11th IYPT '98
solution to the problem no. 6
presented by the team of Slovakia

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Mount Everest

Can you see Mount Everest from Darjeeling?

Abstract

Everybody must know Mount Everest – it is the largest mountain in the world. The question is, wheather or not this mountain can be seen from a small town called Darjeeling. The aim of this report is to show you that this is possible, when you choose good weather conditions for your trip to India.

Overview

- Geographical details
  - Obstacles
  - Earth as a sphere
- Refraction
- Atmosphere

1 Geographical details

Darjeeling is a town in northeastern India. The town is situated on a ridge ranging from 1,820 to 2,405 m, Darjeeling itself is 2,255 m above sea level. Mount Everest is 8,848 m tall and its distance from Darjeelig is about 168 km.

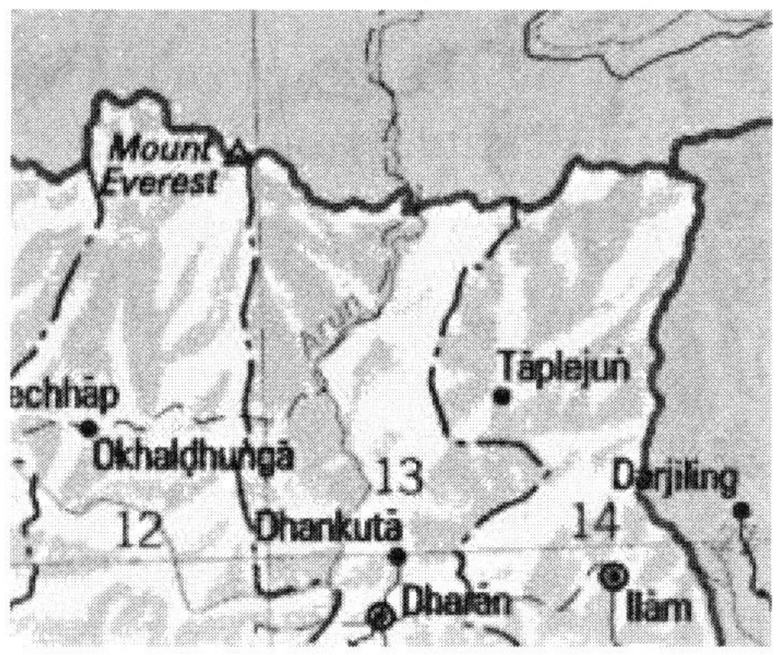

Figure 1: Map of northeastern India

1.1 Obstacles

The first condition that must be fulfilled is that no other hill that would interfere with our sight stands between Darjeeling and Mount Everest. To answer this question we need a good map of northeastern India, from which we are able to produce a cross-section of the terrain between Darjeeling and Mount Everest. From such a graph we can easily say, if something else stands in the way. On the following picture we can see the cross-section, as well as two lines – dotted one, which connects Darjeeling and Mount Everest, and dashed one, which connects Darjeeling with the highest hill between Darjeeling and Mount Everst that could cause problems, i.e. we can see everything over this dashed line.

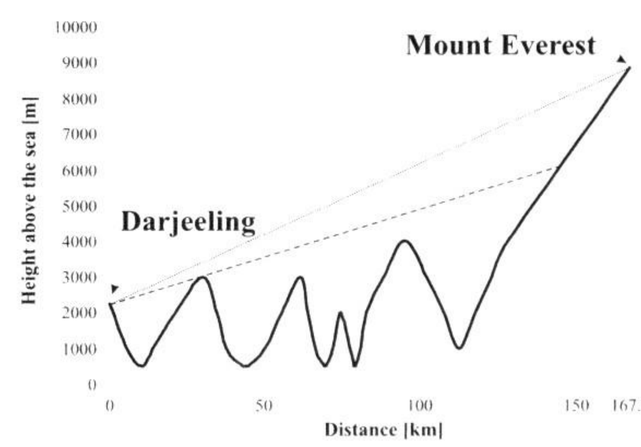

Figure 2: Cross-section of the area

1.2 Earth as a sphere

From this picture we see, that it should be possible to see Mount Everest, because its top is over our dashed line. Of course it is not so easy. In the last picture we supposed that the Earth is only a plane, but in fact it can be approached by a sphere. If we make the same graph, only with its base mapped onto a large circle with radius about 6,400 km, we get following picture. Here the angle between our two lines is a bit smaller, but still larger than zero, and therefore we are still able to see it.

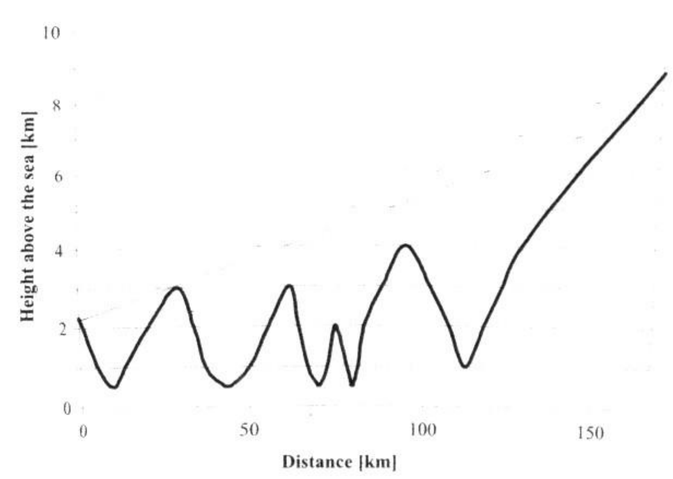

Figure 3: Cross-section 2 of the area

2 Refraction

There is also one phenomenon which can help us – refraction of the light beam. In atmosphere the light beam refracts down, so the angle of our two lines will appear greater to the observer.

