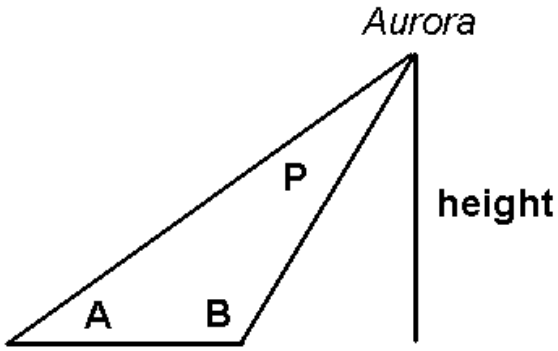
Image courtesy Tim Tomljanovich, http://www.nsaclub.org/photos/aurora/

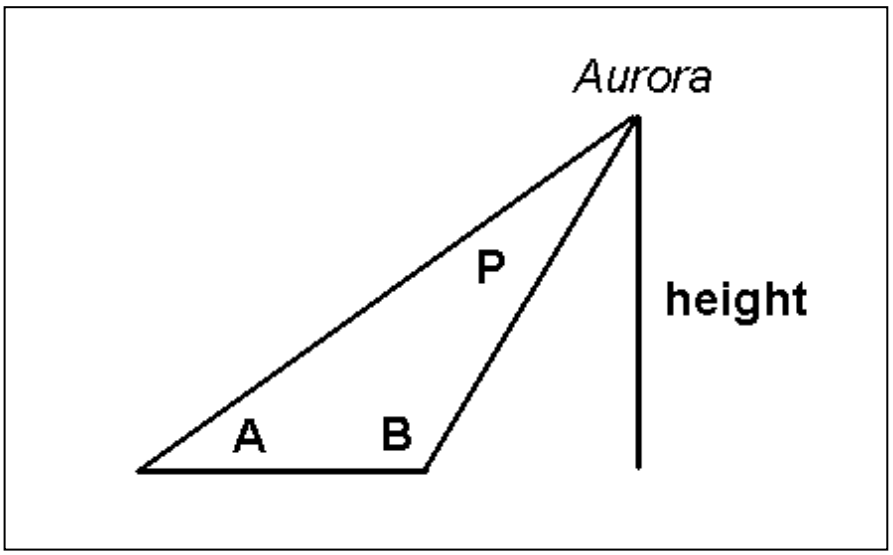
For thousands of years, people living at northern latitudes had no idea how high up the Aurora Borealis was located. Before the advent of photography in the 1880's, auroral observers tried to determine the height of aurora by the method of triangulation. One of the earliest of these measurements was made by the French scientist Jean-Jacques d'Ortous de Mairan between 1731 and 1751. From two stations 20 km apart, observers measured the angles A and B between the ground and a specific spot on an aurora. From the geometry of the triangle, they estimated that aurora's height was between 650 - 1,000 km above the ground. More precise measurements yielded estimates from 70 to 200 kilometers.



Question 1 - Suppose that two observers were located 30 kilometers apart. Observer A measured an angle of 53 degrees and Observer B measured an angle of 114 degrees. By making a scaled drawing of this triangle, what was the height of the auroral feature they were studying?

Question 2 - Use a protractor to measure the vertex angle, P. What happens to the measurement of angle P if you decrease the 'baseline' distance between the observers to 5 kilometers?

Question 3 – What would the measurements of the two angles be if the aurora were located over a spot half-way between the two observers?



Question 1 - Suppose that two observers were located 30 kilometers apart. Observer A measured an angle of 53 degrees and Observer B measured an angle of 114 degrees. By making a scaled drawing of this triangle, what was the height of the auroral feature they were studying?
Answer: Students should get an answer near 100 kilometers.

Question 2 - Use a protractor to measure the vertex angle, P. What happens to the measurement of angle P if you decrease the 'baseline' distance between the observers to 5 kilometers?
Answer: The angle P should have a measure of 180 – 114 – 53 = 13 degrees. If the baseline is decreased to 5 kilometers with Observer A moving towards Observer B and Observer B remaining at the previous location, Observer B will measure an angle of 114 degrees, Observer A will measure 64 degrees, angle P will decrease to 180 – 114 – 64 = 2 degrees. This is a very small angle to accurately measure.

Question 3 – What would the measurements of the two angles be if the aurora were located over a spot half-way between the two observers who are 30 kilometers apart?
Answer : From a scaled drawing A = B = 80 degrees.