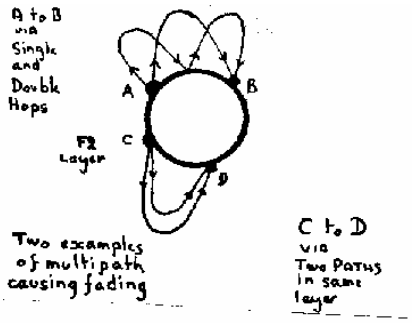
Fading

Fading causes large changes in the strength of a signal at the receiver aerial. Fading will occur when the signal arrives via two (or more) paths.



For example. Both single and double hop sky waves are received but the path lengths are very different. The result of this is that the two (or more) signals are most likely to arrive out of phase. At one moment the signals will add and a little later they will tend to cancel each other out. This is fading. Fading can occur whenever the same transmission is received over more than one path - even if they are very similar. For example the F2 layer, being broad, can refract the same signal at two different heights. A receiver with good "automatic gain control" (AGC) can greatly overcome the problems of fading.

Selective Fading

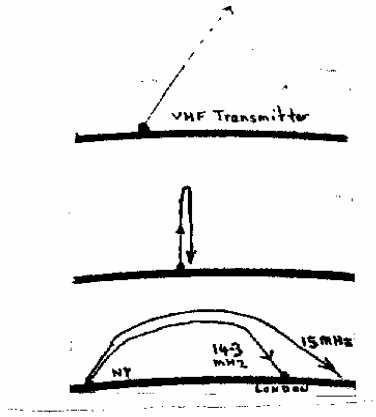
The refractive effect of the ionosphere varies with frequency. Usually this is gradual but dramatic changes are possible causing adjacent frequencies to be affected very differently. X+ this difference occurs within the bandwidth of a transmission severe modulation distortion will take place. The signal is suffering selective fading and speech may become unreadable.

Fade Out

This is quite different from fading. A major flare eruption on the sun will rapidly increase the ionisatlon of the E layer. Its absorption will dramatically increase for a period of up to two hours. Many radio signals will suddenly disappear during this time.

What hapoens if higher freouencies are used?

Remember the D Layer is counter-productutive. It mainly **absorbs** the radio waves rather than refracting them.
The absorption becomes less as the frequency is increased. VHF passes through this and other ionised layers with little alteration and little refraction. At the other end of the scale, low frequencies (EG 1.8MHz) are completely absorbed by the D Layer. Between these two extremes, the effect of these ionised layers on various frequencies will depend on the daily and seasonal ionospheric variations. This brings us to two important definitions:



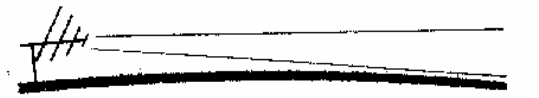
The Critical Frequency is the highest frequency signal that, when transmitted straight up, will be *reflected* (total refraction) back to earth at the same point.

Maximum Usable Frequency (MUF) This is maximum frequency that can be used to communicate between two stated places.

It is important to understand that a MUF has to include the path and the time.
For example: at noon yesterday the MUF between London L New York was 14.3 MHz.
This does not mean that higher HF frequencies cannot be used to other places or at other times……and this leads on to other things…….

VHF (and above) Propagation

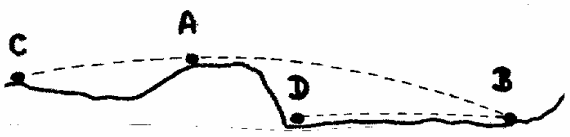
At frequencies above 30 MHz the propagation is rather different. The signals tend to travel more or less in straight lines. As they dont get refracted by the ionosphere those going up, go on and on to get lost in space'. VHF aerials are usually designed to transmit the VHF signal in a narrow beam, parallel with the earth's surface.



Does it bend?

