The mechanics of propagation Part 2

The basic facts of VHF propagation explained.

How it works

If the mechanics of radio progagation were the same regardless of the frequency being employed, life would be a bit dull on the amateur bands, whether one was using Top Band or 70 cm. As it is frequencies from about 30MHz upwards and into the UHF region are dependent almost entirely upon the six-mile thick shell of air that surrounds the earth for their occasional ability to travel hundreds and, indeed, thousands of miles, to the delight of our VHF and UHF enthusiasts.

The newcomer to the VHF bands, 144MHz in particular, can be a bit disappointed when he finds that he can only work a matter of a few miles over what is generally called 'quasi-optical' distances, that is, a bit further than the optical path between the two stations. Provided the two stations can 'see' each other they can communicate, and if one station is on the top of a mountain the range can be quite considerable.

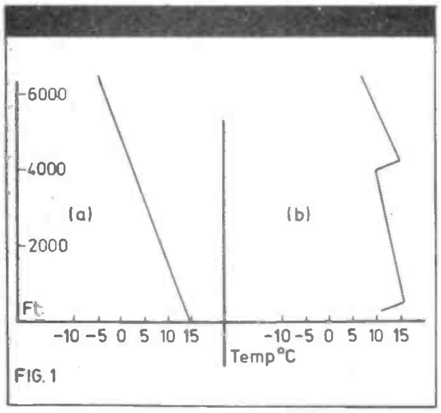


Fig. 1 (a) shows the relationship between height above sea level and the temperature of the atmosphere under standard conditions. (b) The changes that occur when condititions are conductive to refraction at around 4000ft.

But the day, or night, comes when the band seems full of Continental stations and stations in the farthest parts of the UK, and all hell is let loose as everyone tries to QSO them before 'normal' conditions return. This may be an hour or so or very much longer. So what's it all about?

Back to the shell of air where it all happens. This atmosphere, or more scientifically the troposphere, is densest at sea level as one would expect, thinning out with height until a near-vacuum is reached. The whole atmosphere, and it weighs millions of tons, is clutched to the surface of the Earth by the force of gravity. Air pressure is measured in Bars, the practical unit being the millibar, mB, with the standard pressure at sea level being taken as 1013.2mb. The importance of this measurement will be seen later.

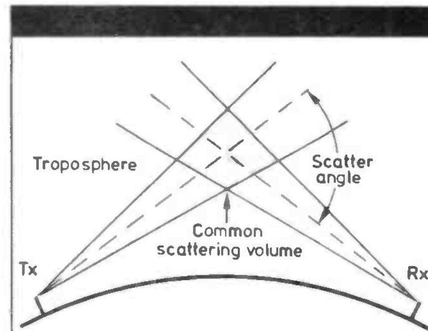
The weather charts of the UK and part of Europe shown on BBC TV are extremely useful to VHF operators and should be studied regularly if the forecasting of DX conditions on the VHF bands is to be undertaken. The maps in the daily press can be helpful but naturally cannot be as up to date as those on TV.

Tropospheric refraction

On the charts we see areas of high or low pressure which infer a varying density of air molecules. From our knowledge of the ionosphere we know that changes in the density in that region refract HF signals to the extent of returning them to earth many thousands of miles away. Much the same happens in the varying density of the troposphere. The degree of 'bending' is quantified by the 'refractive index'.

The effect of this refraction on VHF signals is to gradually bend them so that they tend to follow the curvature of the earth, following the boundary between two differing air masses, a warm air mass riding over a colder and denser air mass. This boundary occurs at heights of, very roughly, 5000ft or less. Suitable refractive effects hundreds of miles away will bring the signal back to earth again. This ducting may be a quite narrow path or it may spread over a wide area, depending entirely upon the nature and extend of the air masses boundary region.

In the summer time tropospheric bending will sometimes take place when the upper air remains warm after a hot day but the lower air is cooled off, frequently by the off-shore breezes along a coastline. The boundary between the warm



Tropospheric scatter.