016).

Department of Chemistry and Physics,  
Institute of Science,  
Nagpur, India, January 18, 1978.  
D. M. DHARMADHIKARI,  
D. K. KULKARNI,  
V. V. DISHPANDE.

1. Goldschmidt, V. M., *Chem. Berichte*, 1927, 60, 1263.
2. Romeign, F. C., *Philips Res. Rep.*, 1953, 8, 304.
3. Rozhdestvenskaya, M. V., Mokiesskit, V. A. and Stogova, V. A., *Soviet. Phys. Cryst.*, 1967, 11, 765.
4. Jahn, H. A. and Teller, E., *Proc Roy. Soc.*, 1937, A 161, 220.
5. Alfred, A. C., *J. of Inorg. and Nucl. Chem.*, 1958, 5, 269.
6. —, *Ibid.*, 1961, 17, 43 and 215.