LANDFORMS OF LOWLAND GLACIATION IN THE UK

by Andrew Gunning

IT IS VERY EASY TO SEE and wonder at the extent of ice erosion in the mountain areas of the United Kingdom. Its effects there are truly spectacular, and it is not surprising that much less is written about the way in which the Ice Age affected lowland areas of our country. The impact of the ice sheets and glaciers is far less obvious in these areas. Nevertheless much has been learnt about the extent and nature of the Ice Age in Britain through the study of the landforms left behind in lowland areas.

A glance at Figure 1 shows that it went way beyond the mountains. It is important to realise that the line shown represents the furthest limit of the ice. During the Ice Age, which lasted for nearly 2 million years, the ice margin moved backwards and forwards as the climate changed. The further north you go, the more frequent the advances and the longer the ice remained. Also, the last areas which were subject to glacial deposition were those places closest to the mountains.

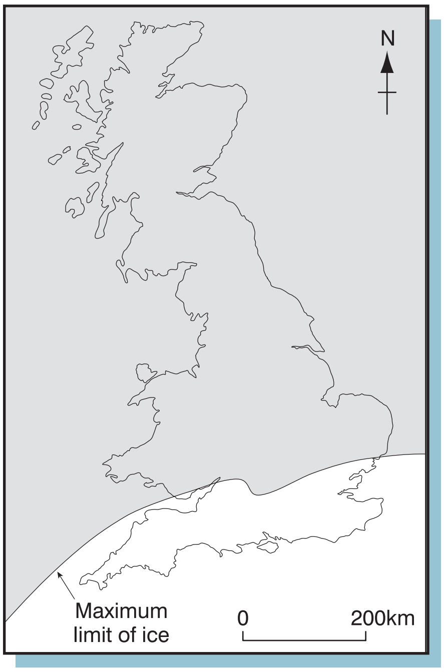

Figure 1: **Extent of ice over Britain during the last Ice Age**

There are several important differences between the effects of glaciation in the uplands and in the lowland areas. In the lowlands:

1 The ice was more likely to be in the form of ice sheets than valley glaciers. This meant that ice completely covered large areas of the land and was not confined to the valleys.

2 The ice sheets were probably carrying a lot of rock debris.

3 It was warmer at the lower altitudes, especially in the short summers, so there was a lot of meltwater around and this could wash away much of the smaller and finer material left behind by the glaciers.

4 Perhaps most importantly, there was far more deposition of material than there was erosion. This does not mean to say that erosion did not happen – it did, but deposition is the main process in the lowlands.

Where does the material a glacier carries, come from?

The first obvious source of material is from the frost shattering which occurs along valley sides. The rock is often angular and is of all different sizes. It forms long lines of debris on the glacier surface, and at the edges of the glacier it becomes **lateral moraine**. The second supply is from the erosion processes of abrasion and plucking that go on beneath the glacier. As the material is moved along by the glacier, some of the angular fragments of rocks have their corners removed and become **sub-angular**. This eventually form a layer of material called **ground moraine**. It can have fine particles in it from abrasion, and larger rocks produced by plucking. Because the size of the material in the moraine is so varied, it used to be called **boulder clay**, but today geographers prefer to use the term **till**. As the ice sheets and glaciers melt, they can no longer erode so effectively and the material is simply dumped or spread over the rocks. The key features of till are:

- It is made up of material from a number of different places.
- It is made up of material of different sizes and shapes, from boulders to clay-sized particles.
- Some of the larger boulders may have striations or scratch marks on them caused by other rocks.
- Many of the rocks have had the corners knocked off, and are sub-angular.

The areas closest to the mountains have the best-preserved depositional landforms. This is because they were usually some of the last places to be exposed by the retreating ice, and also because some of the greatest thicknesses of material were left behind here. One of the problems with

