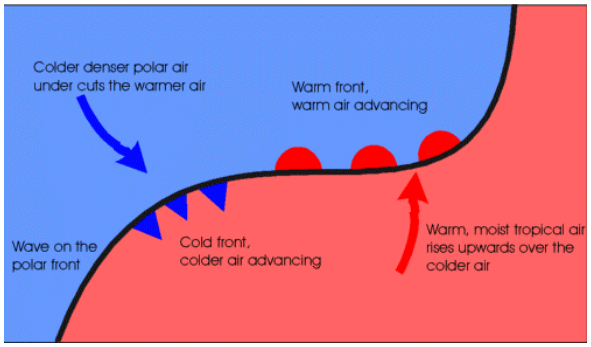
8. Depressions & Anticyclones

Depressions

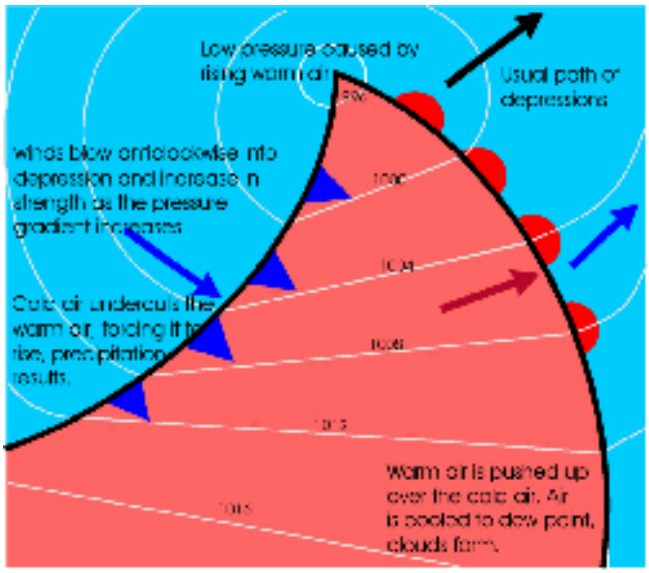
Depressions or cyclones or, more commonly, "lows" play an important part in the weather of the British Isles, tending to bring rain and strong winds. The polar front separates two air masses with contrasting properties; cold "polar" air to the north and warm, moist "tropical" air to the south. The line of the polar front is usually found across the North Atlantic between Newfoundland and Iceland - further north in summer and further south in winter. It is here that depressions or low pressure systems are born. A depression starts simply as a wave in the polar front, but this can deepen rapidly and develop a characteristic frontal pattern. Depressions follow a life cycle of about 2-5 days.

1: Embryo Stage



Depressions develop from small waves in the polar front (by a process called "frontogenesis"). The polar front is where cold air meets warm air; often cold dry polar continental (Pc) air meeting warm moist tropical maritime (Tm) air. Convergence of the air masses results in the warmer air being forced up over the colder air in a spiral motion. The upward movement of the air results in "less" air at the Earth's surface giving an area of below average pressure, known as a "low". The wave develops and the kink becomes more pronounced. The developing depression with its warm front and cold front usually moves in a north-easterly direction under the influence of the upper westerlies, i.e. the front of the polar jet stream.

2: Mature Depression



A mature depression is recognised by the cold front starting to catch the warm front up. The pressure continues to fall as more and more air is forced to rise. As the pressure falls and the pressure gradient increases, the inward blowing winds increase in strength. Due to the Coriolis force these winds blow anticlockwise. Different effects are produced when each of the fronts of the depression pass over.

Warm Front passing over

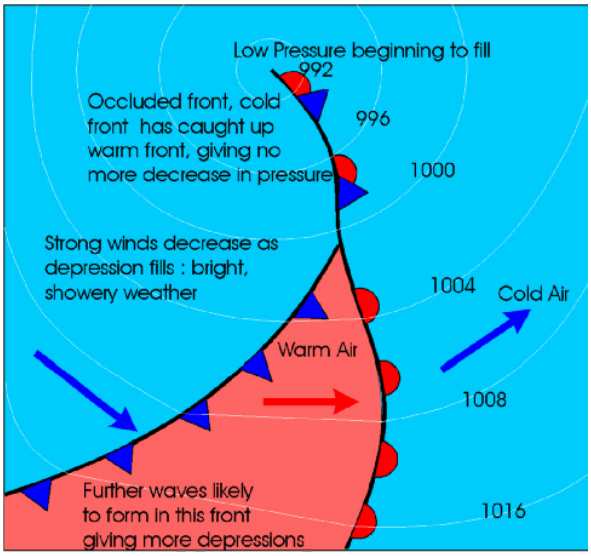
- As the warm air is forced to rise its temperature falls below the dew point and clouds are formed. The continued uplift and cooling produces precipitation as the clouds become thicker and lower. Satellite pictures show that there is likely to be a band of precipitation which extends up to hundreds of kilometres in length and can be 150 km wide. As the warm front passes over temperatures rise, the uplift of the air decreases, low cloud may

break up, and there is a chance of sunshine. Then next the cold front passes over, this moves faster and has a steeper gradient than the warm front.

