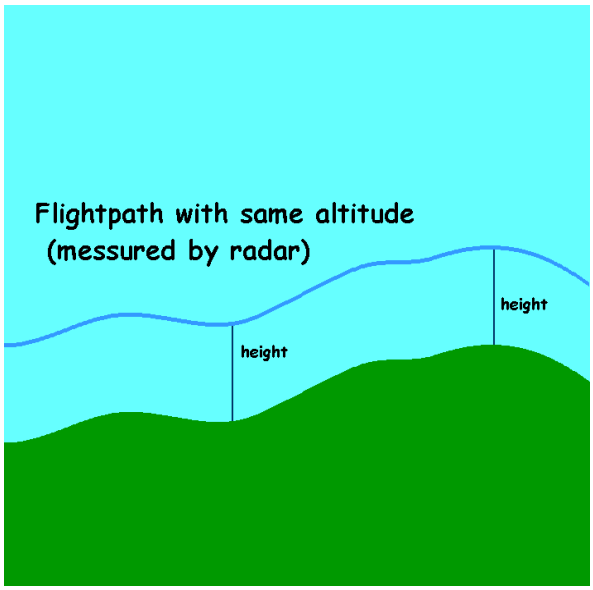
♬ ”Up, up and away”.♬

How high are you?

I promised you, I would try to explain the consept of Transition Altitude and Transition Level in part 4 of MyWay. Usually you just “dial the numbers”, when climbing higher than TA or descending lower than TL and everybody is happy. But why bother at all?

Radar



One way of finding your altitude could be by the means of a Radar (or radioaltimeter). It works by sending a signal down from the plane and recieve an echo from it. Knowing the speed of the radiosignal and timing the time from sending to recieving you simply calculate the distance: d = v*t/2, where v=velocity of the radiowaves (300000km/s), t= time and divide by 2 as the signal travels from the plane to the earth and back. But it would be extremely difficult, not to say impossible, to keep a constant height this way, as the numbers will change along with the terrain under the plane. So your plane-ride would be more of a rollercoaster-ride instead (also it is a very hightech solution, not for the common people).

Air pressure

The messurement of airpressure dates back to the time of Evangelista Torricelli (1643), when he found, that the atmosphere could sustain 1013cm of water equivallent of 29.92 inch of Mercury (Hg). The french scientist Perrier took Torricellis way of messurement with him to the mountain peak of Puy de Dome, where he found, that the airpressure at the top was some 80mm less than that of the bottom of the mountain. So the idea of finding the altitude by messuring the airpressure with a barometer was born. Today we would say, that the airpressure drops by 1hPa for every 30ft you go up (as long as we are in the lower region of the atmosphere).

So finding your height is easy - look at the barometer and find, how much below 1013hPa it shows and multiply by 30 and you have your height in feet!

Pressure 1000hPa gives an height of (1013-1000)*30 ft = 390 feet

Well, not quiet. It works sometime, but alas - the airpressure at sealevel (MSL) is not allways 1013hPa. And not all airport are located at sealevel - very few are, as a matter of fact. So things are a bit more complicated than that.

A local flight

Doing a sightseeing tour round your local airstrip, doesn’t bring you big troubles. Take a seat in the plane, dial your altimeter, so it says “0" and off you go. When you land 15min later the altimeter will probably show a “0" again. Setting your altimeter to you local airpressure like this, is called *QFE*. And it works for this senario! If all you did, were small trips round your local airstrip, there would be no need for this paper ;-)

Visiting your neighbour
But as your experience grow, it would be great, if you could take a flight to your neighbour airstrip (and back). So you place yourself in the cockpit, dial the altimeter, so it shows “0" and take of. And somehow you even find your neighbouring airstrip, but as you line up for landing you notice something is looking funny! You have a mental picture of how the runway should look, when at final, but even though the altimeter reads your usual 500 feet, it doesn’t look right! And it isn’t!! Because your neighbouring airstrip is situated lower than your local, you are actually higher up on the approach than you should be. You abort the approach and go around for a new try, while you find your chart and sees, the your neighbouring airstrip is 150 ft lower than your own. So a little mental calc: 150'/30 hPa = 5hPa needs to be added to your altimeter. After the correction is made, you find things to your liking and land for a cup of tea - the altimeter shows “0" once on the ground again.