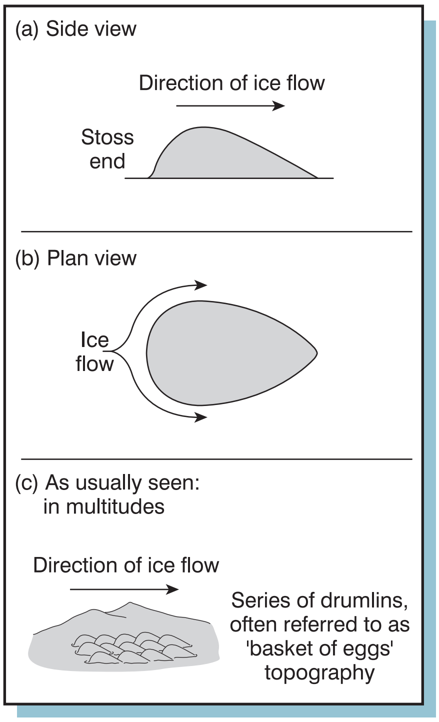

Figure 2: **Drumlins as features of glacial activity in lowland areas**

depositional landforms is that many were quickly destroyed by the huge quantities of meltwater being produced by the melting ice, and this has made their study that bit more difficult. Generally it was only the biggest and most recent features that survived.

Drumlins

Drumlins are features that can be found in lowland areas close the mountains. They have a very distinctive shape and profile, a bit like half an egg (Figure 2). Because drumlins are always found in large numbers in any one place, they are sometimes referred to as 'drumlin swarms', or 'basket of eggs' topography. Typically a drumlin has a blunt end – the **stoss** end – which faced towards the oncoming ice, and a tapered tail pointing downstream. The dimensions of a single drumlin vary from about 1,000 to 2,000 metres long, 400 to 600 metres at the widest point and up to 50 metres high.

Drumlins are made up from glacial deposits, or till, that is all different shapes and sizes.

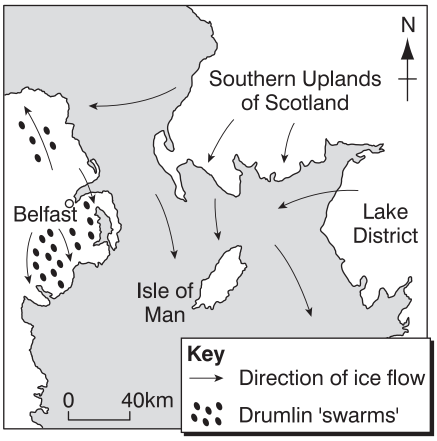

Figure 3: **Extent of glacial movement in south-west Scotland and northern Ireland**

Their streamlined shape seems to suggest that they were formed under the ice whilst it was still moving forward. There must also have been a large quantity of till available to create so many of them, but exactly why and how the glacier moulds some of the material into these distinctive shapes is still a bit of a mystery.

There are a number of places in Britain where drumlins can be found. They are especially common in the Eden Valley in Cumbria, on the Arfon lowlands of Snowdonia, and they are widespread in Northern Ireland. In County Antrim (Figure 3), the ice came from as far away as the Southern Uplands of Scotland. As it moved south through the area the drumlins were formed towards the edge of the ice sheet, and their orientation clearly shows the direction that the ice took.

Moraines and till plains

When ice melts, it deposits the material it is carrying. The most common form of moraine found in lowland Britain is called **ground moraine**, or **till**. It may be a mixture of fine clay-sized particles and material up to the size of large boulders – hence its original name of **boulder clay**. Much of East Anglia and parts of Cheshire are covered in large areas of till. Rather surprisingly, the evidence suggests that the till is made up from rocks that came originally from places that are not very far away from where they are found today, rather than from the mountains, where erosion is so important. In some places, such as around Cambridge and St Neots in Cambridgeshire, the till is up to 60 metres thick, but on average the figure is nearer 10–15 metres. This means that the ice sheets must have been capable of quite a lot of eroding in order to produce such vast quantities of material. In East Anglia the effect of this deposition is to create a rather flat and monotonous landscape, which can be fertile and has all the obvious benefits for intensive agriculture.

In one part of the East Anglian till plain, there is a ridge, up to 90 metres high and nearly 8 km long. It stands out clearly from the flat landscape all around. This ridge, called the Cromer Ridge, is an old terminal moraine. The ice sheet reached its most southerly limit at this point and probably remained in this position for some time in order to allow so much material to be deposited.

