The role of chert in later prehistoric lithic industries with specific reference to South-West England

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This paper focuses on the use of chert in the West Country during the later prehistoric periods and the reasons for its selection in the making of stone artefacts. Research was based on the collection of geological samples, assessment of regional deposits and detailed studies of museum collections. Given the ready accessibility to flint sources in South-West England, use of the relatively less available Upper Greensand and Portland cherts must have been a matter of choice rather than necessity among the peoples of later prehistory. It also appears that the different cherts were utilised for different purposes, as both cherts have particular knapping qualities. Portland chert was often selected to make arrowheads and seems to have had significance beyond the utilitarian.

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Introduction

Stone implements were essential for the survival and well-being of prehistoric people. Certain qualities were required of a rock type to optimise working and utilisation and the availability and accessibility of these materials would have presented opportunities and imposed limitations on peoples' lives in prehistory. Choices concerning raw materials for implement production would have been made for practical reasons. However, it seems that considerable effort was also expended in the collection of rocks with particular aesthetic qualities. Certain colours were favoured (Bradley, 2000) and other factors were sometimes important such as special locations and places within the landscape (Bradley and Edmonds, 1993). The rock types used for everyday stone tool making were by necessity hard, durable and fine-grained. They also needed to be commonly available. A number of siliceous rocks possess these qualities. The most common, everyday materials available for use were the cryptocrystalline siliceous deposits of chert and flint. Flint was the most widely used raw material for this purpose in Britain. However, where flint was infrequent or absent other chert types were utilised. A wide range of different ages and varieties of chert are found across Britain and Ireland. Many of these were utilised in prehistory.

Stone-working

Knapping is the process of working flint or stone either by direct or indirect percussion or by pressure (Darvil, 2003). The nature of the rock type used has a strong effect upon the resulting implement. Most importantly, the best materials with a pronounced ease of working are those which allow a shock wave to run smoothly through the rock resulting in the production of a flake or blade. Andrefsky (2005) states that "*Progressively less homogenous materials may display progressively less predictable characteristics*". The waste pieces produced during implement making and sharpening are referred to as debitage. Debitage type can elucidate the knapping process for lithic analysts. Types of stone artefact changed between one prehistoric period and another, and this assists archaeologists in providing a chronological context. A central piece of stone remains after blades or flakes have been removed during the knapping process. This shows distinctive flake removal scars and is referred to as a core (Figures 1 and 5). Core shape provides information about the stone-working process and the core form may also assist as a chronological indicator.

The main characteristics that single out a rock type for stone tool making may be summarised as follows (Lord, 1993; Waddington, 2004; Andrefsky, 2005; Butlar, 2005):

1) Very hard/strong.
2) Dense to fine grained or cryptocrystalline, usually with a high silica content.
3) Durable.
4) Cleaves leaving a sharp, tough edge.
5) Reacts in a consistent, predictable way.
6) Fine working possible and no coarse crystal structure.
7) Common and easily obtained.

Flint occurrence

Flint possesses all the qualities listed regarding suitability for stone tool making. Questions concerning the use of chert in later prehistory cannot be addressed in isolation from the availability of flint. The term 'flint' is restricted to siliceous concretions which originally formed in Upper Cretaceous Chalk (Hauptmann, 1980; Schmid 1986).

Flint raw material is most abundant in south and eastern England in the vicinity of the Chalk. However, in most areas of Britain flint is available in some form. For example, beach pebbles of flint are found around the western Scottish coast originating from gravel deposits in the Irish Sea basin and eroding from the Antrim limestone. Tertiary deposits in Scotland, such as those at the Buchan Ridges, were also exploited in late prehistory (Saville, 2008). Beach pebbles worked by prehistoric people have been found in archaeological excavations far from the coast, in sites throughout Britain. This indicates the transport or trading of flint and flint implements over considerable distances and indicates its desirability. Far from primary sources of flint, acquisition would have been much more difficult and the available flint often of considerably poorer quality. Flint beach pebbles suffer abrasion in the sea and may be small and tough to work. This is reflected in the archaeological record. In Scotland the archaeological evidence indicates that knapping techniques were refined and honed to overcome the problems presented by these more challenging raw materials (Coles, 2008) (Figure 1).

