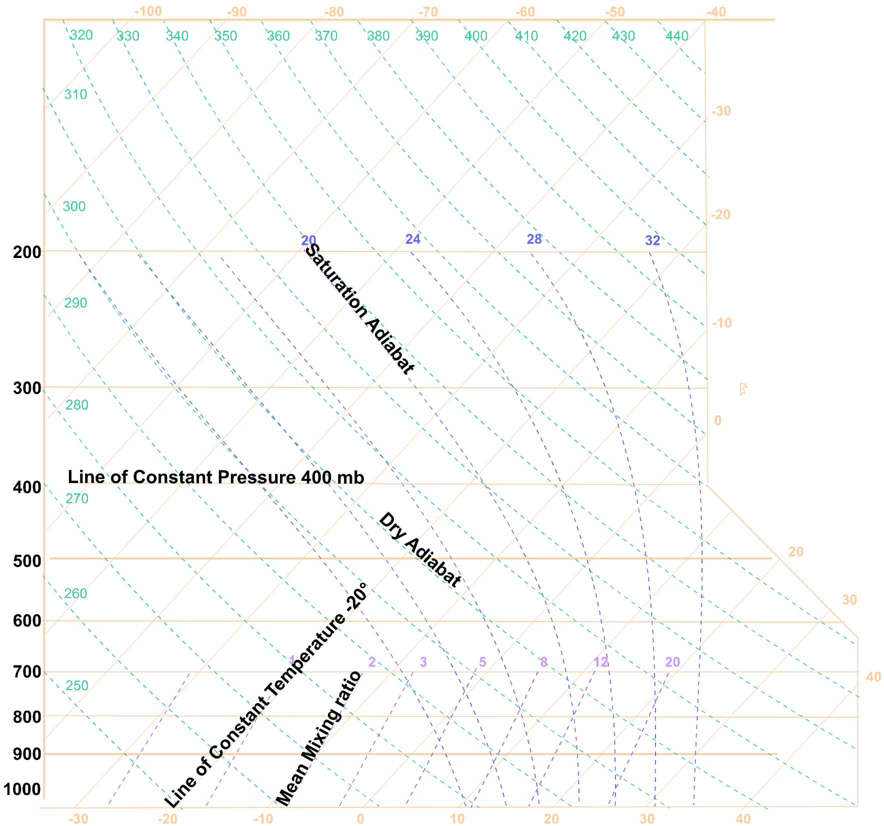
Temperature trace.

The temperature trace, known as an F160 is with the weather chart one of the most useful pieces of information that the weather bureau can give us, but many do not understand what it is and how it works. With some very nice computer programs that use information from the temperature trace, to give us details on the day, we become lazy and in turn loose the ability to read this very useful document. So let’s look at what it is and how it can help us.



First let us look at the basic chart that we will soon draw the data on. There are a number of lines chris-crossing the chart these are as follows.

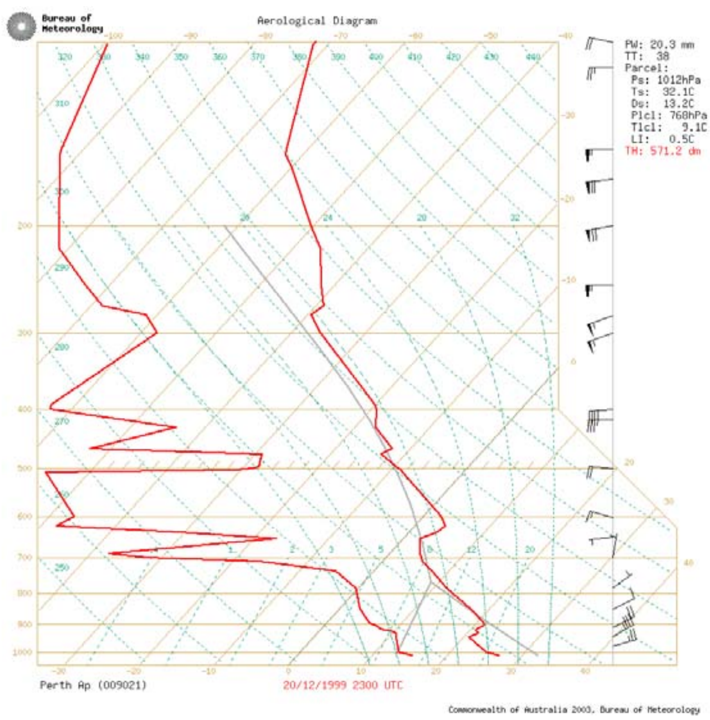
Line of constant pressure / Height. They are shown in Millibars this produces the first area of confusion but the calculation to measure height is easy. Zero ft is the air pressure at QNH this varies a little depending upon the day. You will notice on Graphs particularly up north with low pressures how the start of the trace is a little up the chart, but minimally. In other words if the pressure at sea level is 1008mb then the graph drawn will start at the point of 1008mb. As a guide for each 100mb is about 3000ft, this is as accurate as we need to know.