Erratics

The ability of ice sheets to move over large distances means that rocks from one

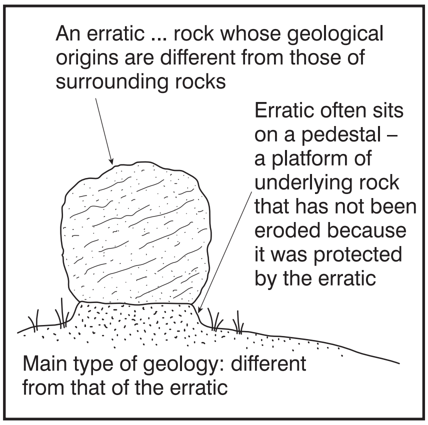

Figure 4: **An erratic**

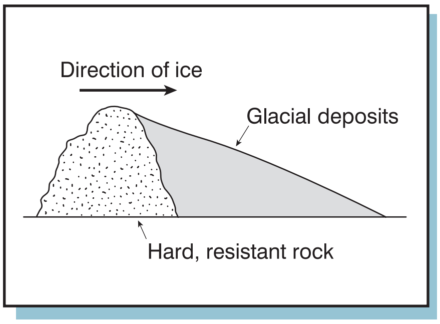

Figure 5: **Cross-section of a crag and tail**

place are sometimes moved hundreds of kilometres to another place. As the ice melts, these boulders may simply be left abandoned on the surface (see Figure 4). Because the geology of the area where the boulder came from is completely different from that of the area where it ends up, the rock is referred to as an **erratic**. Erratics can sometimes be thousands of tonnes in weight, although most are much smaller. One very good example of how an erratic can show the direction and distance of ice flow is erratics that came from a small volcanic rock outcrop off the Isle of Arran in Scotland, called Ailsa Craig. The unique granite from here has been found as far south as Anglesey and the North Devon coast. It has also been found down much of the length of the east coast of Ireland.

Crag and tail

Another feature which has the same sort of streamlined profile as a drumlin is the crag and tail. In this case the **crag**, or steeper section, is made up from a hard, resistant rock which it was difficult for the ice to erode. Behind the crag there is a lot of deposition and this forms the **tail** (Figure 5). One of the most impressive examples is the crag of hard igneous rock, an ancient volcanic plug, in Edinburgh. With its high viewpoint, it became the obvious site for a castle. Leading gently away from the castle and down the tail is the Royal Mile road.

Beyond the ice sheets

As the ice melted it produced huge amounts of water and created vast river systems. These rivers were sometimes fast-flowing and powerful and could carry large amounts of sediment. When it was colder and there was less melting, the discharge would be much less. As the sediment was deposited, it formed very gently sloping areas of sands and gravels called **outwash plains**. Because the sands and gravels could be moved easily and the rivers varied enormously in their discharge, the rivers rarely stayed in one defined channel, but instead split and rejoined to create what are called **braided streams**. Outwash plains can be seen in front of many of today's glaciers, but in Britain they can only be identified by looking at cross-sections that have become exposed by a river cutting downwards. The River Thames has cut its valley into the thick layers of sediments, creating a series of terraces. By looking at the old plant and animal remains found in these terraces, geographers have been able to decipher what the conditions were like at the time they were laid down, and this has provided the evidence they need to show that the ice age was not a simple, single advance. It was a much more complicated process in which the ice sheets grew and melted a number of times with fluctuations in the climate. They have also found erratics in the deposits that can be located to places tens of kilometres away.

Activities

1 Explain what is meant by the term **glacial deposition**.

2 What are the key differences between glaciation in lowland areas, and that experienced in upland regions?

3 (a) What is a **till plain**?
(b) Explain how till plains are formed.
(c) Why might the till plain in East Anglia be deeper in the more northerly parts of the area than in the south?

4 What are the main differences between a **drumlin** and a **crag and tail**?

5 Explain how erratics can indicate the direction of ice flow.

6 Make a larger copy of Figure 1. Using an atlas, locate and mark on your map the position of all the landform features described in this unit.

7 Construct a cross-section of the drumlin along the line A–B in Figure 6. On your cross-section, you should add a suitable title, and mark on the direction from which the ice would have flowed.