Newberry (2002) has explored the sources and knapping properties of flint from various secondary sources in Devon and collaborating with John Lord, an expert flint worker, has demonstrated that many of these sources produce material that would have been satisfactory for use in prehistory. However, secondary flint deposits, ubiquitous in many areas of Britain, have often undergone a complex and varied depositional history. This potentially causes difficulties in sourcing much of the flint raw materials used in prehistory (Van Gjin, 2010).

Why use chert?

In the regions of Britain where flint was difficult to obtain, chert and various other siliceous rock types were used to make stone tools. In Northern Scotland quartz (Ballin, 2004) and bloodstone (Wickham-Jones, 1990) were used. In the Southern Uplands of Scotland prehistoric people utilised local cherts. Ballin (2008) divides the prehistoric use of raw materials in Scotland into two areas: the quartz-using zone north of the Highland Boundary and the zone of chert use to the south.

The variable geology of Britain results in a number of chert types occurring in bedrock across the country. These are more restricted in geographical distribution than flint which makes it easier to identify their source. Some deposits were affected by ice movement but usually only in their local areas. British cherts vary vastly in age and this age range results in different physical characteristics. By studying the availability of the sources of chert and the use of particular lithologies, practical and theoretical information may be obtained for studying the human use of these more distinctive geological materials in prehistory. The logistics of raw material procurement from geological sources including the effort required, distances covered and the choices made has the potential to give insights into the lives of prehistoric people. Quartz and chert were chosen alongside flint and in some cases were the predominant lithic material used for tool making.

Figure 1. *Example of a tiny Neolithic flint core made on a beach pebble. Picture taken at an excavation site in Orkney.*

Key areas and geological setting

Cherts occur in rocks throughout Britain but the types most widely used in prehistory (Figure 2) are:

1) The Ordovician and Silurian cherts of the Southern Uplands of Scotland, occurring as large lenses of chert in greywackes, mudstones and shales.

2) Chert in the Carboniferous strata of the Scottish Borders, the Pennines and Peak District occurring mainly as tabular cherts in limestones and calcareous mudstones.

3) Carboniferous cherts in North and South Wales and the Mendips. These occur as nodular and tabular cherts in limestones. In certain areas of North Wales they outcrop over a wide area.

4) The Jurassic Portland and Purbeck nodular cherts in the limestones of Dorset.

5) The Upper Greensand chert of Southern England. These are bedded and nodular cherts and siliceous sandstones of Upper Cretaceous age.

Research method

There were three facets to the research conducted for this study:

1) Geological samples were collected from outcrops and secondary deposits in the West Country. These were located using geological maps, guide books and available literature plus some extrapolation. Accessibility and position in the landscape were noted.

2) Correlation with the nearest flint sources was made by visiting and assessing the regional deposits.

3) Detailed studies were undertaken on museum collections. The occurrences of pieces of worked chert in archaeological assemblages, from excavated and field-walked sites, were studied. Both chert implements and debitage were recorded from more than thirty assemblages usually consisting of thousands of worked pieces.

