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# BELLSCAMPHIE

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## Highlights

Deposits exposed in the disused railway cutting at Bellscamphie include three distinct tills, two of which are believed to pre-date the Late Devensian. The sequence provides important evidence for interpreting the glacial history of north-east Scotland and the patterns of ice-movement associated with different glacial events.

## Introduction

The section at Bellscamphie (NK 019338) lies 7 km north-east of Ellon in a railway cutting, now disused, and was described by Jamieson (1906) from his observations during the original excavation for the railway in the late 19th century. The site is important for a sequence of three superimposed tills, which include the 'indigo boulder clay' of Jamieson (1906). The tills, the Bellscamphie Upper, Middle and Lower Till Members, may mark three separate phases of glaciation, two of which pre-date the Late Devensian. The Bellscamphie Middle Till (the indigo boulder clay of Jamieson) was originally described at three sites, but is now accessible only at Bellscamphie. The Bellscamphie Lower Till has not been previously described in the literature and has no known correlative deposits in the Ellon area. The Bellscamphie site is therefore of great importance in the study of the Pleistocene history of Buchan. The only published work on the site is that of Jamieson (1906), but it has recently been reinvestigated by Hall (1989b).

## Description

Jamieson (1906) described the following succession which had a total thickness of 16 ft (4.9 m):

6. Red clay, a few feet thick, of the Red Clay "Series".
5. Gravel, containing pebbles of yellow limestone and sandstone and shell fragments of Crag affinities. Similar in lithology to the gravels forming the Late Devensian Kippet Hills esker, 2.5 km to the south.
4. Sand, fine, clean-washed.
3. Red Clay, similar to bed 6.
2. Indigo boulder clay, with small fragments of schist and granite. No more than a few feet thick.
1. Bedrock, schist.

No other descriptions were produced as the section was soon obscured by vegetation, but numerous references to the site and Jamieson's description exist in the literature (for example, Bremner, 1916b, 1928, 1934a; Syngé, 1956; Hall, 1984b; Sutherland, 1984a).

Jamieson (1906) also described the indigo boulder clay at two other sites:

A. Craigs of Auchterellon (NJ 952308). The indigo boulder clay was discovered at a depth of 14 m in wells dug east of the rock knoll of Craigs of Auchterellon, apparently preserved in the lee of the bedrock high. The site is now covered by housing.

B. "A railway cutting a few miles south of Ellon". Jamieson's description is vague and the location of the site was not precisely recorded. Consequently, this site has not been relocated.

Excavations in 1988 (Hall, 1989b) revealed a different stratigraphy at Bellscamphie (Figure

8.6) to that described by Jamieson (1906):

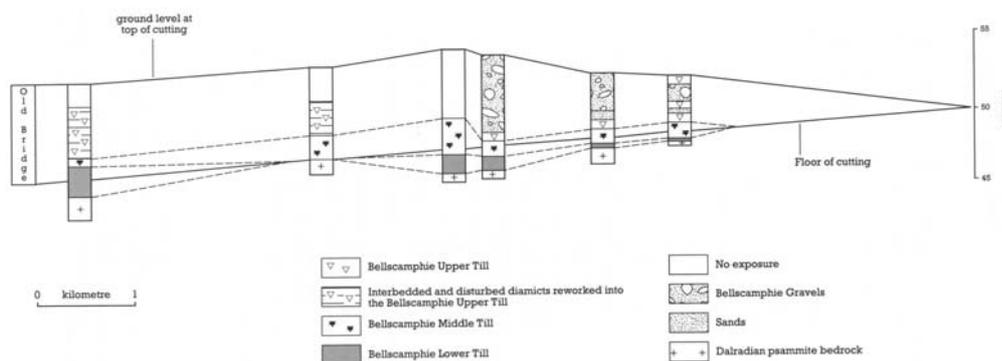


Figure 8.6: Sediment logs and stratigraphy in the disused railway cutting at Bellscamphie.