Line of constant Temperature. Lines of constant temperature on most graphs you would think would go vertically upwards. The problem with making this particular chart this way is that if the lines of constant temperature were vertical the graph would lean back to the left with height to such a degree that the width of paper would be excessive. So to reduce the paper width the lines of constant temperature move to the right with height. Remember as a rule of thumb air cools at 3° per thousand feet, so the lines of constant temperature will lean to compensate this. All to protect trees and reduce the size of compute monitors.

Dry Adiabat. These lines indicate the temperature a bubble of air would cool at as it gains height. To clarify if a bubble of air rising as a thermal starting at say 10°C rises from the ground it will dissect the 700mb line at –20° a cooling rate approximately 3° per thousand foot.

Saturated Adiabat. Should the bubble of air cool sufficiently to form into water droplets and form cloud it gains latent heat. (Latent heat can be described as follows. When boiling water it takes energy to convert water into steam, this is latent heat. Now as every action has an equal and opposite reaction if the water vapour turns back into water droplets latent heat is given back.) As the water droplets are being formed they will give off latent heat and therefore the cooling rate will be lower than the 3°C per thousand feet. Now a saturated bubble will cool at about 1.5°C per thousand feet, but this depends much on initial temperature and height.

Mean mixing ratio. These lines are drawn to indicate at what temperature and height cloud will be formed. We will see their use in the next diagram.



Now let us look at a diagram where the temperatre trace has been drawn in. Each day two lines are drawn, the right line being the **Environmental laps rate**. This being a plot taken by the baloon giving the temperature of the air with height. The left line is the due point line, that being the temperature at which the air would form cloud if it were cooled to that temperature. If these lines come close to each other at any point it would be the case that cloud will form.

The Bureau draws in three grey lines for us as well. The right component of the bottom triangle is usually drawn from the maximum temperature for the day 32°C in this case, and the line follows up the dry adiabat line. The other line on the left of the triangle starts at a point of the average due point for the bottom 50mb, and follows the mixing lines until it intersects the right grey line mentioned. Should these lines intersect to the right or close to the environmental laps rate then cumulus will form at that height. If on the other hand they intersect to the left of the environmental laps rate no cumulus will be formed. Further study of this diagram would indicate that cloud would probably have a base at 780mb about 7,000ft provided 32° was reached and certainly if a hot spot of 33° was found. In addition it is necessary to note that the start of this line should not only start at the temperature but also the height. So if it reaches 32° in this case and you are flying over terrain 1000 ft above the place the balloon was launched for the trace you can start your grey line at this point, in effect moving the grey line to the right and in the diagram above it will now appear to the right of the environmental adiabatic laps rate. It will intersect with the grey mixing line to the right of the environmental laps rate and thus form cumulus for certain.

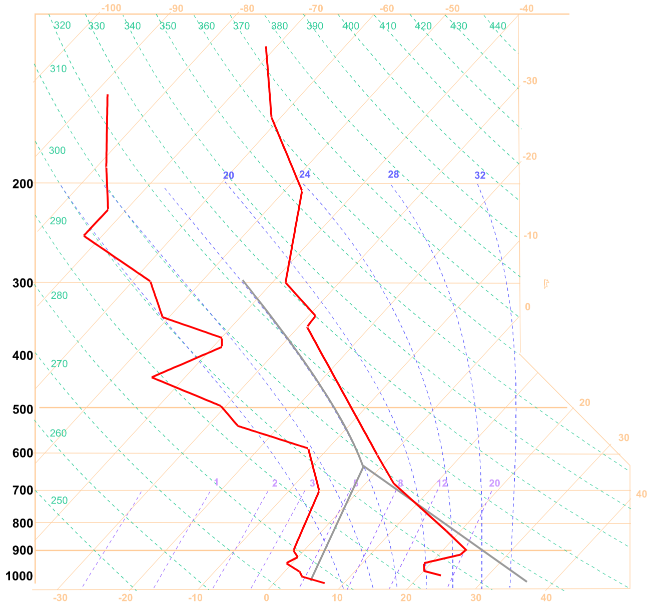
Now there is a further grey line that starts from the point where the two previous lines intersect, 780mb in this case being about 7,000ft, this line follows the saturated adiabat. If this line is to the right of the environmental laps rate cumulus will continue until it crosses to the left of the environmental laps rate, 650mb in this case, where there is a strong inversion. This will be the top of the cumulus. So studying the diagram, if we get a maximum of 32° it will probably be blue. If we get 34° we will get lovely Cu, if we are 1000ft above Perth and it reaches 32° we will get Cu. Incidentally this trace was for the first day that 1000 k was flown at one of the gliding clubs local to Perth.

