The ionosphere

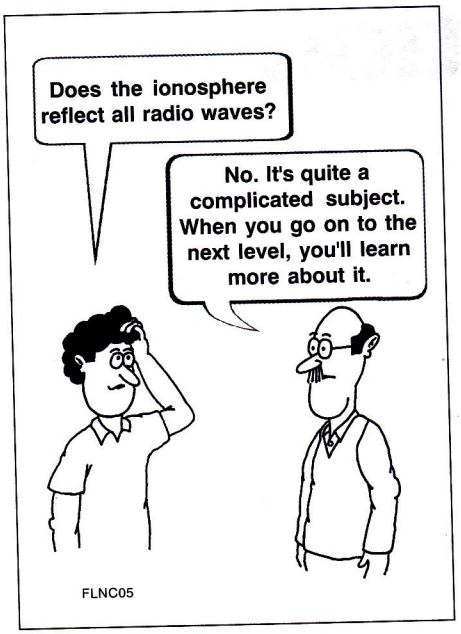
THE IONOSPHERE is the name given to layers of partially conductive gas occurring at heights between 70 and 400 km above the earth. These layers are formed by the action of ultra-violet light from the sun, interacting with the air molecules in the upper atmosphere. The details are considered in the Intermediate and Full licence courses.

For Foundation purposes it is sufficient to note that the strength or level of ionisation of the ionosphere varies with the time of day, that is the amount of sunlight. It also varies with the season, ie from summer to winter.

The ionosphere can refract or bend radio waves in the same way as a lens bends light. To see this effect in light, hold a pencil or drinking straw at an angle in a bowl of water and look through the water at the straw. It appears bent at the point it enters the water. It isn't, of course. What has happened is that the light is bent on entering the water, so the wet part of the straw appears to be in a slightly different position.

As **Fig 23** shows, radio waves travelling up towards the ionosphere may be bent or refracted back to the earth's surface some thousands of kilometres from the transmitter.

The key point about this is that the signal can now be heard far over the horizon and well beyond the range that would be achieved by a wave travelling direct to the receiver.



Frequency & time of day

THIS EFFECT IS frequency dependent. When the ionosphere is strong or highly ionised, it can bend higher frequencies back to earth than when it is weak. During the day frequencies as high as 30MHz or more may be returned, whereas during the night this may be as low as 3MHz. In the summer the highs and lows are more modest. In the winter the highs are often higher and the lows lower.

The highest frequency that will return to earth is known as the Maximum Usable Frequency (MUF). As just explained, the MUF depends on time of day and the season. Amateur radio magazines often give a prediction of the MUF for the month, so the amateur can decide which HF band offers the best chance of a contact. Ideally the band chosen should be a bit below the MUF.

Any one band may only offer contacts for a few hours each day. The band is said to be 'open'. As the morning progresses it may be necessary to move up one or two bands until early afternoon, when it may be necessary to move back down a bit. Further moves down in frequency will be needed as the evening and night progress.

World-wide propagation is possible by ionospheric or 'sky wave' paths. A single hop can travel up to 4000km. The radio wave can bounce off the earth's surface, allowing multiple hops and world-wide coverage. Part of the fun and skill in amateur radio is knowing which bands to use, at which time, and where is likely to be reached for a contact.

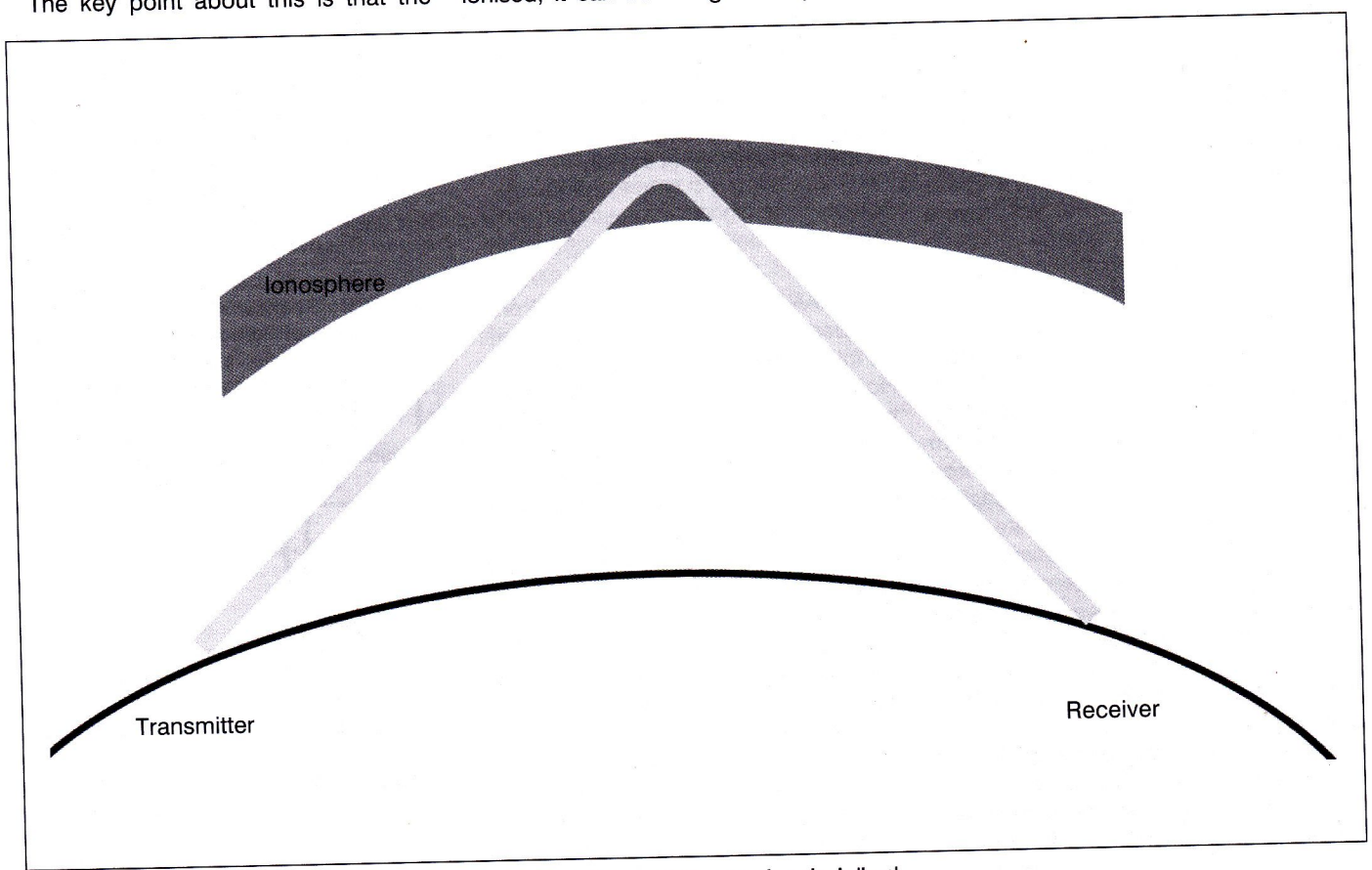


Fig 23: The ionosphere can reflect radio signals back to earth as much as 4000km away in a single 'hop'.