LETTERS TO THE EDITOR

ON THE HEIGHT CONTROL OF THE ONSET OF EQUATORIAL SPREAD-F

RATHER extensive information exists in literature on the morphology of spread-F (appearance of diffuse echoes at F-region hights on ionograms) at equatorial latitudes. The origin of equatorial spread-F is widely considered to be due to partial reflections from small field aligned irregularities in F-region ionization[1]. However, the physical processes responsible for the initiation and maintenance of the irregularities that cause spread-F are yet to be established. The phenomenon of equatorial spread-F is now being studied with renewed emphasis in view of its effect on VHF and UHF radio wave propagation and the recent interests in transionospheric radio wave propagation. As far as the synoptic studies from ground based ionosonde data are concerned, the current approach is to make use of the original ionogram data (instead of the earlier practice of sing published foF2 data) to gain a better insight into the phenomenon[2–4].

One of the well documented features of equatorial spread-F is the close association of its onset time and occurrence with the post-sunset rise of the F-region[2,5–7]. From a comparative study of the average nocturnal variation of h'F on nights with and without spread-F Rao[8] inferred the presence of a threshold height of about 400 km for the occurrence of spread-F in the post sunset period, around a period of high solar activity. The VHF scatter observations of Farley *et al.*[9] also indicate that the bottom of the F-region is to be above some threshold altitude for the irregularities and hence spread-F to manifest. In a very recent detailed study,[10] we have found that there is no particular threshold height for the bottom of the F-region, for the onset of equatorial spread-F in the post sunset period, under high sunspot activity conditions (mean sunspot number = 185). This prompted us to further examine the height dependence of the onset of equatorial spread-F under low sunspot activity conditions, because the behaviour of equatorial ionosphere is known to be markedly different at low sunspot activity compared to high sunspot activity conditions. The study is based on the original quarter hourly ionogram data at Kodaikanal (Geo. Mag. Lat. 0·6° N, Dip 3·5° N) for a two year period, Jan. 1963–Dec. 1964 of low sunspot activity (mean sunspot number = 19). The analysis essentially consisted of a careful examination of the quarter hourly ionogram data in the post sunset period and the values of h'F at the first post sunset appearance of spread-F are noted down for individual nights. The value of h'F is taken to represent the true height of the bottom of the F-region following accepted practice.

