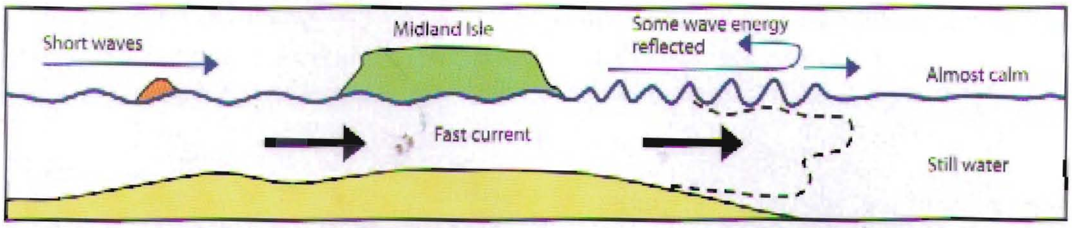

Fig 6.2 Short waves reflected where a strong current meets still water

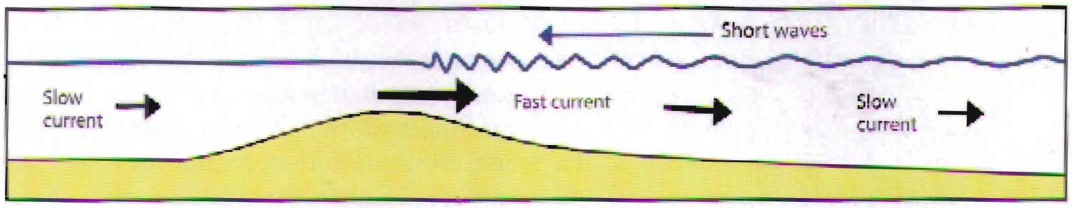

Fig 6.3 Overfalls at a shoal, with short waves stopped by the current

even rear up into a line of steep breakers. This is because the speed of the current increases over the shoal and then decreases again. If waves are moving upstream, they slow down when they meet the faster current and may be stopped, as shown in Fig 6.3.

At the 'stopping line', the wave group speed has been reduced until it is exactly equal to the speed of the current, which is why the wave train has been halted. However, that is not the whole picture because the wave crests are moving over the water at twice that group speed (ie half the original crest speed). This means that the wave crests are still moving upstream. In fact, the wave crests only move upstream against the current until they reach the stopping line, whereupon they fade away because they cannot exist ahead of their own wave energy.

(If we return to my earlier mechanical analogy of a tracked vehicle, our bulldozer is now driving along a conveyor belt, which is running at exactly the same speed in the opposite direction. The bulldozer – the wave group – is not actually moving anywhere, but its upper track segments – the wave crests – are still moving forward until they reach the front, whereupon they disappear from view.)

When observed from upstream, the stopping line appears to be an abrupt wall of water, formed by a row of steep wave faces, but these are not true standing waves. By watching the stopping line carefully, it can be seen that the wave faces are not static, as would be the case downstream of a weir, but are continually rising and falling as each wave fades away and is replaced by another wave coming up behind it.

Immediately upstream of the stopping line, the surface of the water is calm because the waves have been eliminated. Photo 6.4 shows a picturesque example of this phenomenon; the current is flowing from left to right, over a shingle ridge, and the wind is blowing from right to left. The sea on the upstream side of the overfall is as flat as a mirror because the small waves that are coming from the right have all been stopped by the strong current. Further to the left, where water is deeper and the current is weaker, more ripples are appearing on the surface as the wind starts to establish a new wave pattern.

What happens to the wave energy when it reaches the stopping line? Some is lost when the waves break, but the waves do not always break. If the waves are initially very low, they become steeper as they approach the stopping line but then subside or fade away with very little fuss or foam (for an example, see Photo 10.7). Some of the wave energy is actually reflected, being returned downstream