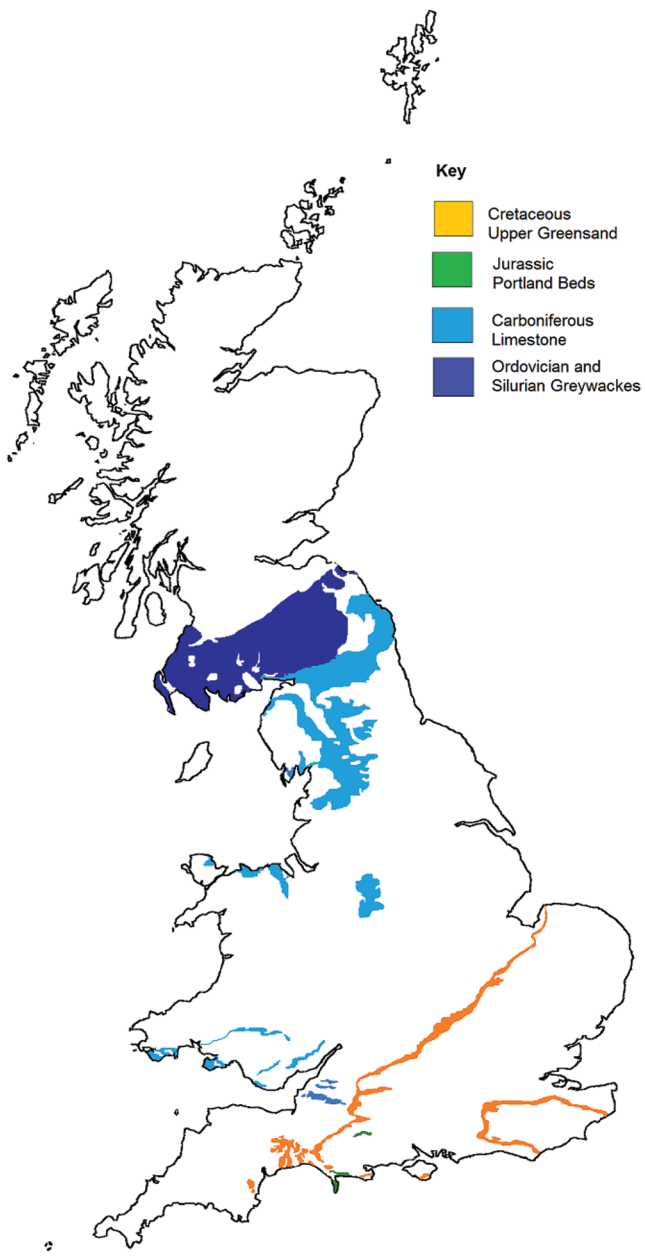

Figure 2. *The main geological sources of chert in later prehistory.*

Findings

Cherts in the West Country, their geological occurrence

What a geologist classes and describes as chert is not always what an archaeologist might recognise as chert. The key issue for archaeological research in this area is the suitability of a rock type for making stone tools as opposed to its lithological classification. Numerous cherts with a high clastic fraction along with rocks described as siliceous mudstones, cherty limestones, etc. are recognised as cherts by geologists. However, people in prehistory and therefore archaeological researchers in modern times were and are interested in pure, flint-like cherts that may be efficiently knapped in order to fashion a durable tool.

There are a number of chert types in the West Country but not all were used in significant amounts to make stone implements in prehistory. Examples of cherts that were very rarely used are the radiolarian cherts of the Devonian strata in Cornwall, the cherts found in the Devonian Limestone and in the Carboniferous rocks of Devon and Cornwall. Discussion has continued between lithic analysts about the possible use of the prolific chert occurrence in the Lower Carboniferous succession of the Culm Measures. However, the Carboniferous rocks of Devon and Cornwall are of a deep water facies, dominated by mudstones and shales rather than the cleaner cherts of the Carboniferous limestones of South Wales and the Mendip Hills. There is scant evidence of the use of the bedded, silty cherts in the Codden Hill and Bampton areas in North Devon or the chert deposits around and to the west of Dartmoor. Only one single scraper of this black, clastic chert has been found in the Mount Ararat area and is held in Torquay Museum. Chert from the Carboniferous rocks of the Culm Measures was taken for knapping by John Lord. He found it reasonable to work with but reported that the knapping quality of the rock graded in and out according to the amount of silt in the chert. One exception is the fine, pale Firebeacon chert at Meldon. This knaps well and seems to be a candidate for use in prehistory. However, this material is not seen in any of the lithic assemblages in Devon and Cornwall. One explanation for this may be that this chert did not outcrop on the surface where it would have been accessible. These cherts are of interest because they pose the question: why were they not used?

The two main types of chert that were used in prehistory in the Devon, Cornwall and Dorset area were Upper Greensand chert and Portland chert.

