MORE ON HF PROPAGATION

All in all, our amateur signals have a very rough time in what can only be described as a very hostile environment once they leave our antennas. It's a wonder they ever come back at all. If we wish our radio signal to travel to the destination, we must first take into account the changes that take place during each 24-hour period as the earth turns through 360 degrees relative to the sun. We must remember, also, that the ratio of night to day is constantly changing at any point on the earth's surface giving rise to our seasons as we move in our orbit round the sun.

Winter is pretty much upon us and the higher HF bands are more or less dead by tea-time. However, 160,80 and 40m are pretty lively and some very long distance stations can be worked — if you choose your times carefully. We explain the 'how and why' of the propagation situation — with special emphasis on the lower bands.

Seasonal and Diurnal Changes

An interesting fact that is seldom appreciated, and hard to believe at first, is that we are nearer the sun in the winter than in the summer! If it were otherwise the summers would be infinitely hotter and the winters many times colder than at present. In fact, man would probably find a large part of the earth to be uninhabitable owing to the extremes of temperature. But, then again, man would have no doubt adapted himself after a few million years.

The daily or "diurnal" changes are themselves affected by changes linked to the seasons, already mentioned, when the sun's altitude runs from its lowest in mid-winter to maximum in mid-summer. Just to add to the confusion, we should remember that opposite seasons occur in the northern and southern hemispheres at any one time. When it is mid-summer in the southern half of our world it is mid-winter in the northern half, so a radio signal travelling half way round the world, on an essentially north/south path, will be subject to completely different propagation conditions at the reception point compared to the transmitting point.

To the diurnal and seasonal changes we can now add a third ingredient to the propagation "pudding", the oft-mentioned changes on the surface of the sun, the violent storms that involve the eruption of millions of tons of material many thousands of miles into the sun's photosphere and seen by us on earth as small spots on the sun's disc: sunspots. Their eventual effect on radio is to change the degree of ionisation in the various layers of our upper atmosphere and hence the propagation of radio signals. For reasons which we still do not understand, these eruptions vary in intensity and frequency over a remarkably well-defined period or cycle of, from maximum to the next maximum, around 11 years. Remarkable indeed for what, as far as we can understand, should be an entirely random phenomenon.

Sunspot maximums are seldom of the same magnitude. Not only that, but it is difficult to predict more accurately than a year or so *when* they will occur. We only safely say when the peak occured *after* the event by looking at the curve of sunspot numbers.

Just for flavour, we can also add a final dash of magnetic field, itself caused by solar activity, and thus varying enormously in intensity with sunspot numbers. It is manifested to the delight of VHF addicts as an auroral curtain in the neighbourhood of the earth's magnetic poles.

Getting down to the nitty-gritty of propagation and our endeavours to predict what is going to happen to our ionosphere in the immediate future it would be very nice if we had a network of radio transmitters all over the earth's surface sending out signals from, say, 1 to 30 MHz, and measuring the frequency at which the signal was barely being reflected back to earth. We would then know that it would be a waste of time transmitting above that critical frequency over a particular path.

Such ionospheric sounding stations do actually exist. It is thus possible to produce a chart that shows the highest or maximum usable frequency (MUF) at a given time of a given day of the year. To cut a long story short, such charts enable the communications engineer to predict the best frequency for maintaining radio communication over a set path for any time of the day, any day of the year. The benefits of such predictions are enormous and, of course, overflow into the field of amateur radio. The amateur, following the day-to-day activity of the HF bands in preparation for a contest, or just for the fun of it, is merely confirming these findings.

Propagation Predictions

The making of the actual predictions is still far from being a precise business. Published MUFs are usually more of an average value which is likely to be reached on only *half* the days of a month over a predetermined path. This is at least better than having nothing at all.

Even though everything may seem set fair for a contact over a DX path, one final hurdle has to be cleared by our poor, battered signal. In passing up to and down from the particular reflective layer the signal will be subject to absorption, an effect that varies from being almost negligible, giving excellent DX conditions, to