3 Atmosphere

Another problem is the visibility in the atmosphere. According to the literature, the rainy season lasts here from June to October and after that the atmospehere clears. The definition of visibility range says that we can differ an object from the background, if the difference of intensity of the object and the background divided by intensity of background is at least 0.02. This is written in well-known formula

$$\varepsilon = \left| \frac{B_o - B_b}{B_b} \right| = e^{-b_u X_0}$$

where $\varepsilon = 0.02$, $b_u = 0.14 \frac{1}{\mathrm{km}}$. The solution of this equation is that the maximum distance when we can differ the object from the background is about 280 km, what is much more than distance between Darjeeling and Mount Everest.

This all means that **we can see Mount Everest from Darjeeling**.

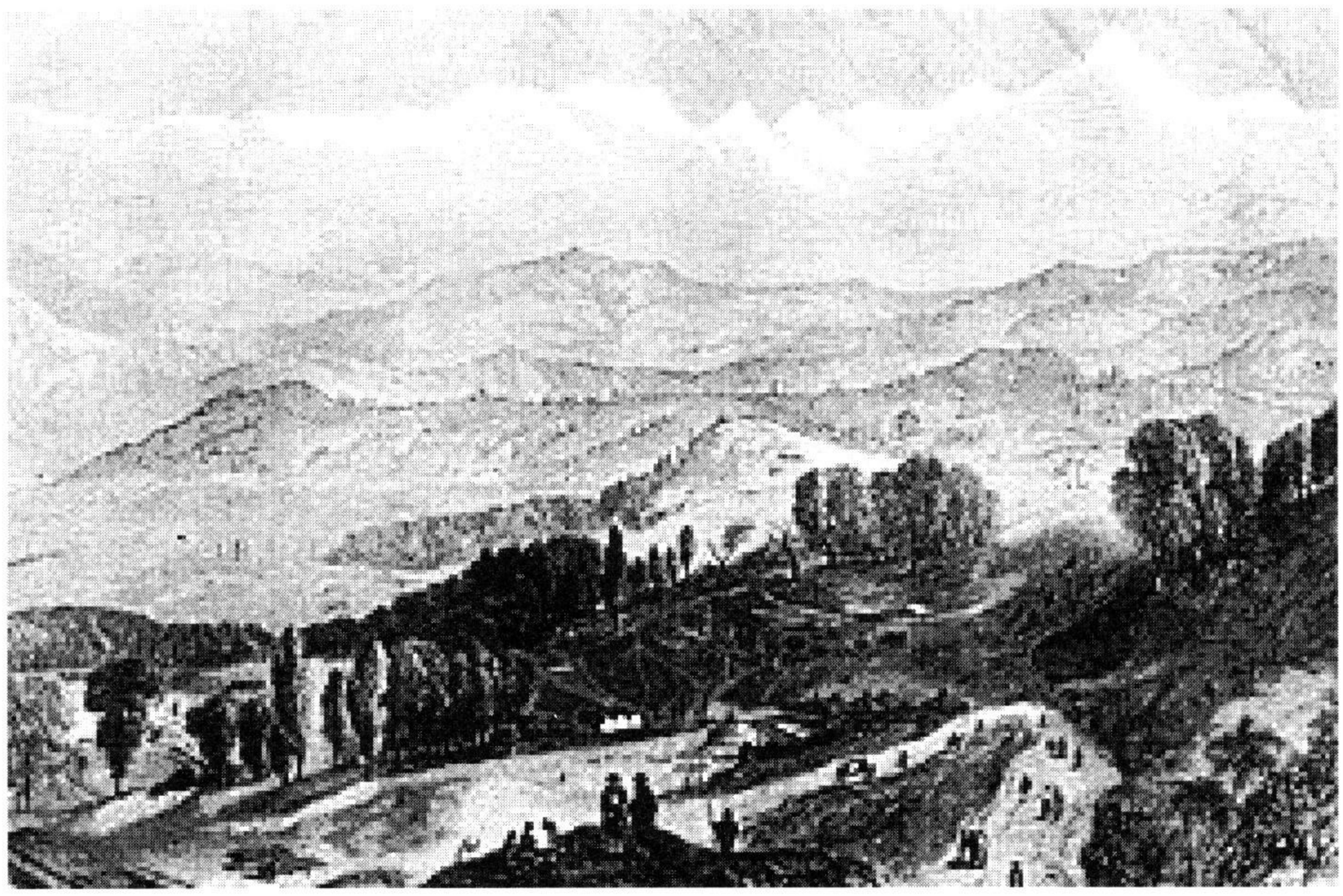

Figure 4: View of Mount Everest
View from Darjeeling of Deodhunga [Mt. Everest]
The Highest Mountain in the World
Lately Measured by Colonel A. S. Waugh.
Height Above the Sea, 29,002 Feet.