



### **Maths as others see it.**

*Great-circle distance*

#### **NARRATOR**

To get a general formula, the longitudes and latitudes can be replaced by letters, to give a formula that can be used by global-navigation computer programs, like that written by Don Cameron, to calculate the great-circle distance of all the stages in the Breitling Orbiter flight. Flying along a great circle is the shortest distance between two points, but it's not always easy to do this – even if the winds are favourable!

#### **ALAN NOBLE**

You've then got to worry about all the countries you've got to fly over. And so we spent a lot of time contacting embassies and various governments to obtain overflight permissions. Generally speaking, there were no difficulties. The only real problem we came across was China.

They didn't want us to fly over the central part of China. Bertrand Picard and I went to Beijing and negotiated and they'd allow us to fly over the southern part – that's up to 26 degrees north. Anything above that and the balloon would have had to land.

#### **BERTRAND PICARD**

Coming from Sudan, heading for Saudi Arabia and Yemen. Flying flight level two-one-five. And if we fly a little lower, we'll get at the right time over Saudi Arabia and Oman to go south of China. And we have to gain as much possible degrees to the south. So I'm going to open the gas valves and let bit a little of our helium go out.

#### **ALAN NOBLE**

And so we talked with meteorologists in the control centre. They would give us forecasts for up to five days ahead, as to what the wind was going to do. And so we might say to the balloonists: if you fly at 25 000 feet, then you will move towards the south-east; if you fly at 30 000 feet, you might track east. We were always looking to track a little further south.

#### **NARRATOR**

With careful navigation – and favourable winds – the Breitling balloon flew across China, just south of the restricted area.

#### **BERTRAND PICARD**

The line across China was a straight line at 25 point five degrees north; it was incredible. I think that there was a little bit of miracle also to be able to fly so many thousand kilometres in a straight line – it's the only part of the flight where we were absolutely in a straight line.

#### **NARRATOR**

But flying along latitude 25 point five degrees north isn't the shortest way, because, as we found earlier, apart from the equator, lines of latitude are not great circles. So, what is the shortest route? Well, if the balloon had flown the great-circle distance across China, it would have flown dangerously close to the restricted region. You can work out just how far they had to travel, in comparison with the shortest great-circle distance.