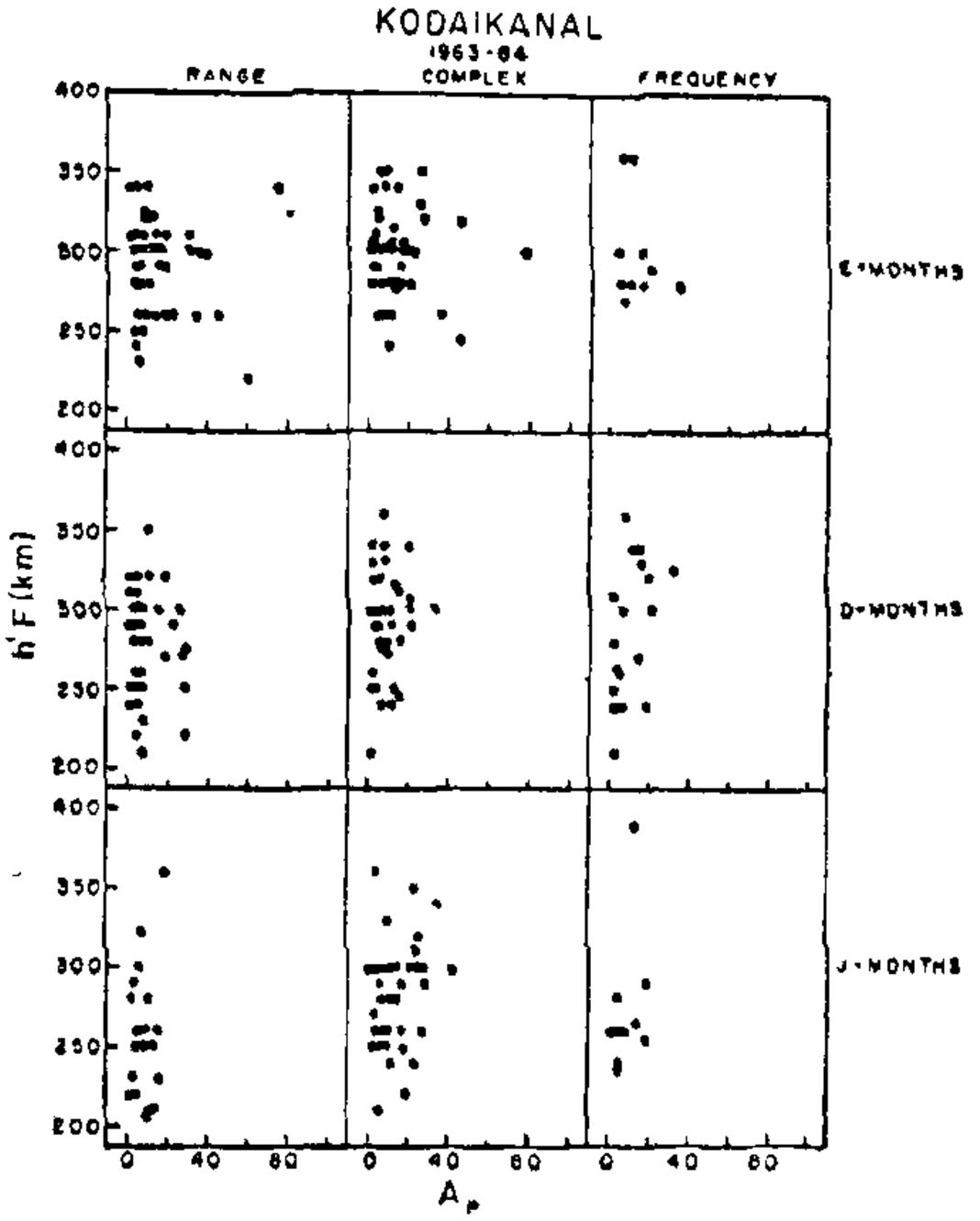

FIG. 1. Mass plots of h'F corresponding to the first post sunset appearance of spread-F at Kodaikanal during the period: January 1963–December 1964.

In Fig. 1 are shown mass plots of h'F at the time of the first post sunset appearance of spread-F corresponding to individual nights, as a function of planetary geomagnetic index, Ap. The mass plots are drawn as a function of Ap because the post sunset behaviour of h'F at equatorial latitudes is known to be influenced by geomagnetic activity and hence could contribute to variability in the values of h'F on individual nights. The season-wise breakup is felt necessary as the earlier work of Rao[8] indicates the occurrence of spread-F associated with different heights of the F-region to be dependent on season. Further, it is felt desirable to examine mass plots of h'F separately for different types of spread-F configurations in view of our observation that the spread-F configuration is not the same on individual nights at the time of the onset. This is all the more appropriate as the VHF scatter observations of Farley *et al.*[9] refer to a particular type of spread-F wherein

irregularities are present only at the bottom of the F-region. In this study, spread-F configurations at the time of onset are divided into three groups: range, complex and frequency. The range group consists of two types of configurations, one wherein spreading is present only at the low frequency end of the F-layer trace with clear cut foF2 cusps and the other wherein spreading is present over the entire frequency range of the F-layer trace. The frequency group represents the configuration wherein spreading exists only at and around the critical frequency of the F-region. Configurations which do not fall either into range or frequency group are taken as complex.

It can be clearly seen from Fig. 1 that there is considerable scatter (100–140 km) in the values of $h'F$ at the time of onset of spread-F irrespective of season and the type of spread-F configuration. This behaviour, which is very much similar to the one we have observed recently[10] for high sunspot activity conditions, establishes the absence of any particular threshold height for the bottom of the F-region for the onset of equatorial spread-F. In an earlier study, we have found that there is no particular threshold height for the bottom of the F-region for the sustenance of equatorial spread-F.[11] It is therefore concluded that the conset and sustenance of equatorial spread-F does not uniquely depend on the height of the F-region. Any theoretical study of equatorial spread-F has to take into account this feature.

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CIS-CHLORO-AQUO-TETRAMMINECOBALT(III) SULPHATE AS A PHOTOINITIATOR OF VINYL POLYMERIZATION

MOGGI[1,2] *et al.* studied the photobehaviour of *cis*-$[Co(NH_3)_4(H_2O)Cl]^{2+}$ complex at 254 nm and 313 nm and observed that irradiation of the aqueous solutions of the complex resulted in photoredox and photoaquation reactions. The photoredox products were identified as Co(II), NH_3, H_2O and chlorine atom, whereas the photoaquation was due to replacement of Cl^- ligand in the complex by H_2O. However the photobehaviour of this complex at longer wavelengths was not known. The present investigation was undertaken to follow the photobehaviour of this complex at light of $\lambda = 365$ nm and also to explore the role of this complex as a photoinitiator of vinyl polymerization. For the first time the present study reports some interesting aspects of photopolymerization of acrylamide initiated by the *cis*-$[Co(NH_3)_4(H_2O)Cl]^{2+}$ complex at $\lambda = 365$ nm in nitric acid medium at 30°C.

The *cis*-$[Co(NH_3)_4(H_2O)Cl]^{2+}$ complex prepared[3] in pure condition showed absorption maximum at $\lambda = 360$ nm and 520 nm. The rate of disappearance of monomer, $-d[M]/dt$, was determined bromometrically, the rate of complex disappearance, $-d[C]/dt$, spectrocolorimetrically and the light intensity, I, by ferrioxalate actinometry[4]. The formation of photoredox products at $\lambda = 365$ nm was evident since an aliquot of the irradiated solution of the complex in concentrated HCl showed the characteristic absorption of Co(II) ion at 690 nm. Analysis of the irradiated solution also revealed that the rates of Co(III) disappearance and Co(II) production were not equal implying the presence of photoaquation reaction. With the *cis*-$[Co(NH_3)_4(H_2O)Cl]^{2+}$ complex, in the presence of vinyl monomers like methyl methacrylate, acrylonitrile, acrylamide etc. photoinitiation of vinyl polymerization was also observed.

We summarize below the results of acrylamide polymerization photoinitiated by *cis*-$[Co(NH_3)_4(H_2O)Cl]^{2+}$ complex at $\lambda = 365$ nm in aqueous nitric acid medium at 30°C. 1. The reaction was definitely photochemical in nature since polymerization started almost immediately without any induction period in the presence of light. 2. Polymerization was also observed in the presence of sun light. 3. No thermal polymerization was observed upto 50°C.4. The steady state was attained in about 45 minutes with 20% conversion of monomer and all experiments were