2 INTRODUCTION

Volcanic glass is generally recognised by modern knappers as the ultimate lithic raw material, as it tends to flake in a highly predictable manner, and it provides sharper edges than any other form of silica (Whittaker 1994, 69). Natural glass is usually subdivided into two groups of materials, namely obsidian and pitchstone. The former is defined by having less than 1% water, no or few phenocrysts (that is, crystals in the glass) and a vitreous lustre, whereas pitchstone may have as much as 10% water, some forms are rich in phenocrysts, and all pitchstones have a tar-like lustre (Pellant 1992, 197). Aphyric, homogeneous pitchstone (that is, pitchstone without phenocrysts), such as some of the material from Corriegills on Arran, flakes almost as well as obsidian, whereas the more porphyritic varieties (that is, pitchstone with phenocrysts) are less easily controlled. Volcanic glass is known from igneous complexes throughout the world, but in Britain it is only found in western Scotland and Northern Ireland (the British Tertiary Volcanic Province or BTVP; Richey 1961; Emeleus & Bell 2005; illus 1), and only in the form of pitchstone (a more detailed geological characterisation of pitchstone is presented below in Section 3).

Although the provenance of archaeological pitchstone has been discussed on a number of occasions, first by Mann (1918) and fifty years later by Ritchie (1968), the most influential contribution in this respect is arguably that of Williams Thorpe & Thorpe (1984). Their now widely cited paper on the distribution and sources of archaeological pitchstone in northern Britain is based on petrographic, chemical and thin-section analyses of archaeological pitchstone, and by comparison of archaeological samples with samples of geological pitchstone from various parts of the BTVP, it was concluded that most, if not all, archaeological pitchstone derives from the Isle of Arran in the Firth of Clyde. As almost all of the analysed samples represented homogeneous aphyric glass (ibid, 16) they suggested that the so-called Corriegills outcrops, on Arran's east coast (see illus 24), were the most likely sources of the archaeological pitchstone. This suggestion has been accepted by many scholars as an accurate description of the archaeological reality, and it has become the logical point of departure for archaeological research into the use of Arran pitchstone in Scottish prehistory.

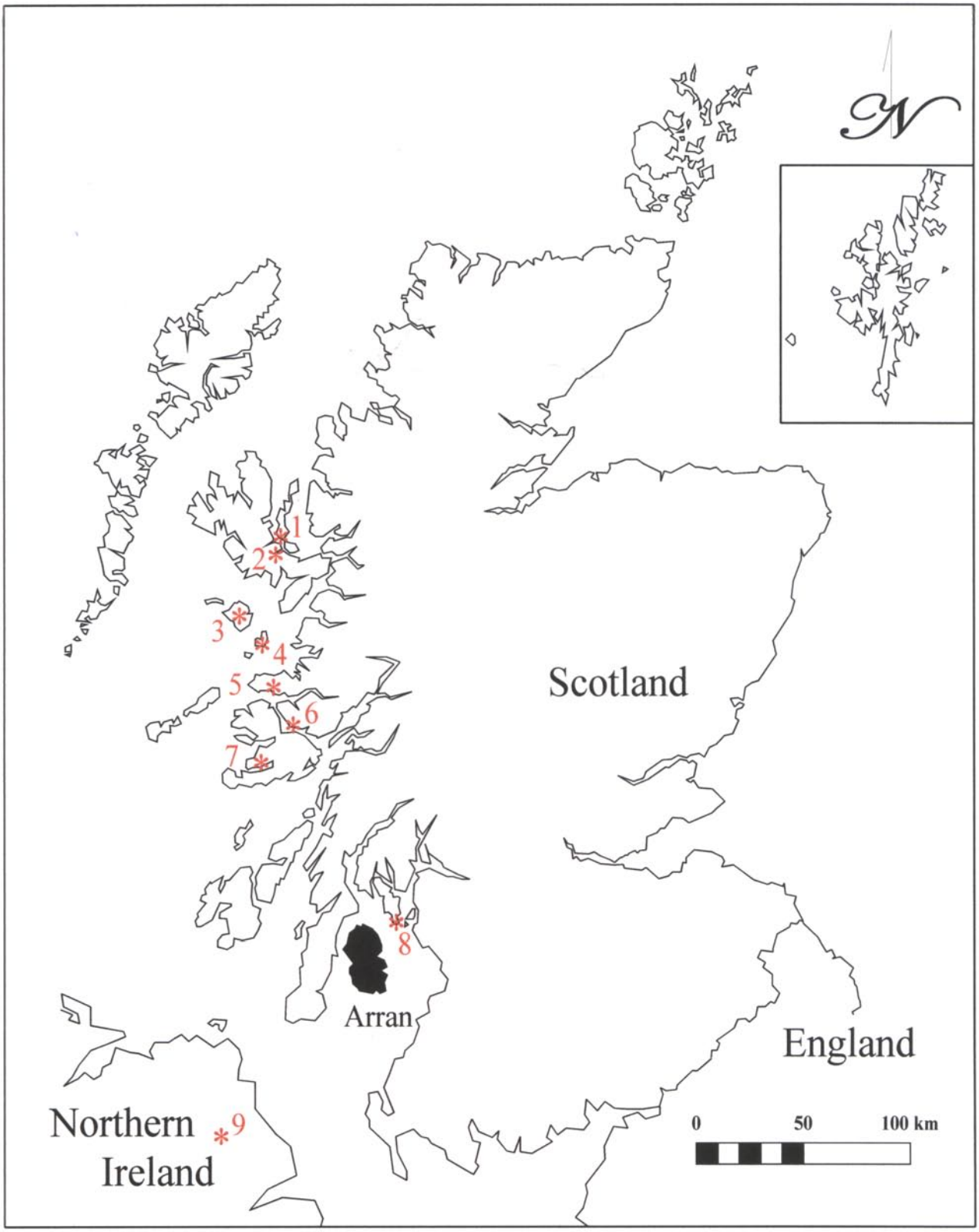
Although the sills of the Corriegills district are likely to be the main sources in relation to the approximately 1000 years of pitchstone exchange with mainland Scotland, Williams Thorpe & Thorpe's suggestions probably do not cover the situation within Arran precisely, as pitchstone procurement for local use is likely to have included many of the more localised, smaller outcrops. Recent research has shown that assemblages outwith Arran may also include non-Corriegills pitchstone artefacts (for example, Blackpark Plantation East on Bute and Barnhouse on Orkney; Ballin et al forthcoming; Ballin forthcoming (a)).

