27 March 1969

SOME PROBLEMS IN SOLAR-TERRESTRIAL RELATIONSHIPS

By F. Cook

Mr. Cook, a scientist in the Ionospheric Prediction Service Division of the Bureau at Sydney, opened his talk saying that his Division is concerned with the main task of predicting radio propagation conditions in relation to the state of the ionosphere. He first outlined the general structure of the electron density with height and the techniques of exploring the ionised layers by vertical incidence sounding. He pointed out that the intensity of the ionising radiation varies with the sunspot cycle, in the long term, and since at any point in the ionosphere the intensity is a function of solar zenith angle, it undergoes large daily and smaller seasonal variations. Knowing other complicating factors such as non-uniformity of the atmosphere and the existence of the earth's magnetic field, which is neither regular nor symmetrically aligned with the earth's axis of rotation etc., it is possible to forecast the ionospheric conditions. Predictions of the F_2 layer critical frequencies can now be made some months ahead, making use of the partial knowledge of the diurnal, seasonal and sunspot number variations.

Again, after a brief survey of ionospheric conditions such as the heights of reflections of radio waves of different frequencies from the E and F layers, Mr. Cook discussed the solar control of the lower ionosphere where material is only lightly ionised and recombination is rapid. Large increases in the ionisation intensity during major flares result in radio blackouts as the lower frequency waves are absorbed. Energetic particles from the flare may arrive, particularly in polar ionosphere, some minutes to hours later causing "Polar Blackouts". The upper ionosphere, upon which high frequency radio propagation largely depends, is affected by magnetic storms which are associated with increases in solar wind velocity or with arrival of plasma clouds.

This led him to discuss the catastrophic event on the sun itself - the solar flare, which has repercussions on the earth. The sun's atmosphere itself can be described in the following way. Below the photosphere, which is an optical boundary and where we observe sunspots, negative hydrogen ions absorb radiation from the interior where the hydrogen-to-helium reaction liberates energy. This energy is transmitted outwards by convection and re-radiated from the photosphere into the upper layers. The chromosphere, about 10,000 km thick, is observed by isolating one of its strong lines, H-Alpha or Calcium 11 (ultra violet), for photographic work. The chromosphere, where we observe flares, shows spicules which are associated with convection cells in the photosphere. The corona is observed by bright emission lines close to the limb, by the "streamers" and by radio emission at frequencies 30 GHz or higher, down to below 20 MHz. It is interesting to note that there appears to be some evidence that the Coriolis effect on rising hot gas in sunspots causes the spot groups to rotate slowly - those which show most rotation could be potential sources of proton showers.

The warning service attempts the forecasting of solar activity. Given an active region, what will it do next? Will it produce a flare, particularly a proton flare, and if so how soon? Secondly, given that a flare or a major event is in progress or has occurred, will there be a proton event or a magnetic storm or both? No definite conclusion has been reached statistically regarding the probability of the occurrence of a storm, given a flare. There are so many small features on the sun any of which may be associated with a storm.

Thus the solar terrestrial picture divides itself into four parts:

1. Forecasting the flares themselves.
2. Given a flare will there be a magnetic storm?
3. The effect of a magnetic storm on the ionosphere.
4. The effect of the ionospheric storm on the radio propagation.

Mr. Cook concluded his talk on this wide subject by showing films of types of solar flares and solar activity.

R.N.K.

22 April 1969

ESTIMATING NET RADIATION INTENSITIES

By E.T. Linacre

Dr. Linacre, Associate Professor of Climatology, Macquarie University, presented an outline of his studies of methods of estimating net radiation from commonly available climatological statistics.

In opening his talk he stressed the importance of a reliable knowledge of net radiation income in relation to the evaporation from crops, irrigation practice and hydrology generally. As satisfactory techniques for measuring net radiation directly have not yet been applied widely, it is necessary to devise simple and reliable methods of estimation capable of wide application.

Starting from the expression for net radiation income, Q_n, in terms of its components and introducing Swinbank's atmospheric longwave radiation formula with an Ångstrom type allowance for cloudiness, Dr. Linacre showed how after some approximation one arrives at

$$Q_n = (1 - \alpha)Q_s - 16 \,.\, 10^{-4} (100 - T)(0.2 + 0.8n/N) \ \text{cal/cm}^2 \ \text{min}$$

in which Q_s = global shortwave radiation intensity,

α = albedo of surface ($\simeq$ 0.25 for most crops),

T = mean daily screen temperature (^{o}C),

n/N = bright sunshine as fraction of day length.