

# Luminescence Dating of Burnt Flint at Boston Spa

## Background

In the autumn of 1999 fieldwalking by Boston Spa and District Community Archaeology Group revealed the presence of a prehistoric site on land near the River Wharfe. An article in *Archaeology & Archives in West Yorkshire* described the preliminary results of fieldwalking to the end of 2001. In that period the group recorded flint artefacts that suggest temporary or permanent settlement activity from the hunter-gatherers of the Mesolithic period to Neolithic and early Bronze Age, plus thousands of pieces of burnt flint and waste pieces from flint tool manufacturing. The site is interesting because of the amount of manufacture that took place, reflected in the high proportion of flint debitage on certain areas, including material from all stages of knapping. There were also some modern gunflints in the assemblage, plus waste from their manufacture. In 2002-3 a further 25 hectares was fieldwalked, doubling the area looked at. It was found that the distribution of flint thinned away from the flint-knapping areas and the proportion of tools amongst the waste pieces increased. The date range remained the same. There was a mixture of artefacts from all periods around the site, as well as a few period groupings, including one notable concentration of Mesolithic artefacts on a low river terrace. Domestic and industrial exploitation of flint material on site can therefore be seen to have continued from Mesolithic to modern times. In prehistoric terms, however, the concentrations of knapping waste in certain areas, the overlay of diagnostic tools from different periods and the pattern of more discrete flint scatters moving away from the main site all suggest that it may have been used repeatedly for temporary camping and then gradually in a more settled way, but also raise the possibility that it became a place where groups met and exchanged raw materials or produce with other sites along this stretch of the Wharfe that exhibit similar scatters of flint artefacts but only small amounts of manufacture waste.