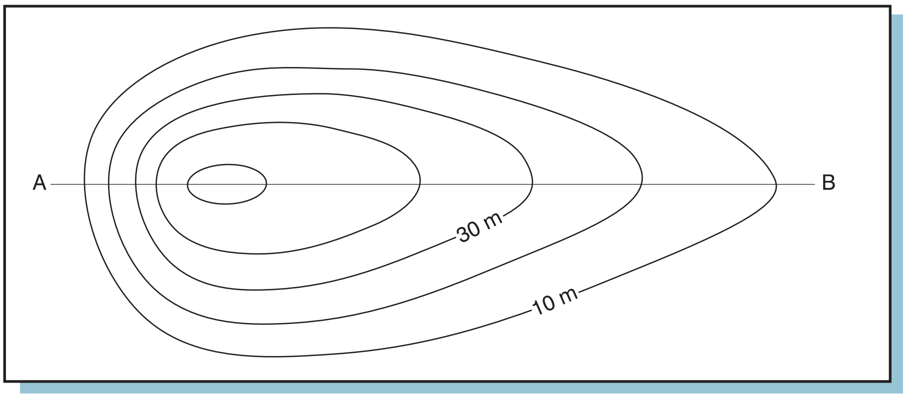

Figure 6: **Plan view of a drumlin**

8 Imagine you are looking at a vertical section of some glacial till. Draw a box, about 10 cm high and 5 cm wide, and in it draw the shape and sizes of the types of material you might expect to see. Make sure you label your diagram, and give it a title.

9 In small groups, prepare a presentation, perhaps using a computer presentation program, on the topic of features of lowland glaciation.

10 Draw up a table with two columns:
List as many glacial landforms as you can think of that are formed in lowland and highland areas.

Lowland glaciation	**Highland glaciation**

11 Figure 7 shows a lowland landscape during and after glaciation. Write a description of how the landscape has changed. Try to use good geographical vocabulary.

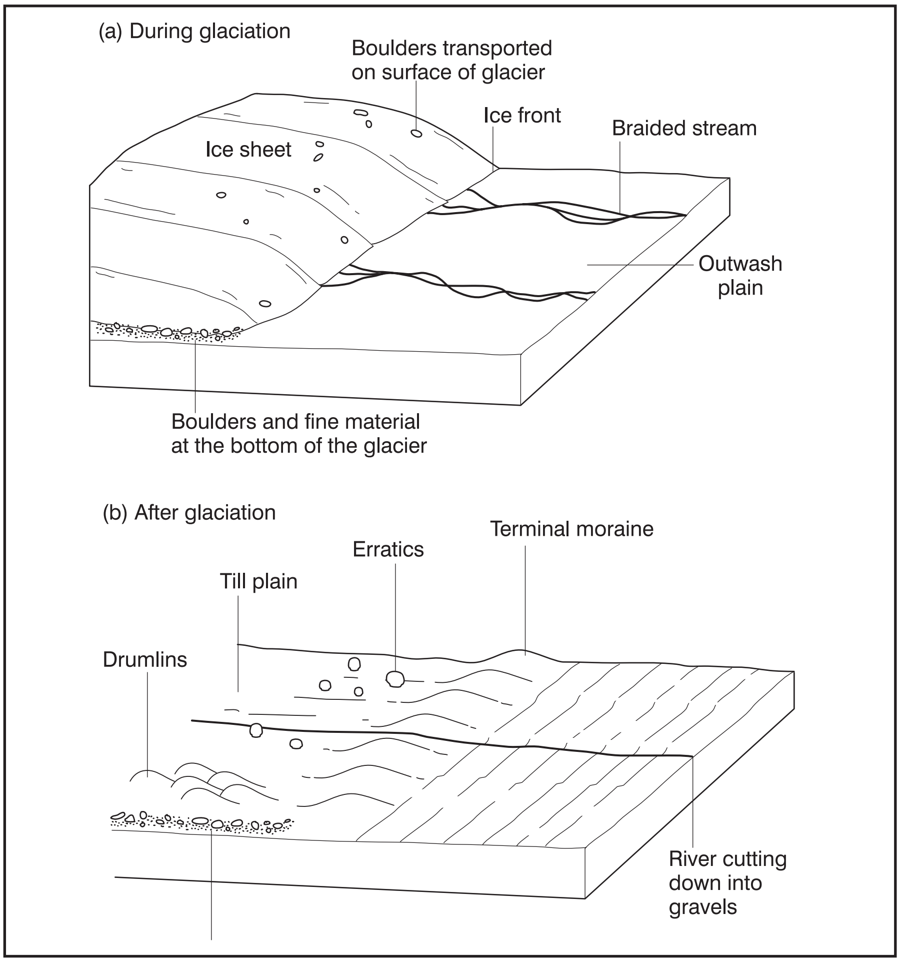

Figure 7: **Before and after glaciation**