The weak point of Williams Thorpe & Thorpe's otherwise brilliant paper is the fact that they disregarded many pitchstone sources *a priori* with reference to arguments which may appear logical to a modern person, but which probably had no relevance to prehistoric people. Their main reasons for deselection of pitchstone sources were: 1) The quality (that is, homogeneity, 'knappability') of the individual pitchstone sources; 2) the size of the outcrop; 3) the degree of exposure; and 4) source remoteness in relation to known prehistoric habitation.

Material homogeneity: It is clearly Williams Thorpe & Thorpe's presumption that aphyric pitchstone was much more desirable than porphyritic pitchstone (for example, 1984, 17–19), and in terms of the use of this material at the beginning of the Early Neolithic period, they are probably right. As recent research has shown (Ballin 2009), this phase of the Early Neolithic period was characterised by the production of exceedingly small microblades (as demonstrated by finds in radiocarbon-dated pits; for example, Fordhouse Barrow in Angus, Carzield in Dumfries and Brownsbank and Nether Hangingshaw near Biggar in South Lanarkshire; Maynard 1993, 31; Ballin & Ward 2008; Ballin 2004 (a)), and it would have been impossible to produce these (usually 6–10mm wide) blanks in porphyritic pitchstone, or even in aphyric pitchstone with large spherulites (quartz/feldspar devitrification products; see Section 3.2).

However, as the Neolithic period progressed, blades grew increasingly larger (Ballin 2009), and at some stage in the middle or later Neolithic period, the average blades were so broad and thick that it was possible to produce them in porphyritic pitchstone without risking immediate fragmentation. At Late Neolithic Barnhouse on Orkney (Ballin forthcoming (a)), three blades are between 10mm and 16mm wide, and at this site lightly porphyritic pitchstone was used, in conjunction with aphyric material; at Late Neolithic Blackpark Plantation East on Bute (Ballin et al forthcoming), 19 blades are between 10mm and 30mm wide, with two-thirds of the pieces exceeding 15mm. In this case, the assemblage is dominated by heavily porphyritic pitchstone.

Size of outcrop: The size of the outcrop may be relevant in relation to the procurement of material for large-scale 'export', but it is quite likely that the prehistoric inhabitants of Arran also exploited



Illus 1 The location of the Isle of Arran, and the distribution of pitchstone occurrences throughout the British Tertiary Volcanic Province (BTVP)

smaller local sources for their own everyday implements. In his paper on the use of quartz on Lewis, one of the authors (Ballin 2004 (b)) demonstrated how the inhabitants of prehistoric settlements along the Lewisian west coast procured most of their quartz from small local outcrops, or, as it was put, 'back-yard quarries'. It cannot be ruled out that the inhabitants of Arran also exploited so-called

'back-yard sources' of pitchstone, and not only the major outcrops listed in Williams Thorpe & Thorpe (1984).