5. Grey gravels and sands (Bellscamphie Gravels and Sands).
4. Interbedded red diamictons (Bellscamphie Upper Till).
3. Dark grey diamicton – the indigo boulder clay (Bellscamphie Middle Till).
2. Brown diamicton (Bellscamphie Lower Till).
1. Dalradian psammites.

The Bellscamphie Lower Till is a brown, sandy, silty, massive and overconsolidated diamicton. At the time of the original railway excavations this unit would have lain largely concealed below the cutting floor and this is probably why the unit was not described by Jamieson (1906). The Bellscamphie Lower Till is dominated by clasts of local metamorphic rocks. It rests in shallow hollows on the surface of the Dalradian.

The Bellscamphie Middle Till is a dark grey, clayey silty, massive and over consolidated diamicton with sparse, small shell fragments. In the deposit at Craigs of Auchterellon, Jamieson (1906) recognized fragments of shells including *Arctica islandica* (L.) and *Astarte arctica* (Gray). At Bellscamphie, both species are also present. The Middle Till reaches a maximum observed thickness of 2.5 m and shows planar and erosive upper and lower contacts, except that in one pit it was seen to have incorporated small bodies of the underlying Bellscamphie Lower Till. The till incorporates palynomorphs of Kimmeridge Clay affinity (W. Braham and E.R. Connell, unpublished data), and its overall lithology is consistent with transport by ice from the Moray Firth, as Jamieson (1906) suggested.

Overlying the Bellscamphie Middle Till are interbedded red diamictons (Bellscamphie Upper Till) and grey gravels and sands (Bellscamphie Gravels and Sands). The red diamictons are, in places, crudely bedded and washed and may represent deposition into water bodies beneath glacier ice. The Bellscamphie Upper Till closely resembles in its lithology other diamictons in the Ellon area, which belong to the Red 'Series' (Hall, 1984b). The Bellscamphie Gravels and Sands are poorly sorted, horizontally bedded and rich in shell debris. Lithological comparisons indicate that the Bellscamphie Gravels and Sands form the western extension of the body of shelly gravel, with clasts of late Tertiary (?) limestone and mudstone, which extends from the coast to the Kippet Hills and to Bellscamphie (Jamieson, 1906; Merritt, 1981; Hall, 1984b). Both units are to be correlated with the Late Devensian Red 'Series' deposits found southwards from Peterhead along the North Sea coast and deposited by ice moving from the south or south-east. In the north-east part of the cutting, excavations revealed a complex sequence of interbedded and interdigitating diamictons of varied colour and lithology, which probably represents reworking of older diamictons by the ice that deposited the Bellscamphie Upper Till.

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## Interpretation

Analysis of the deposits at Bellscamphie continues and interpretation of their age and significance is preliminary. Strong lithological similarities leave little doubt that the Bellscamphie Upper Till and Bellscamphie Gravels and Sands belong to the Red "Series" formation and date from the Late Devensian.

The Bellscamphie Middle Till is correlated with Jamieson's (1906) indigo boulder clay, for which a pre-Late Devensian age has been widely accepted (for example, Synge, 1956; Sutherland, 1984a), although this has yet to be demonstrated. At Craigs of Auchterellon, however, originally the key locality for the indigo boulder clay, there is a grey till derived from the west which underlies the Red "Series" and overlies the indigo boulder clay. This inland till is known from several other sites in the Ellon area and is probably of Early Devensian or early Late Devensian age (Hall, 1984b; Hall and Connell, 1991). This till is not represented at Bellscamphie, where the Middle Till is covered only by deposits of the Red "Series". Bremner (1916b, 1928, 1934a) regarded the indigo boulder clay as part of the ground moraine of a Scandinavian ice-sheet and suggested correlation on lithological grounds with dark shelly tills at Burn of Benholm and Aberdeen. Such correlation is dubious, however, because (1) palynological work indicates that the Benholm shelly till is derived from the North Sea, whereas other dark shelly tills in Buchan are derived from the Moray Firth (Hall and Connell, 1991) and (2) there is only one doubtful record of the recovery of a Scandinavian erratic from these dark shelly tills (Hall and Connell, 1991).

