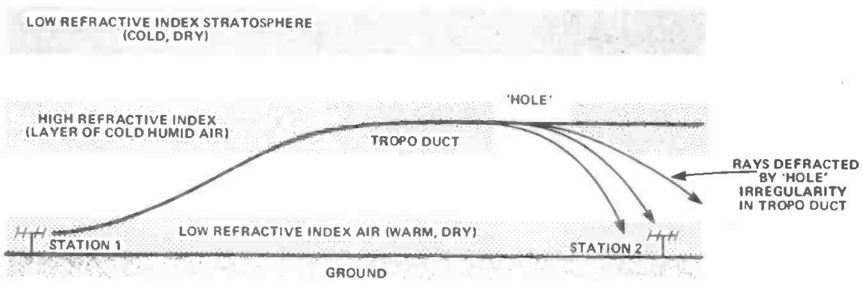

Fig. 1 Tropo ducting is the dominant propagation mode during a 'lift'. The duct comprises a layer of cold damp air caught between warm dry air near the ground and cold dry air above.

into the holes. If the aerial can 'see' a hole in the horizon sky then the signal will propagate into the duct, provided that the angle of incidence is not too great. The horizon is viewed almost equally well at any height. There is a slight advantage at being high because the angle of incidence will be a bit smaller. Radiation tends to enter (and emerge from) holes most effectively when the beam is almost tangential to the surface of the earth. However the advantage is not worth going up the top of a mountain for.

The great surface waveguide

The radio horizon chart tends to be only of limited value. OK, so you know the height of your QTH and that of the station with whom you are in contact, look up the horizon in the table and then find out that the QSO which you have been having for the last half an hour is an impossibility!

Even when conditions are completely 'flat', a half decently equipped station (particularly in respect of the aerial system) will consistently achieve distances in excess of the radio horizon regardless of whether the location is on a flood plain of some estuary or other or on a hilltop. Using just 25W of SSB each way on 2m, a colleague and friend of mine, Pete Metcalfe G8DCZ, has been able to establish a regular link up to Leicester from his home in Sussex. Neither location is particularly high — perhaps a couple of hundred feet ASL — although a workable QSO is something like an 80 per cent certainty.

All that is needed for this type of performance is an expanse of clear countryside before the first set of hills or other apparent obstructions. The aerial itself does not need to be mounted on a massive tower either. It simply needs to be high enough to see across the rooftops of the near neighbours.

The transmission mode is troposcatter, a reliance on small local disturbances in the atmosphere to forward scatter signals to a distant reception site. If you look up 'troposcatter' in the great and wise books of reference, they will tell you that you need enormous power and massive parabolic aerial to work the mode. This is (possibly) true to achieve a 99 per cent certainty of contact but the statement is, in the main, bunkum.

Troposcatter works on such a modest level because the surface of the earth comprises one great director system. In essence, the undulations in the surface of the earth and the obstructions upon it (houses, powerlines, trees, etc) serve to make a surface waveguide aerial system of truly massive proportions.

The importance of topography

The microwave fraternity have long been aware of surface waveguides. If you make an open metal channel with sinusoidal undulations in the bottom, it becomes possible to propagate a wave along this structure with virtually no loss. The ground surface can act in the same way. Of course, the action will not be nearly so efficient because the undulations are random in comparison to the operating wavelength. However, 'natural selection' takes place on the weak troposcatter wavefront. The ground illuminated by the wavefront will be covered with weak standing wave nodes, some in phase with the incoming signal, others out of phase. Those out of phase tend to radiate their surplus energy isotropically, ie in all directions, while those which are in phase 'tend to keep on coming' re-enforcing the original wavefront.

The precise value of this surface waveguide gain can be more than 6dB in a good location. It is easier to say where you won't get it than where you will. If you are in the lee of a hill, you won't get it. If the ground around you slopes down sharply before rising much higher, ie on top of a small hill in the shadow of a larger one. If the aerial view is significantly obscurred by a gas holder or block of flats. If you happen to be situated on the side of a hill (even near the top of high one)

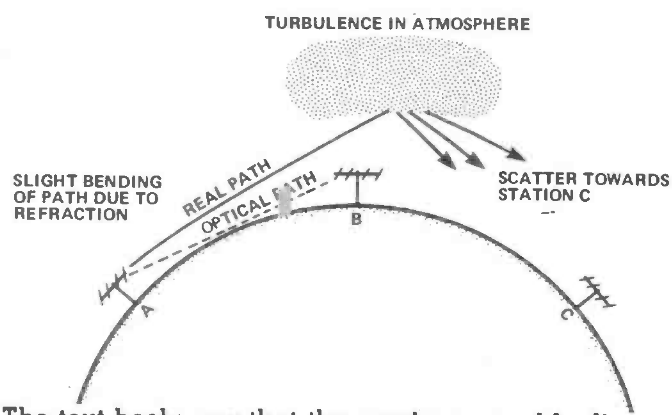

Fig. 2 The text books say that the maximum usable distance is normally limited to the optical path A to B. However, the path A to C will be likely, even under normal condition through refraction and forward troposcatter. The effect is useful on two metres and substantial on 23cm.