Upper Greensand chert was used extensively in the West Country throughout prehistory. Numerous Palaeolithic hand axes have been recovered from the land surface and river valleys in East Devon (Wymer, 1999). This material is not a true chert (Tucker, 2008) because it exhibits a grainy structure. Some of the silica in the rock matrix is cryptocrystalline but much of the structure consists of chalcedonic silica around sand grains which give the material a sugary appearance. Rod-like sponge spicules and tiny marine fossils are usually visible along with flecks of oxidised glauconite and these features assist with recognition of this material in archaeological assemblages in the West Country.

Upper Greensand chert pebbles and cobbles have been observed by the author along the West Country coast. Much erodes from the cliffs around Seaton and Lulworth but worn slabs are found on some beaches to the west of the cliff exposures, particularly around Paignton and Torquay. Cretaceous strata occur in the English Channel seabed (Hamblin *et al.*, 1992) and the plucking of chert from this source is the likely origin of these fresh clasts. Greensand chert occurs as pebbles in some of the raised beaches in Cornwall and in glacial outwash in deposits in Somerset (Gilbertson & Hawkins, 1977). Pebbles are found along the north Devon and Cornwall coast and there are clasts in the Exe Valley gravels (Edwards, 2000). Weathering and dissolution caused the chert bands to disintegrate and settle into tightly packed, very resistant broken masses that cap the tops of the Greensand hills in East Devon and Dorset (Gallois, 2004) and there are 'clay with flints and chert' deposits on the surface in this area. Upper Greensand chert from most, if not all, of these sources appears to have been used in prehistory (Bond, 2009). Worked pieces of Greensand chert, dating back to prehistoric times, may frequently be found along the Greensand ridges, indicating the importance of this chert to people in the past.

Greensand chert in the West Country occurs in two discrete facies (Williams, 1986). The coarse western 'Blackdown facies' is found in the western Blackdown Hills and in the Haldon area. To the east is the 'normal facies' of finer-grained chert. In the South of England, Upper Greensand chert outcrops in Devon, Dorset, in the Vale of Pewsey and on the Isle of Wight. In Kent chert occurs in the Lower Greensand but the lithology of Lower Greensand chert is different and recognisable from that of the Upper Greensand.

Upper Greensand chert is remarkably variable in appearance (Figure 5). It occurs in an attractive range of colours including translucent white, yellow, orange, banded brown and gold, caramel, brown and shades of grey. In Cornish lithic

assemblages it is commonly a pale brown 'biscuit' colour. Greensand chert often occurs with a cortex, and the absorption of chemical compounds from the aqueous environment surrounding the deposits sometimes results in pronounced banding under the cortex. Greensand chert exhibits variable grain size ranging from almost pure chert to siliceous sandstone or calcarenite. The fine-grained Greensand chert type is of particularly good quality for knapping. Not only is there a diversity of grain size and colour but also it has a wide geological occurrence of both primary and secondary deposits throughout the West Country and southern England. This presents problems in attempting to source Greensand chert because it is equally as complicated and mixed as flint in the region.

Portland chert outcrops in a far more limited area than the Upper Greensand chert. The best-known occurrence of this rock is on the Isle of Portland (Figure 3). However, the Portland Beds are found in the Vale of Wardour in Wiltshire (Wimbledon, 1975) and there are other exposures near Urchfont in Wiltshire. In Dorset the chert occurs in cliff exposures on the Isle of Purbeck and on the northern edge of the Weymouth Anticline where there are a number of exposures in small limestone quarries (Gorman *et al.*, 1993). Pebbles of Portland chert occur on the beaches eastwards of Portland. There are occurrences of Portland chert debris found on the surface with flint nodules on ploughed fields in certain areas of Wiltshire and Dorset. These deposits are similar in appearance to residual 'clay with flint' deposits.