As indicated above, transport of the Bellscamphie Middle Till from the Moray Firth seems likely. Dark clayey tills and Mesozoic erratics of probable Moray Firth provenance occur at numerous sites in Buchan (Hall, 1984b, figure 3) and are thought originally to have been part of a more extensive till-sheet, the "Mesozoic Drift" (Hall, 1984b). The ice movement or movements which formed these deposits probably pre-dated the Late Devensian, as inland tills of Early or early Late Devensian age incorporate masses of this material at a number of localities. Amino acid analysis of shell fragments from the Middle Till is awaited and may help to establish the age of this deposit more precisely.

No new sites for the indigo boulder clay have been reported since the turn of the century. However, in 1988 drainage ditches at Pitlurg Station (NK 021344) exposed a diamicton of very similar lithology to the Bellscamphie Middle Till underlying Red "Series" deposits. A dark grey till underlying red till was also logged by the Department of Geology, University of Aberdeen, in pipeline excavations at Eastertown of Auchleuchries (NK 015364). Dark grey till underlies red-brown till and gravel in British Geological Survey (BGS) borehole NK 03 SW 5 at Pitlurg (NK 02633312) and underlies brown till and gravels in BGS borehole NK 03 NW 1 at Hill of Auchleuchries (NK 00573649) (Merritt, 1981). Some or all of these occurrences may correlate with the Bellscamphie Middle Till, but detailed lithological comparisons are required.

Jamieson regarded the indigo boulder clay as the oldest glacial deposit in the Ellon area, but the discovery of an underlying till, the Bellscamphie Lower Till, forces the recognition of an earlier ice movement from the west or north-west. The Lower Till has not been recognized elsewhere in the Ellon area, but may correlate with the weathered till derived from inland at Kirkhill (Connell *et al.*, 1982; Hall, 1984b).

Deposits of the Red "Series", which are directly comparable to the Upper Till and Gravels and Sands at Bellscamphie, are exposed at numerous localities in the Ellon area, notably around the Kippet Hills.

In summary, the Bellscamphie Lower Till has so far been recognized only at the type site. The Bellscamphie Middle Till can only be easily re-exposed at Bellscamphie. Moreover, the superimposition of three tills probably reflecting separate phases of glaciation is matched at only one other site in the Ellon area, Craigs of Auchterellon, and this site has been fossilized by house building.

The sequence of deposits at Bellscamphie provides a key stratigraphic record of the glacial history of the Ellon area and it is the only accessible site which shows three superimposed till units. The Bellscamphie Upper Till and interbedded Gravels and Sands were deposited by ice

moving from the south during the Late Devensian and are well represented at other sites. The Middle Till (Jamieson's indigo boulder clay) was deposited by ice moving out of the Moray Firth, probably prior to the Late Devensian. The Lower Till is known only from this site and represents the oldest period of glaciation known in this part of Buchan. Bellscamphie is one of only two sites known in Buchan where two superimposed tills of probable pre-Late Devensian age occur; the other is at Leys Quarry (Hall and Connell, 1986; see Kirkhill). As Buchan contains the most complete pre-Devensian sequence known on land in Scotland (Hall, 1984b; Sutherland, 1984a; Hall and Connell, 1991), the site is also of national importance for the study of Pleistocene stratigraphy.

## Conclusions

The deposits at Bellscamphie provide evidence for three separate phases of ice movement in north-east Scotland, two of which pre-date the last (Late Devensian) glaciation. Such a sequence is rare in Scotland, so that Bellscamphie is a valuable reference site for studies of Quaternary history and for interpreting the patterns of ice movement across the landscape. It is also a type locality for two of the individual ice-deposited till units.

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