While drinking your nice cup of tea, your mind is fiddling with this problem? Instead of messuring height above ground, you could messure height above mean sea level (altitude).

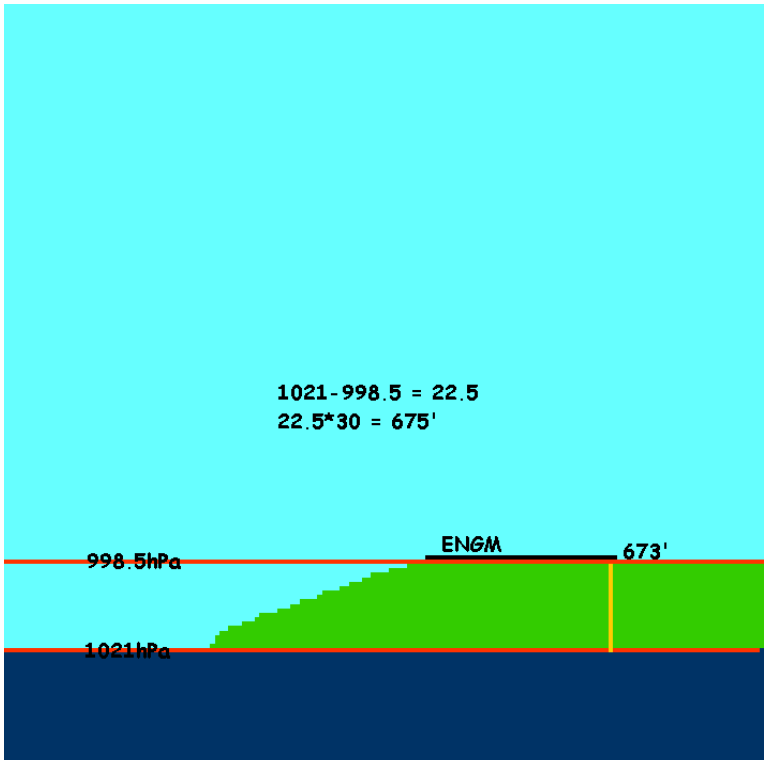
So upon takeoff after the tea has become cold, you make sure to dial in the local pressure in your altimeter - this is refered to as *QNH*. On your flight back you memorize the altitude of your home airstrip, add some 500ft upon final and the runway has your usual perspective, when on approach. But on the ground the altimeter no longer shows “0" - it shows the altitude of your home airstrip.

Longer flights
As your experience grows even further, you may feel an urge to make even longer flight. So one morning you load your plane with fuel, some snacks, a couple of b... no - bottles of water and takes of for a beautiful flight in the sun. The engine pur, the birds sing (though you are not able to hear it) and you do a nice long roundtrip in your country to visit all the castles (or whatever) and some hours later, when the fuel is almost used, the chocolate melted in your pocket and no more water (well - you really need to pee, but you can wait), you get back to your home airstrip for landing. But wait - once again things look a bit different - the perspective is wrong when approaching the runway. So you drop the use of the altimeter, use your senses and land on the runway - just like you use to. Something must be wrong with the altimeter (or your airstrip is sliding toward the sea), because now the altimeter reads to little. Well, welcome to the real world, where airpressure is changing, not only with height, but also with time.

This is the time, where you really needs to get that radio, so you can call the airstrip below and get the pressure, when you need it. And it would also allow you to fly into all these controlled airfields, where two-way radioes are a must.