Portland chert grades from an arenaceous, grainy chert to a very fine, grey-blue chert often with small but visible fossils. The main fossil types are the sponges *Rhaxella* and *Pachstrella* (Maliver and Siever, 1989). Arkell (1978) noticed differences in grain texture and has divided the cherts into the Upper and Lower chert series with variations from outcrop to outcrop. In some beds the Portland chert is pale, grainy and brittle but prehistoric people seem to have consistently utilised the very finest, dark grey material. Grey flint types, especially some seen in archaeological lithic assemblages in Cornwall, have a similar appearance to Portland chert. However, the density of Portland chert is lower than that of flint and even in hand specimen it is possible to feel the difference in weight between the two materials.

Figure 3. *Deposits of Portland chert in the Albion Quarry, Isle of Portland.*

The highest succession of the Portland Beds passes into the Purbeck Beds. These contain fine, brown, flint-like chert with good exposures in the cliff section at Peveril Point on the Isle of Purbeck. The appearance of Purbeck chert is almost indistinguishable from good quality flint; however, it has been recognised in archaeological assemblages in Dorset (Palmer, 1970).

Flint occurrence in the West Country

Compared with the limited access to flint deposits in the central, inland areas of Wales and in Scotland, prehistoric people in the West Country had a wide variety of flint raw materials to utilise. Available sources of flint would have been:

1) The most westerly primary source of flint in the Chalk cliffs at Beer (Jarvis & Woodroof, 1984).

2) Remanie deposits of flint on the Haldon Hills and in East Devon (Edwards & Freshney, 1982).

3) Tertiary deposits at Orleigh Court (Cope, 2007) and flint bearing Palaeocene and Eocene gravels located in the area east of Torquay (Edwards & Freshney, 1982)

4) Flint nodules in 'Clay with Flint' deposits, widespread especially in East Devon (Gallois, 2009).

5) River terraces particularly on the River Exe (Edwards, 2000).

6) Glacial outwash in North Devon (Gilbertson & Hawkins, 1977).

7) Raised beaches in Cornwall (Edmonds *et al.*, 1975).

8) Common as pebbles and large cobbles on beaches along most of the West Country coast, observed by the author during an investigation of beaches at 10 km intervals from Beer in Devon to Swallowcliff in Somerset.

Archaeological observations

Upper Greensand chert and Portland chert were observed in archaeological assemblages throughout Cornwall, Devon and Dorset. Amounts vary, with greater abundances of chert nearer to areas where it outcrops. Away from areas of primary sources there may only be one or two pieces of chert seen among a collection of several thousand pieces of worked flint. However, in Devon and Cornwall it is very rare for chert to be absent, at least as small pieces of debitage, in archaeological assemblages. In collections from coastal Mesolithic sites it may be seen that Greensand chert and flint were being used in equal proportions to the ratio of these two pebble types on the local beaches as noted by Smith & Harris (1980). Greensand chert was more frequently utilised in the Mesolithic than the Neolithic.

There is no evidence in archaeological material from Devon and Cornwall for the utilisation of the Carboniferous chert from the Bristol and Mendip area, although it was widely utilised in Somerset. This chert type does not seem to have been treated or regarded in the same special way as Portland chert; indeed Portland chert artefacts have been found in the Mendip Hills landscape on top of chert-bearing limestones.

In modern times quarries on the Isle of Portland and along the Ridgeway that marks the northern side of the Weymouth Anticline, give the best access for Portland chert sampling (Figure 3). Cliff outcrops must have been obvious in prehistory

but there are no obvious primary inland outcrops. However, the soil eroding from some of the Bronze Age barrows on the Ridgeway contains chunks of Portland chert so it must follow that people were aware of its location inland. Portland chert beach cobbles are found along the coast on Chesil Beach and eastwards from the Isle of Portland. An interesting phenomenon is that a number of the Portland chert pieces in archaeological assemblages from Devon and Cornwall were made from beach pebbles. Before the English Channel was breached the Channel River flowed east to west (Smith, 1989). The Portland Beds extend out under the sea into the Channel, possibly providing a source of these pebbles, which may have been available to Mesolithic people when sea levels were lower. However, worked pebbles also occur in Neolithic assemblages. This time period was one when the Channel had been breached and longshore drift would be moving the littoral bedload west to east. Would people in the Neolithic and Bronze Age have searched out extremely infrequent Portland chert pebbles on beaches many kilometres away from their primary source or would these pebbles have been brought from Dorset as part of the movement of this exotic material across the south of England?