Cold front passing over

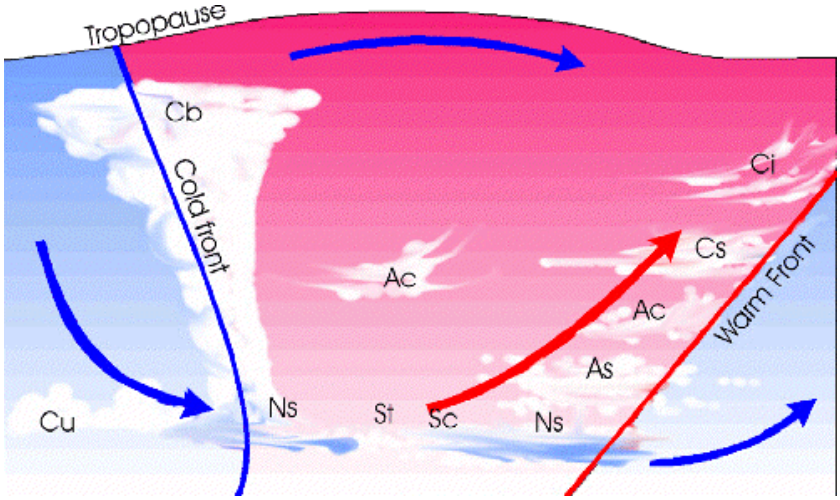
- At the cold front there is a second episode of precipitation as the warm air is once again forced to rise. Although this episode is more intense (due to the steeper gradient of the cold front) it is of shorter duration (to those of us on the ground). This band of precipitation caused by the cold front is not as wide as the band of rain due to the warm front. A cold front is usually 10-50 km wide (c.f. 150 km for a warm front). The air behind the cold front is cooler than before, but even so it becomes unstable, forming cumulo-nimbus clouds and heavy showers. Strong winds often occur at this stage too.

3: Decay



The depression begins to decay when the cold front catches up with the warm front, forming an occluded front, or occlusion. By the time this has happened the warm air has been squeezed right up so it is no longer in contact with the ground. As the uplift of the air is decreased, so too are the amount of condensation, the amount of cooling, and the amount and pattern of precipitation. Often there is only one episode of rain. Later cloud cover begins to decrease, pressure rises and wind speed decreases and the colder air replaces the uplifted air and "infills" the depression.

The following diagram shows how the cloud cover changes as a depression passes above. You can see the cold air undercutting the warm air at the cold front (left hand side) and the warm air being forced up over the cold air at the warm front (right hand side). (Note that this is a diagrammatic representation and the fronts are actually at a much less steep angle.)



General Points Concerning Depressions

- In winter the polar front moves south to lie roughly on a line between the eastern seaboard of the USA and the British Isles. Hence depressions crossing the British Isles are more likely in winter.
- If the Azores high extends northwards - as is usual in summer - it pushes the polar front northwards away from the British Isles resulting in warmer, more settled weather.
- The centre of a depression generally moves parallel to and at the same speed as the wind in the warm sector.
- A wide warm sector means that the depression is likely to deepen.
- Small developing depressions move quickly and tend to follow the main airstreams.
- Depressions move from areas of rising pressure tendency to area of falling pressure tendency.
- Depressions tend to follow the flow of air around large stable anticyclones.
- Families of depressions tend to follow the parent one, with each new one starting progressively further south.
- A secondary depression tends to move around the primary.
- A warm occlusion tends to follow the line of the warm front.
- A cold occlusion tends to follow the line of the cold front.
- A depression slows down as an occlusion progresses and may even cease altogether.

Anticyclones

In contrast to depressions, anticyclones only involve one type of air mass, usually involve large areas, and do not involve fronts. An anticyclone is a large mass of subsiding air which produces an area of high pressure. The air converges in the upper troposphere where the air has little moisture content and descends down the air column. As it descends it warms up and so warm, dry air arrives at the ground. It then diverges and winds blow out from the centre spiralling in a clockwise direction (in the northern hemisphere). The pressure gradients in such a feature are gentle and so there are light winds and calm conditions. Anticyclones can be very large typically at least 3000 km wide, much larger than depressions, and once they become established can give several days of warm settled weather with clear skies.

Anticyclones do not always produce fine weather. They sometimes produce temperature inversion. This means that daytime heating may lead to a layer of instability below the inversion giving stratus clouds. This is known as “anticyclonic gloom” and may produce persistent drizzle. Because anticyclones are very stable and stay in one place they can divert mid latitude low pressure systems around them. Anticyclones often develop in Europe over Scandinavia and Siberia in winter and over the Azores in summer. Anticyclones are never found over the equatorial regions because they are dominated by low pressure.

In Britain in summer an anticyclone will mean heat waves during the day, but as there is no cloud cover, the nights will be cold and mist or heavy dews will form. After a few days a layer of hot air is built up at ground level which will eventually break away giving thunderstorms and ending the anticyclone.

In Britain in winter we have short days and long nights. This means that when we have anticyclonic weather there is intense radiation cooling during the night time leading to severe ground frosts. Over several days, a ground layer of very cold air is built up causing a temperature inversion. In this case we often get fogs, which are slower to clear than the summer mists.

The very stable conditions present in anticyclones mean that pollution can be held to the ground giving very poor air quality e.g. smog. Summer poor air quality is caused by the photochemical reaction of exhaust gases because of intense insulation giving low level ozone and there are no winds to blow it away because of the stable conditions.