domly additive or subtractive giving much wider variations in the resultant signal strength than may occur from sky wave signals only. This effect is very well known on the higher frequencies in the medium wave band as evening advances and the normally received ground wave combines with the gradually increasing strength of the sky wave signal, causing violent and rapid changes in signal strength accompanied by severe distoration of the audio signal.

Ducting

The appearance of an aurora in the northern sky is a visual indication of very intense radiation from the sun, the particles from the sun bombarding the upper layers of the ionosphere to the extent that light is produced, seen as an aurora on the earth. However its significance in propagation is mainly on much higher frequencies, as will be seen in Part 2.

Although the classical theory of propagation via the ionosphere has never been challenged, since the theory has always been borne out in practice, some further ideas have been formulated over about the last 20 years suggesting that other propagation paths are possible. These have arisen because there have been many examples of very long distance propagation with very low power levels that could not have occured by normal multi-hop propagation after the path losses had been calculated.

In addition, certain SW broadcast stations, mainly concerned with political propaganda, were observed to be putting down tremendous signals into certain parts of the world which, again, could not be accounted for by standard transmission techniques. To cut a long story short, it was proposed that these signals were entering the ionosphere but instead of being refracted and turned down to earth they were travelling along a spherical path inside the ionosphere before once again being refracted and returned to earth. **Fig. 2.** Thus the attenuation of the normal hops at the earth's surface were eliminated and the resulting signal strength considerably increased. This 'chordal hop' mode of transmission was found to represent a path of some 4000 miles in some cases.

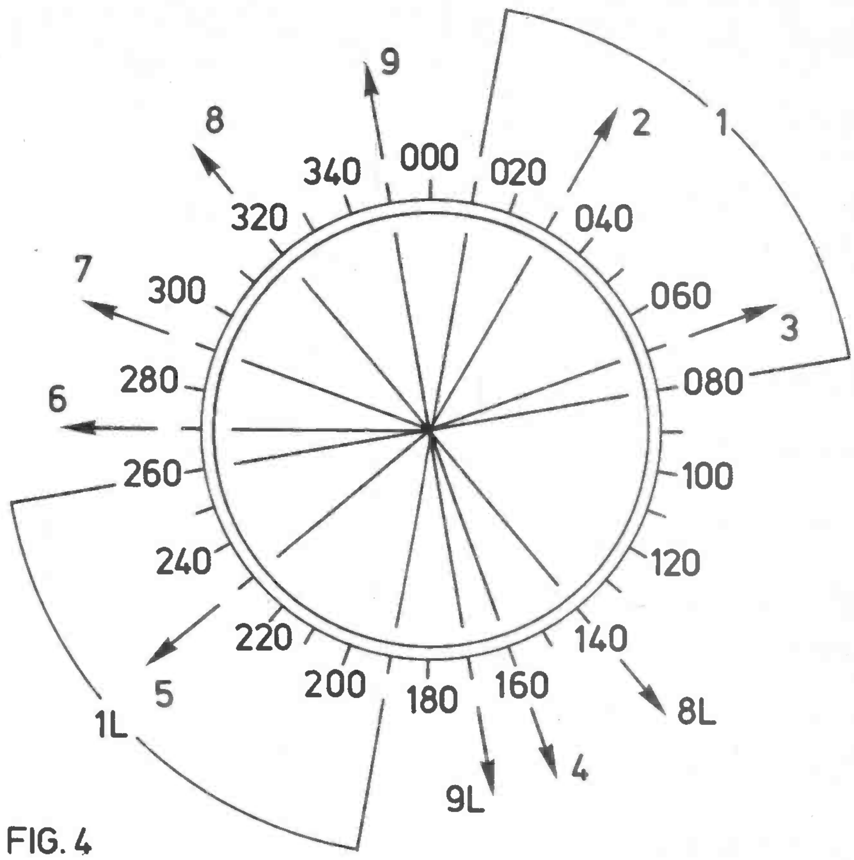

FIG. 4

Approximate great circle bearings, from the UK, to principal areas of amateur activity. Check the number on the bearing and locate that number on the appropriate table against time of year and time (GMT) to find optimum propagation period for that area. Remember that the 28MHz band is subject to large variations linked to the sunspot cycle.

1	**Australia-New Zealand**	6	**Caribbean**
1L	,, ,, **long path**	7	**East coast USA**
2	**Japan-USSR in Asia**	8	**West coast USA**
3	**Far East**	8L	,, ,, **long path**
4	**Africa**	9	**Central Pacific**
5	**South America**	9L	,, ,, **long path**

The secret was to use antenna systems having extremely low angles of radiation, much less than the five degrees that is the best that the average amateur can hope to achieve. Les Moxon G6XN, antenna expert par excellence, solved the problem by erecting a simple antenna, such as an inverted-V dipole, on a very steep slope of some 35 degrees with the slope continuing in the desired direction for many wavelengths. Thus he was able to consistently get into VK-land with powers as low as 1W.

As an alternative to the spherical path of the signal inside the ionosphere it has been suggested that parts of the layer may be tilted away from the normal giving the effect shown in **Fig. 3**, thus achieving much the same result. This field of investigation is eminently suitable for the radio amateur especially so now that we have such a wide choice of frequency bands on which to try out ideas.

Possibly the best way to sum up all the many vagaries of propagation on the HF bands in a practical manner is to look at the principal bands over four periods of the year for every hour of the day and night. This assumes average conditions, if there is such an animal, as sometimes the conditions may be bad enough to preclude hearing stations from a particular area at all or they may be good enough to allow reception over a period longer than that shown on the tables.