Discussion

The present paper focuses on the period of later prehistory which extended from the Mesolithic Period that started at the beginning of the Holocene, through the Neolithic Period and the first farming communities and to the end of the Bronze Age where stone was used alongside the innovation of metal. There is evidence that both Upper Greensand chert (Wymer, 1999) and Portland chert (Palmer, 1970) were utilised by earlier Palaeolithic peoples and users of this material in later prehistory must have been aware of this.

Figure 4. *Coarse chopper made from an Upper Greensand chert pebble. Royal Albert Memorial Museum, Exeter.*

Upper Greensand chert in archaeology

There seems to have been a preference for Greensand chert as a raw material for implement making in the Mesolithic Period. Berridge (1986) noted that Mesolithic people often made microliths from this chert. Greig & Rankine (1953) stated that all Greensand chert artefacts are Mesolithic. However, the Neolithic causewayed enclosure site at Hembury Hillfort in East Devon shows ample evidence of the working of Greensand chert (Brown, 1991). Microliths are the definitive artefacts of the Mesolithic period. These small pointed, delicately-worked barbs of flint or chert were used to make composite tools such as harpoons, arrows or knives (Darvil, 2003).

Upper Greensand chert is highly variable and seems to have been employed for practical rather than for ceremonial purposes. The coarse chert was used for large implements and these often display heavy wear or polish. At Hembury Hillfort the more fine-grained type of Greensand chert was used to fabricate carefully made scrapers and knives whereas the coarser type was employed to make larger, heavy duty tools and picks (Figure 4). In Cornwall local Greensand chert was also utilised to make coarse scrapers and knives. Some knives were made on particularly long blades and this may reflect a quality of this chert (Newberry, 2002). A substantial number of Greensand chert core tools such as adzes, picks and axes occur throughout the West Country and some researchers suggest that the exchange of larger tools took place (Berridge and Roberts, 1986). Berridge (1986) suggested that the coarser composition of Greensand chert would have reduced the chance of flakes being accidentally knocked off during vigorous use.

A Devon archaeologist, Nan Pierce, undertook a field walking project around the Blackdown Hills over a period of several decades that included Crandon's Cross which is by far the largest single Mesolithic assemblage from South-West England (Jacobi, 1979). Pierce found hundreds of Upper Greensand chert implements and cores (Figure 5) and it seems the site was used for the procurement of raw materials and utilised Upper Greensand chert from the Palaeolithic Period through to the Bronze Age.

Upper Greensand chert was used because of its similar qualities to flint but was also selected because of differences in its hardness, coarseness and resilience.

Portland chert in archaeology

Portland chert had a special significance for prehistoric people and was used differently to Upper Greensand chert. During excavations at Farnham in Surrey in the 1930s Rankine recognised a Portland chert 'angle graver' in a pit and in later research found more small pieces and noted a number of arrowheads made of the same material (Rankine 1951). He remarked that these pieces of Portland chert represented "*migrations or barter from Mesolithic to Bronze Age times*". In the 1970s Palmer showed that Portland chert had been exploited on the Isle of Portland since the Palaeolithic period (Palmer, 1970, 1976) and she added considerable evidence to Rankine's theory of the transport of this material away from the Isle of Portland in prehistory. At Culverwell on Portland numerous Mesolithic chert tools and thousands of cores were found with 60% of the tools made of Portland chert compared with 11% made of flint and 29% made of other materials. An Early Mesolithic radiocarbon date of 7,150±135 BP (5,200 BC) (Palmer 1970) and a thermoluminescence date of 5,400±390 BC (Palmer 1976) were acquired for the site. At the other end of the South West region, Late Mesolithic Portland chert microliths were found during an excavation at Poldowrian in west Cornwall (Smith and Harris, 1980).