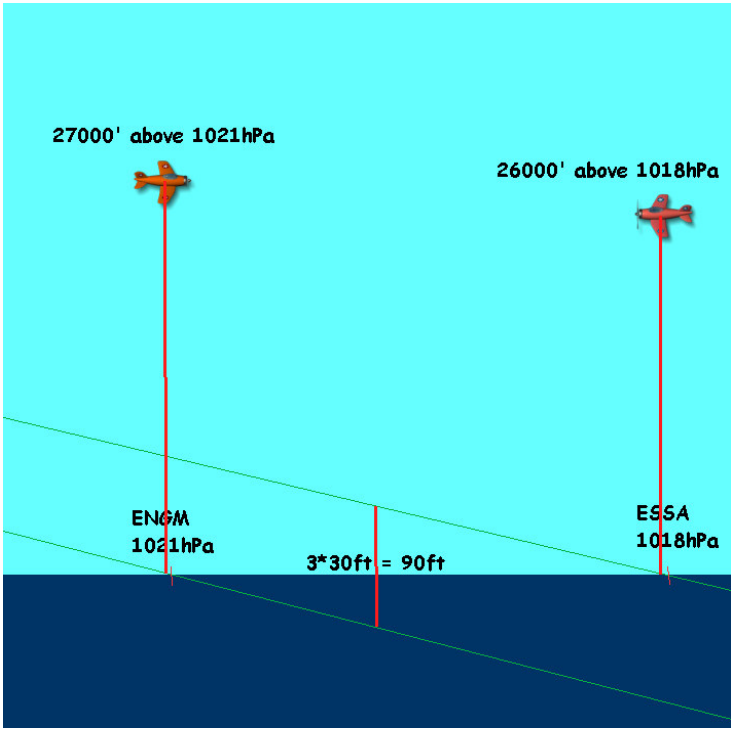
After Christmas you are happy once again - your wife gave you that wonderful piece of equipment called a radio. And you fly and you fly and you reset your altimeter again and again and again and ag.....

Back to our flight EV5521



Let's go back to Oslo/Gardamoen. Sitting on the ground you recieve the ATIS, which informs you, that the local pressure (QNH) is 1021hPa. You set your altimeter and confirms that the altimeter shows 673 ft. But is the local airpressure really 1021hPa. The answer is "**No!**". The 1021 hPa is the pressure at ENGM, if ENGM was placed at sealevel. Sitting at ENGM the pressure is only 1021-673/30 = 998.5hpPa. That is why your altimeter reads 673ft. Remember, the altimeter have no awareness of where the ground or the sealevel is! When the altimeter read 673ft it means, that you are 673ft above the 1021hPa isobar (an isobar is a line, which goes though places with the same pressure). If you dial in "998.5" at your altimeter, it would read "0", because you are 0 feet above the 998.5hPa isobar (This is the QFE-setting, remember?).

Let's for a moment forget to reset your altimeter on climbout. And let consider an other plane, EV5522, taking off from Stockholm/Arlanda (137', qnh 1018) -he also does not reset the altimeter on climbout from ESSA. You, EV5521, have filed 27000' and EV5522 has filed 26000'. ATC looks at the numbers - 5521 are flying east - odd numbers, ok - 5522 flying west - even numbers, ok - and minimum 1000' between - no problems. **BUT THERE ARE!!!!**



You are flying 27000' above the 1021hpPa isobar and EV5522 is flying 26000' above the 1018hPa isobar. As you are not messuring your height above the same isobar, you have actually no knowledge on the separation of the two planes, looking at the numbers only. But how high is EV5522 with reference to "your" isobar, 1021hPa?

