a 1% saline solution advancing along the floor of a parallel-sided channel of fresh water 30 cm wide and 20 cm deep. The front is made visible by adding milk to the dense fluid.

The mixing processes seen both in the laboratory flows and in many environmental examples of gravity currents are complicated. Figure 11.3 shows the two main types of instability which are responsible for the mixing. These consist of (a) billows, which roll up in the region of velocity shear above the front of the dense fluid, and (b) a complex shifting pattern of lobes and clefts, which are formed by the influence of the ground on the lower part of the leading edge.

The next section considers the simplified front of a two-dimensional gravity current advancing along a horizontal surface, firstly in the simplest form of an inviscid flow with no mixing.

11.2 Inviscid-fluid theory

Inviscid-fluid theory has been applied to study aspects of a steady gravity current; in particular it shows the role of wave-breaking and the associated energy losses. In an inviscid fluid, in which viscous forces are completely absent, the frictional effect of the ground disappears but the instability still remains that leads to the formation of billows in the head. Such theory would be expected to give a useful approximation to the behaviour of the front of a gravity current, at least for flows with Reynolds number above a certain value.

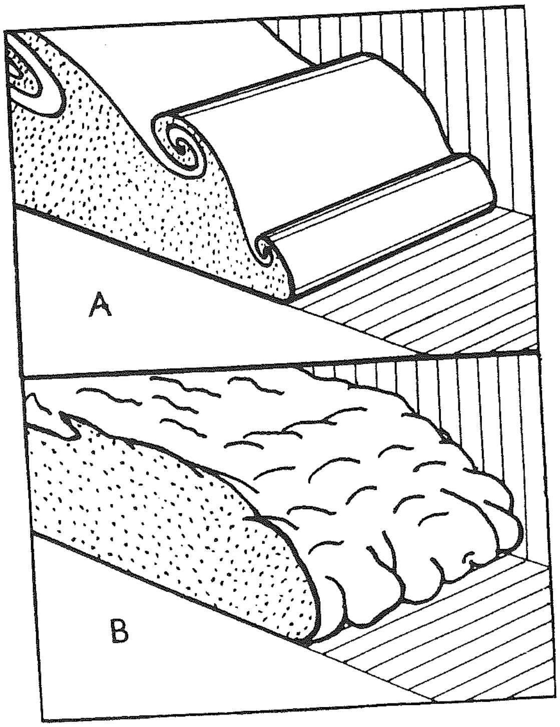

Figure 11.3 Two forms of instability at the front of a gravity current moving along the ground: (a) billows, (b) lobes and clefts.