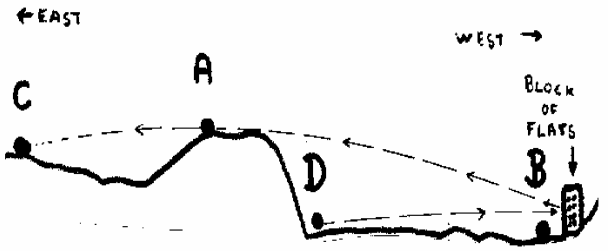
The lower VHF frequencies do bend, to follow the curvature of the earth to a certain extent. In general, reliable communication at VHF ~ UHF Is limited to a little beyond the line of sight.

Are you over the hill?



At VHF the terrain becomes very important. If you intend to operate on the VHF/UHF Amateur Bands you should try to live on top of a hill'. But of course you may not be able to arrange this...

If you live at A you would easily contact stations at B,C or D. The amateur living in his valley at B would be able to contact you at A and the other station In his valley (D). Contact with C may also be possible with the slight bending that can occur. However, the poorly sited station at D is right in the shadow of the hill and may only be able to have reliable communication with B.



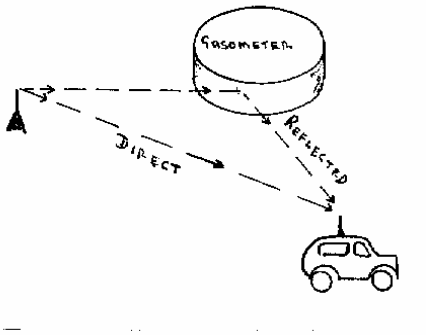
When can an obstacle be an advantage?

There is a large block of flats behind the amateur at B. This may well be an obstacle for him restricting his contacts beyond it. But for the Amateur poorly sited at D it could be a bonus.

D wishing to make contacts to the east (left) would get nowhere pointing his aerial in that direction. It is straight into the large hill. However, by turning It ISO degrees and beaming to the west the signal would hit the block of flats (or any large object) and be reflected back to A and perhaps even C. Both natural (hills, cliffs etc) and manmade obstacles (buildings, gasometers etc) can be 'used' to your advantage, enabling VHF to go round corners.

But obstacles do cause problems

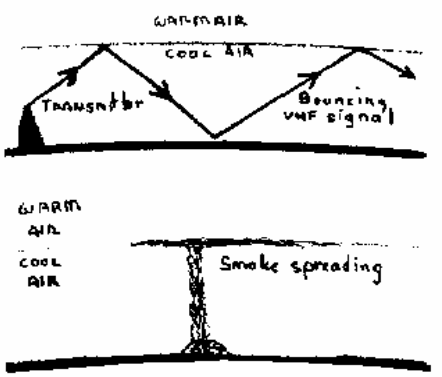
The reflections could cause multipath reception. If two signals (one direct and one reflected) arrive out of phase the signal at *P* will be less than expected. If B is a moving car the phase relationship between the two (or more) paths will change continuously. This results in rapid fading that varies with road speed. This mobile flutter is much faster on UHF than VHF and as such is less objectionable.



Sporadic E

During the summer months clouds of exceptionally dense ionisation form, move around and decay In the E Layer. All this happens in a few hours. During this time, which is most likely to be in the morning (0900-1200) or the early evening (1700-2000). Such a cloud will refract VHF signals resulting in contacts of 2000 KM at 50 MHz and perhaps 1750 KM at 145 MHz.

Tropospheric Ducting - watch for smoke signals



Normally temperature drops with altitude. However, sometimes weather conditions change this and there is a layer where temperature rises with height and then reverts to normal.This is known as a temperature inversion and will duct VHF signals over long distances.

If, on a fairly still day, smoke (from bonfires etc) rises until it seems to hit a horizontal sheet of glass!
- it is a good indication of a temperature inversion.

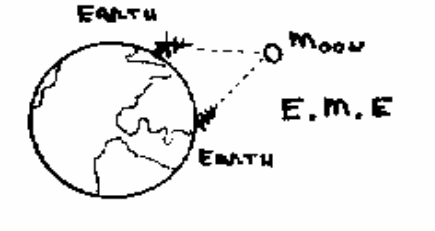
Aurora or Northern Lights

As well as being a beautiful sight the ionised waving curtain also reflects VHF radio signals. This waving causes large Doppler frequency shift which often makes Morse necessary rather than ghostly speech. Contacts can be made between UK and Finland for example, by beaming north from both countries. The *Northern Lights* result from large solar flares on the Sun.