As there are 3hPa between the two settings, we have a difference of 3*30ft = 90ft.
Now you are flying at 27000' above the 1021hPa isobar, but as you can see on the picture, the isobar is NOT parallel with the ground (or sealevel), as you are flying from an

area of high pressure towards an area of lower pressure. So when you are following the 1021hPa isobar, you are actually descending slightly during your cruise. And as EV5522 is following the 1018hPa isobar and flying from an area of lower towards an area of higher pressure, he is actually climbing during his cruise. So when you meet, you are **not** separated by 1000ft, but only by 910ft. This is a violation!!!

Finally - the Transition Altitude

One way of solve this problem could be, that the pilots continously recieved an altimeter setting, so when EV5521 and EV5522 met, they had the same altimeter setting and thus flew at correct altitudes regarding to the Mean Sea Level (MSL). But this would generate a lot of radiotraffic, when planes asked for and recieved new settings, and there would still be problems of making sure, that all the planes had recieved the latest settings etc. It is a lot safer to make sure, ALL planes above a certain altitude, use the same setting. So when flying above a certain altitude = transition altitude, you all fly with an altimeter-setting of 1013hPa, meaning your are all flying at some height messured above the same isobar. Then it is much easier to see, if two planes are getting to close each other.
In North America (US, Canada and Mexico (?)) the TA is at 18000'. But in the rest of the world you need to check for local regulation. In many countries there are actually several TA within the same country, so you really need to keep an eye on the charts for getting the correct number. At ENGM the TA is at 7000' at ESSA the TA is at 5000'

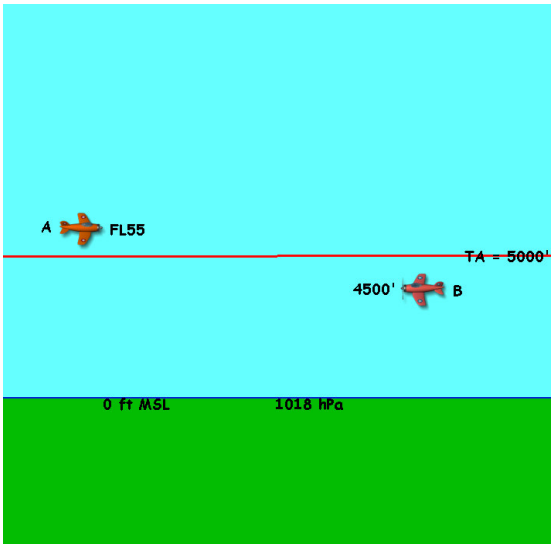
When flying above the TA, your messure your altitude above the 1013hPa isobar, so this is not a “real” altitude. So you refer to this by saying that you are flying at a Flightlevel (FL). Flightlevel 100 (FL100) means, that you are flying 10000 ft above the 1013hPa isobar - FL250 = 25000ft above 1013hPa isobar etc.

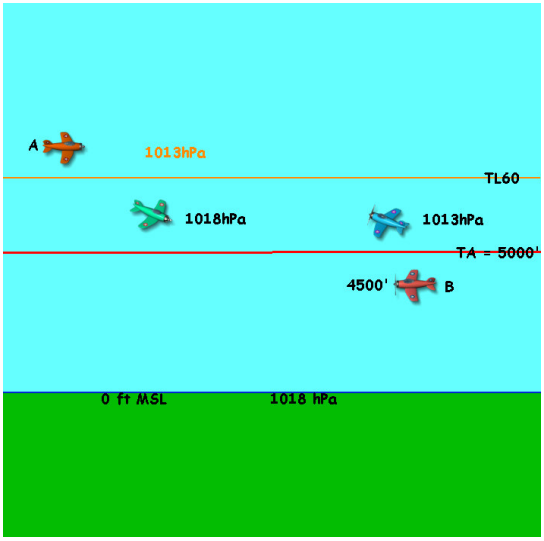
If you are flying at an “altitude”, it is messured from MSL and you need to have obtained the local QNH to do so. Altitude 3000ft, means you are flying 3000ft above msl.

If you are flying at a “height”, then it is messured above ground - that was the qfe-setting.