Degree of exposure: The level of exposure may seem to be an obvious premise, as an outcrop would have had to be visible in prehistory to have been discovered and exploited. However, even this argument is dubious, as it is a very subjective measure. How exposed is *sufficiently* exposed? This question becomes particularly relevant in conjunction with argument 2, above. Another point is that prehistorically available sources may have been completely depleted, or they may have been covered entirely or partially by later soil creep, mudslides or peat formation.

Source remoteness: The argument of remoteness (that is, the distance of outcrops to known habitation/inaccessibility) seems logical to the modern mind, but it has been demonstrated in recent years how many raw materials were quarried in prehistory in extremely remote areas, such as in Shetland's North Roe area (Ritchie 1968; Ballin forthcoming (b)), in the Great Langdale area of Cumbria (Bradley & Edmonds 1993) and in fairly inaccessible parts of Perthshire (Edmonds et al 1992). In cases where a raw material was associated with non-functional values, prehistoric people apparently went out of their way to acquire it. Viewed from this angle, it cannot be ruled out that pitchstone was quarried, for example, from the many dykes and sills in 'The Granite' of northern Arran (see illus 24).

In relation to the question of remoteness/access, it may be relevant to address the problems posed by vegetation. In prehistory, vegetation cover would have obscured many sources at lower levels in southern Arran (as experienced by one of the authors in connection with his survey of the Arran outcrops), whereas the sources at higher elevations in northern Arran (a barren 'lunar' landscape) would have been visible throughout the year. Including vegetation as a factor, the 'remote' and 'inaccessible' sources near the summits of northern Arran may have been the most accessible sources, in practical terms, and several of these outcrops are of significant proportions (Tyrrell 1928).

Examination of geological maps (Ordnance Survey 1972 and 1987) and literature (for example Judd 1893; Gunn et al 1903; Tyrrell 1928) indicates that pitchstone is widely distributed across Arran (illus 24). These pitchstone sources are presented in the present paper, in the form of a gazetteer, which is the main outcome of the Arran Pitchstone Survey Project (APSP), combined with the results of examination of geological samples in the stores of the Hunterian Museum and studies of relevant archaeological and geological literature. As part of the APSP, a survey of Arran was carried out, generously funded by the Society of Antiquaries of Scotland. This investigation was undertaken by Dr Ballin, who spent seven days inspecting the island. The survey had multiple aims and objectives, such as:

- To find and examine as many as possible of the outcrops described in the geological literature; the main purpose of this exercise was to test the above points regarding potential relevance to prehistoric people (material homogeneity, outcrop size, degree of exposure and remoteness).
- To examine the known sources for obvious signs of having been quarried in prehistoric times (cf Ballin 2004 (b)).
- To sample known outcrops to provide hand samples for future archaeological and geological research (for example, to allow specialists at Lithic Research and the Hunterian Museum to be consulted by archaeological units in connection with new finds of worked pitchstone); most of the survey's samples were kept by Lithic Research (Dr Ballin), but samples were also offered to the Hunterian Museum (Dr Faithfull), and, in exchange, parts of existing hand samples were offered to Lithic Research by the Hunterian Museum.
- To find and sample new exposures, or secondary deposits which may indicate outcrops in the vicinity of the findspots.

It is hoped that the resulting gazetteer may – as a tool for future research – increase the understanding of how pitchstone was perceived, exchanged and used within as well as outwith the island. In general terms, the gazetteer should provide a more rigorous basis for archaeological and geological assessment of pitchstone artefacts and sources.

The APSP forms part of the broader Scottish Archaeological Pitchstone Project (Ballin 2009), the main purpose of which was to update Williams Thorpe & Thorpe's (1984) catalogue of pitchstone-bearing sites across Scotland as a whole (supplemented by a small number of find locations in northern England, Northern Ireland and the Isle of Man), and it is hoped that this project will lead to greater understanding of the territorial structure of Neolithic Scotland and the exchange network responsible for the prehistoric dispersion of raw and worked Arran pitchstone.

The present paper consists of three main parts, namely a) a geological section, defining and characterising pitchstone and the different varieties of pitchstone encountered on Arran; b) the actual gazetteer of Arran pitchstone, listing and characterising the presently known outcrops; and c) a brief concluding section, in which the distribution of pitchstone outcrops is discussed in relation to the distribution of worked pitchstone across Arran and Scotland.