Note further that at the point of the formation of cumulus assuming a 32° day there is quite a gap between the due point line and the environmental laps rate, this will give nicely spaced out cumulus. If on the other hand the dew point line and environmental laps rate were closer the cumulus would tend to over develop horizontally, and the cumulus would tend linger longer, often enticing the pilot to a non existent thermal.

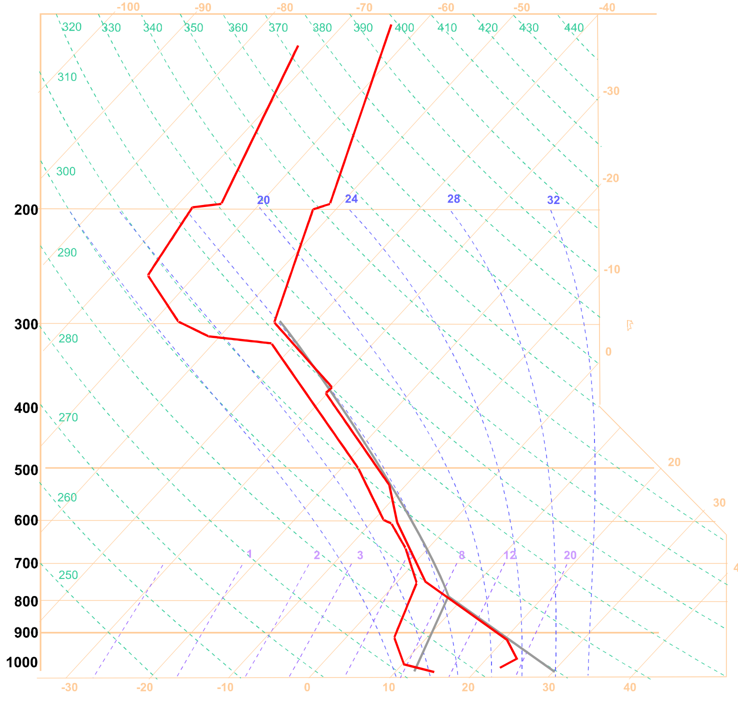
There are two pairs of lines drawn on the chart issued by the Bureau, not in the diagrams I have shown, the heavy one being the most recent trace and the light pair of lines being that of the baloon sent up 12 hours previousley. At the bottom of the chart is the time that the traces were flown, but note they are Grenwich mean time 8 hours after West Australian Standard time.

Let us now look at a couple of other sample charts.

This chart is relatively unexciting as a glider pilot. A strong inversion up to 900mb possibly from the previous night's sea breeze, a late start for the day. If the overnight minimum were taken at the club and it were known to be higher than the lowest temperature in this case 22°C then you would have an indication that the inversion were not so strong were you would be flying, so possibly higher temperatures and an earlier start than were the trace was produced. The chart indicates a maximum temperature of 38°C and no cloud formation, but may be if the area were a little damper, perhaps over salt lakes or if the temperature got a little higher then cumulus may form.



Now for an exciting chart, not a day to be flying. This chart is of the night of the November 18 2001 with incredible lightning, like I have never seen before. You can see from the chart that at a temperature of 30°C the dry adiabat line will bisect the mixing line at 800mb (6000ft). Just to the right of the environmental laps rate. Now the saturated air will continue to rise as it is still to the right of the saturated adiabat all the way to 300mb. Not only this you will see that the due point line is running virtually parallel and close to the environmental laps rate indicating that the air is very moist thus allowing plenty of extra cloud to be formed and an exciting night watching lightning strikes.



Should you wish to obtain the charts go to www.bom.gov.au. Click on "Aviation Users", then "Gliding and Hang gliding Vertical temperatures", you will be asked for the user id this is mentioned on the page bomw0007 and the password is aviation. Now click on the map to select the trace you require and bingo there it is.

James Cooper