In addition to evidence of Mesolithic movement of Portland chert, Green (1980) drew attention to the Neolithic artefacts also found on the Isle of Portland. Studies of assemblages in Devon and Cornwall for the current project indicate that it was regarded as a special material well into the Neolithic period and to some extent into the Early Bronze Age, and Portland chert appears in very small amounts within archaeological lithic assemblages across the West Country.

Figure 5. *Upper Greensand chert cores from Crandon's Cross. Nan Pierce collection at Royal Albert Memorial Museum, Exeter.*

Portland chert was used in the Neolithic to make arrowheads, especially the earlier Neolithic leaf-shaped types (Green, 1980; Keene, 1999). Neolithic and Bronze Age arrowheads were shaped using the knapping technique known to lithics analysts as 'invasive retouch' which is achieved by working from the edge of the implement towards the centre (Darvil, 2003) (Figure 6). The quality of invasive retouch on flint arrowheads is highly variable. Some flint arrowheads observed from collections show quite basic retouch but all the ones made from Portland chert show excellent, careful working indicating that this material was considered worth special effort.

Throughout the Neolithic, Portland chert was used to make artefacts that required neat, specialist working including the unusual discoidal knives, very neatly worked scrapers and, in particular, fancy arrowheads. Later in the Neolithic, arrowhead types proliferated to include oblique forms and chisel-shaped arrowheads. These were fashioned in flint but also, more rarely, were carefully made using Portland chert. During this study Portland chert artefacts and debitage were observed in archaeological lithic assemblages from East Kent to the far west of Cornwall.

Figure 6. *Two finely worked Neolithic arrowheads from the author's collection. One made from flint on the right and one made from Portland chert on the left. The base of the chert arrowhead has snapped off probably along the line of hafting.*

What does the use of chert in later prehistory signify?

Jacobi (2007) noted that people in the Upper Palaeolithic used better quality raw material for their projectile points than other tools indicating that choices were made about the type of stone used for tool making earlier in human history. When discussing lithic artefacts fabricated from special raw materials Van Gijn (2010) suggested that such objects may have been deemed particularly appropriate for initiation ceremonies, burial rites and celebrating special events. Travellers returning to their native community with exotic raw materials or objects may have been regarded in a similar way to craftspeople whose skills may have been thought to be supernatural. Long distance travel would bring power and knowledge that may have been

inaccessible or frightening to those who stayed at home. Objects from far off places may even have had a connection to mythical ancestors or deities (Bradley, 1990; Pétrequin *et al.*, 2012). The use and transport of Portland chert have resonances with that of Arran pitchstone across Scotland (Ballin, 2009) and into Cumbria (Hamilton-Gibney, in prep.).

The fascination with Portland chert seems to have declined as the Bronze Age progressed (Green, 1980). A few rare Portland chert Bronze Age barbed and tanged arrowheads have been recovered. However, significantly, people in the period of transition between the Late Neolithic and the Early Bronze Age, deliberately placed small pieces of Portland chert into pits with other exotic materials and objects (Jones *et al.*, in press). Pieces of Portland chert are occasionally found in assemblages in flint-rich South-East England but Upper Greensand chert is rarely recorded. Whatever the thought processes behind the choices, Portland chert, Upper Greensand chert and flint were recognised as different materials and were treated and regarded in different ways.

Conclusions

Prehistoric people had an intimate knowledge and understanding of their landscape and the underlying geology. Before metal-working, stone was the most durable material available and played an essential role in everyday life. In areas such as southern Scotland, the use of chert in later prehistory alongside the more difficult to obtain flint, may have been a necessity. However, in South-West England flint sources would never have been more than a maximum of 30 km away. Portland chert and Upper Greensand chert must have been utilised as a result of choice and were differentiated from flint and each other for particular reasons. Greensand chert was tough and durable with specific knapping qualities. Portland chert also had particular knapping qualities and was often given special attention and used to make arrowheads. The small but significant amounts of this chert found across Southern England from a relatively limited source implies that it held some kind of importance, beyond simply utilitarian reasons, to the people who used it.

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