would rise at the rate of the dry adiabat. Thus, in moving 100 m, the temperature will increase from 21.15° to 22.15°C. The temperature outside the balloon will increase at the superadiabatic lapse rate to 22.40°C. The air in the balloon will be cooler than the ambient air and the balloon will have a tendency to sink. Again, mechanical turbulence (displacement) is enhanced.

**Stable atmosphere.** If the temperature of the atmosphere falls at a rate less than \( \Gamma \) (for example, \(-0.99°C/100 \text{ m}\)), it is called *subadiabatic*, and the atmosphere is stable. If we again capture a balloon of polluted air at elevation A (Figure 6-13c) and adiabatically displace it vertically to elevation B, the temperature of the polluted air will decrease at a rate equal to the dry adiabatic rate. Thus, in moving 100 m, the temperature will decrease from 21.15 to 20.15°C as before. However, since the ambient lapse rate is \(-0.5°C/100 \text{ m}\), the temperature of the air outside the balloon will have dropped to only 20.65°C. Since the air inside the balloon is cooler than the air outside the balloon, the balloon will have a tendency to sink. Thus, the mechanical displacement (turbulence) is inhibited.

In contrast, if we displace the balloon adiabatically to elevation C, the temperature inside the balloon would increase to 22.15°C, while the ambient temperature would increase to 21.65°C. In this case, the air inside the balloon would be warmer than the ambient air and the balloon would tend to rise. Again, the mechanical displacement would be inhibited.

There are two special cases of subadiabatic lapse rate. When there is no change of temperature with elevation, the lapse rate is called *isothermal*. When the temperature increases with elevation, the lapse rate is called an *inversion*. The inversion is the most severe form of a stable temperature profile. It is often associated with restricted air volumes that cause air pollution episodes.

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**Example 6-3.** Given the following temperature and elevation data, determine the stability of the atmosphere.

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00</td>
<td>14.35</td>
</tr>
<tr>
<td>324.00</td>
<td>11.13</td>
</tr>
</tbody>
</table>

**Solution.** Begin by determining the existing lapse rate:

\[
\frac{\Delta T}{\Delta Z} = \frac{T_2 - T_1}{Z_2 - Z_1} = \frac{11.13 - 14.35}{324.00 - 2.00} = \frac{-3.22}{322.00} = -0.0100°C/m = -1.00°C/100 \text{ m}
\]

Now we compare this with \( \Gamma \) and find that they are equal. Thus, the atmospheric stability is neutral.