What about the Transition Level?

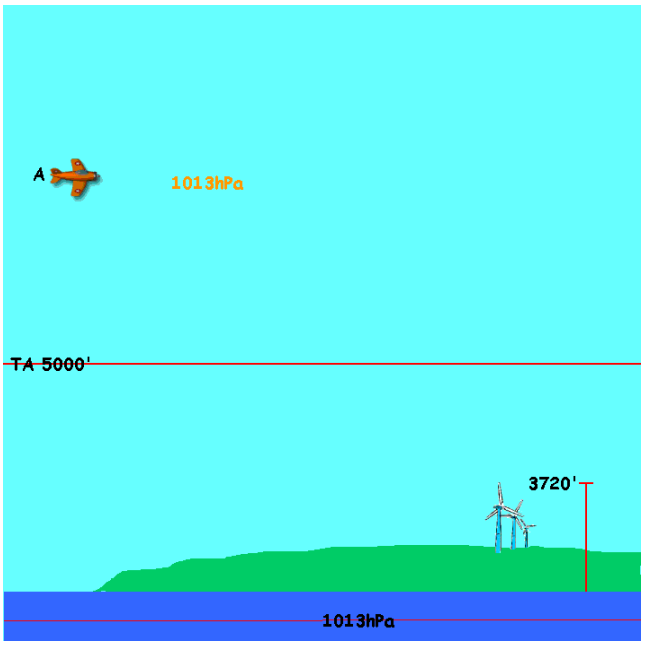
Upon descend you just reset your altimeter at TA and all is ok - NO, it’s not. Just like before, we are having problems between planes flying right below TA and planes flying right above the TA. According to plane B’s altimeter, he is flying at 4500' on local qnh. Plane A is flying at 5500' on 1013hPa, as he is above TA. But this means, that the picture shown to the left below is misleading - again we are refering to two different isobars. So while we assume they are at different altitudes, they may not be! Actually, plane A is 150 ft lower than shown in the





picture, so the 1000' separation is not there. ATC deals with this, by setting a different altitude for resetting your altimeter on descend. ATC tells plane A that Transition Level is 60! When plane A is descending below TL, he reset his altimeter to 1018hPa and the two planes are now messuring their altitude the same way. This also mean, that the area between TA and TL is "forbitten cruiselevels". One can only stay in that area, while descending and ascending. The width of the area is also not fixed. This depends on the amount of pressuredifference there is. A large pressuredifference calls for a higher setting of TL.

Oh- one more thing - I have used two planes here to illustrate the problems, however, the problem still exists with only one plane. This time obstacleclearences must also be dealt with.



Plane A is above TA. So even when descending to TA there will still be an obstaclesclearence of more than 1000', as TA is defined as 5000' above MSL at local pressure. What if TL=TA?
When A is descending to 5000', he is actually descending to FL50, because he is on 1013hPa and he *then* resets his altimeter. But from the picture you see, that FL50 is below TA, because FL is messured from the 1013hPa isobar. So maybe there isn't 1280' down to the windmills. If qnh is 1003hPa the pilot will actually find that, when he resets the altimeter, he suddenly "looses" 300 ft (10*30ft), so he is at 4700' and not 5000'. Now there isn't 1000ft between the plane and the windmills but only 980ft. So ATC must raise the TL from TL = TA to TL = TA+500'. And if QNH gets even further down, ATC must correct the TL accordingly to make sure obstacles clearence is maintained.

BTW - if flying VFR you have even more trouble, as you don't nessesarily have any ATC to give you TL - you must figure it out youself. Remember - if in an ultralight, you may not even have a radio, so you can ask ATC for info. But then again - how many planes without a radio flies above TA? Well, in Europe quiet a few could - in the US, where the TA is a 18000' none. And every pilot above 18000ft in USA is in Airspace "A", so you can't fly there without a clearence.

Until next time

yours

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