Meteor Tail scatter

When meteors pass through the earths atmosphere they create short term ionised tails behind them. It may last only for a few seconds but contacts over 2000KMs are possible. Speeded up Morse is usually sent and a tape recorder used at the receiving end to slow it down again.

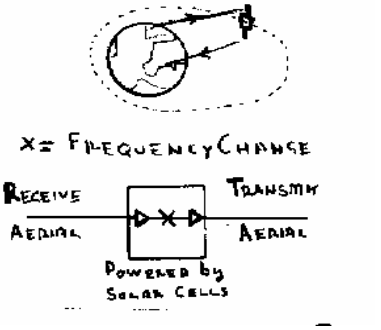
Not always "lost"



VHF/UHF signals are not always lost for ever when they pass through the ionised layers. They can be reflected by the moon or received by satellites

Bouncing off the Moon

VHF/UHF is possible to the other side of the world using moonbounce. This is a very specialised mode which requires high gain aerials, high power sensitive receivers.
The moon is not an easy "target" to hit with a radio wave - and it keeps moving...



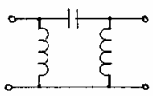
Amateur Satellites

As with moon-bounce, amateurs using satellites must follow them across the skies with their aerials.
Unlike domestic TV satellites, they are constantly on the move relative to the earth in non geostationary orbits.
Unlike the "passive" moon an Amateur Satellite re-transmits the received signal on another Amateur Band.
EG: A satellite could receive in the 433 MHz band and retransmit it In the 145 MHz band.

Questions for Lesson 8B

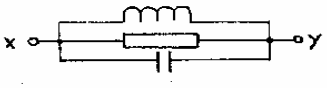
8B/1) Is fading due to:
a) Changes in transmit power b) Signal. arriving out of phase
c) Mixing of two frequencies d) Changes in the I.F. amplifier

8B/2) Is this filter
a) High Pass b) Band Stop
d) Low pass d) Band Pass



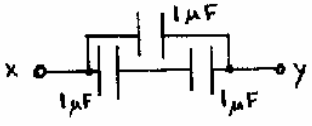
8B/3) The Maximum Usable Frequency (MUF) is:
a) the maximum frequency that can be used to communicate between two stated places
b) the maximum frequency that can be used to communicate between two places in different continents
c) the maximum wavelength that can be used to communicate between two stated places
d) the maximum frequency that can be used to transmit from a stated aerial

8B/4) At resonance this circuit is purely
a) capacitive b) reactive c) resistive d) inductive



8B/5 Which mode of propagation takes advantage of a temperature inversion?
a) Ionospheric ducting b) Waveguide ducting c) Frequency Inversion d) Tropospheric ducting

8B/6) What is the total capacitance between X and Y?
a) 3.0 uF b) 1.5.uF
c) 0.5uF d) 2.0uF



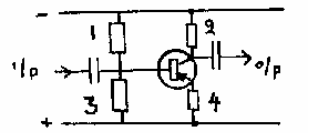
8B/7) An amateur satellite
a) reflects b) refracts c) re-transmits d) restricts
the signal that is sent up to it.

8B/8) A transformer has a turns ration of 1:3
What will be its output impedance if the input impedance is 4 Ohms ?

a) 12Ω b) 24Ω c) 18Ω d) 36Ω

8B/9) What can result in a "fade out" ~
a) Desert fire b) Excessive tidal variation
c) Melting icebergs d) Flares on the sun

8B/10) Which resistor is provided to prevent thermal runaway?
a) 1
b) 2
c) 3
d) 4



8B/11) Which type of feed-back is used in an oscillator?
a) Positive b) Negative c) None d) Inverse

8B/12) Which is the correct formula for "Depth of modulation"?
a) A/B x 100%
b) (B-A)/(B+A) x 100%
c) (A+B)/(B-A) x 100%
d) B/(B-A) x 100%