(Fig. 1) Lithic Finds Chart

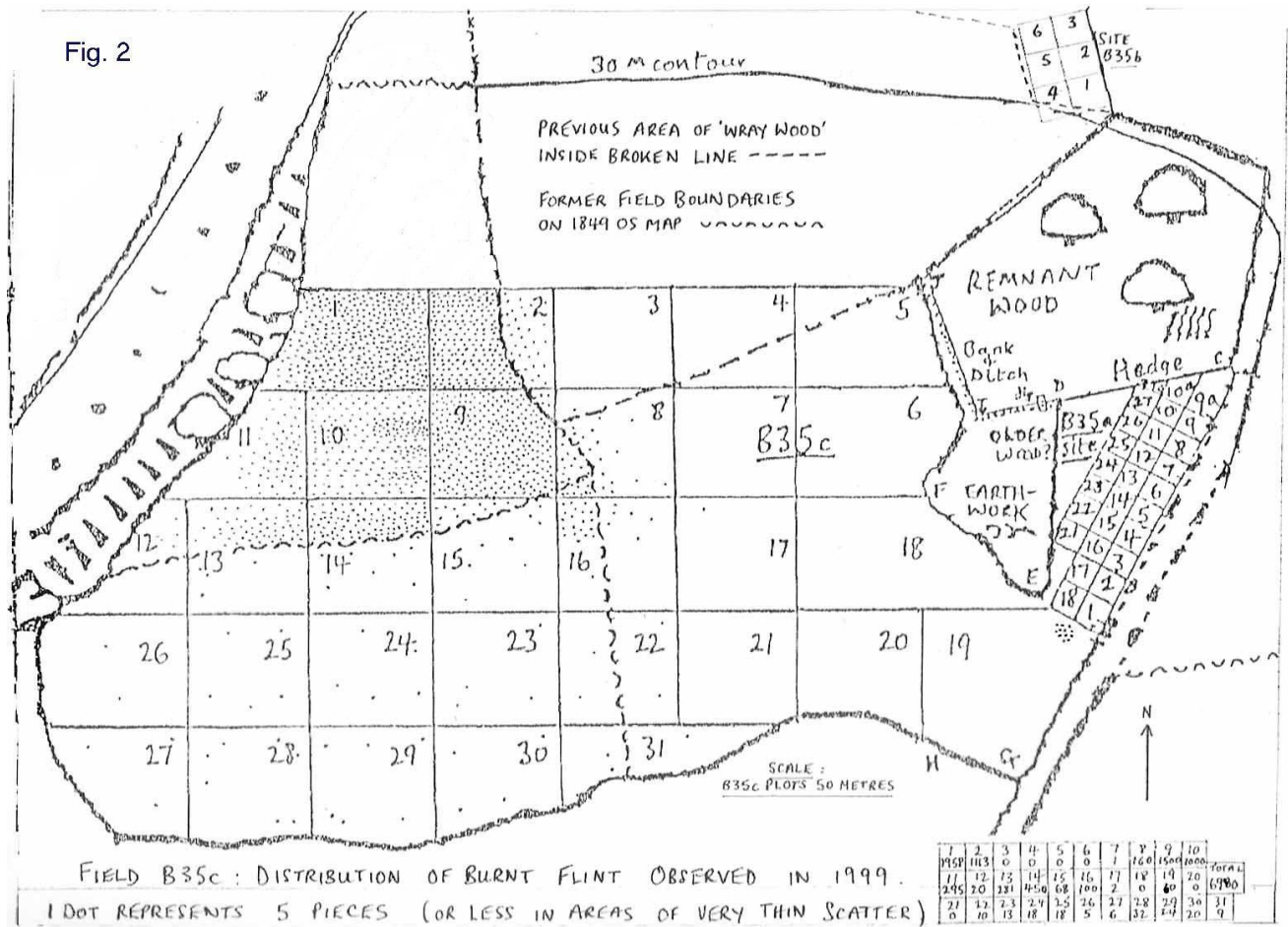
Fields Area m2 walked	B35a 3000 twice	B35b 1350 twice	B33b 56000 twice	B33e 16000 once	B35c 77500 once	B35d 72000 once	B33a 62500 once	B33c 9150 once	B34 42500 once	M1 44000 once	M2 60000 once	B32 19000 once
<b>Flint burnt</b>	<b>281</b>	<b>381</b>	<b>11485</b>	<b>434</b>	<b>2783</b>	<b>2936</b>	<b>47</b>	<b>1</b>	<b>7</b>	<b>4</b>	<b>2</b>	<b>8</b>
till (b/clay)	3205	2181	252	45	145	70	43	0	5	3	6	6
<b>Wolds (chalk)</b>	<b>1</b>	<b>1</b>	<b>11</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>5</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>
corticated	190	51	500	27	110	58	99	10	70	24	35	38
<b>Chert</b>	<b>0</b>	<b>12</b>	<b>538</b>	<b>1</b>	<b>57</b>	<b>48</b>	<b>70</b>	<b>3</b>	<b>13</b>	<b>1</b>	<b>2</b>	<b>0</b>
<b>Total flint (excl. burnt)</b>	<b>3396</b>	<b>2233</b>	<b>763</b>	<b>72</b>	<b>258</b>	<b>131</b>	<b>147</b>	<b>10</b>	<b>78</b>	<b>27</b>	<b>41</b>	<b>44</b>
<b>Total worked</b>	<b>77</b>	<b>3</b>	<b>104</b>	<b>14</b>	<b>30</b>	<b>24</b>	<b>47</b>	<b>2</b>	<b>19</b>	<b>7</b>	<b>18</b>	<b>17</b>
<b>% worked</b>	<b>2.2</b>	<b>0.13</b>	<b>13</b>	<b>19</b>	<b>11.6</b>	<b>18</b>	<b>32</b>	<b>20</b>	<b>24</b>	<b>26</b>	<b>44</b>	<b>40</b>
<b>Artefact Types</b>												
arrowheads	0	0	3	0	1	4	2	0	1	0	1	2
awls	5	0	4	0	1	0	0	0	0	1	1	0
axes	1	0	0	0	1	0	0	0	0	1	0	0
blades	59	3	57	11	11	10	13	1	6	2	4	4
cores	3	0	17	1	4	4	11	0	4	2	5	3
fabricators	0	0	0	0	1	0	0	0	0	0	0	0
gunflints	2	0	1	0	2	0	0	0	0	0	0	0
microliths	0	0	3	0	0	0	1	0	1	0	0	0
Retouched flakes	1	0	0	0	1	2	0	0	0	0	0	1
scrapers	5	0	18	1	8	4	18	1	7	1	6	7
Unfinished or uncategoryed	1	0	0	1	0	0	2	0	0	0	1	0

Each field was divided into fieldwalking plots and finds recorded for each plot. The vast majority of the flint is good quality, semi-translucent, blacky-brown boulder-clay or till flint from the east coast. Only a small proportion is the poorer quality, Yorkshire Wolds flint, with chalky inclusions. If we exclude burnt flint for the moment, it can be seen that the two smaller areas that were used for flint knapping have a high percentage of waste pieces and a low percentage of artefacts, whereas the larger (modern field) areas have a much higher percentage of artefacts and proportionately less waste scattered across them. Test pitting on the first knapping area, B35a, found both burnt and un-corticated flint (no patination) descending below the 25 cms of ploughsoil to reach a probable settlement layer at approximately 35-40 cms deep. This was thought to be a settlement rather than occupation layer as the pieces diminished in size going downwards, as if sifted, and were accompanied by modern waste, including burnt clay with an OSL date of AD 1743 + or - 20. Hardly any

artefacts were found on the second knapping area, B35b, and this, coupled with the 'rougher', more 'lumpy' appearance of the waste, with more pieces still possessing primary cortex, suggested an earlier or different stage in the knapping process.

### The Burnt Flint Enigma

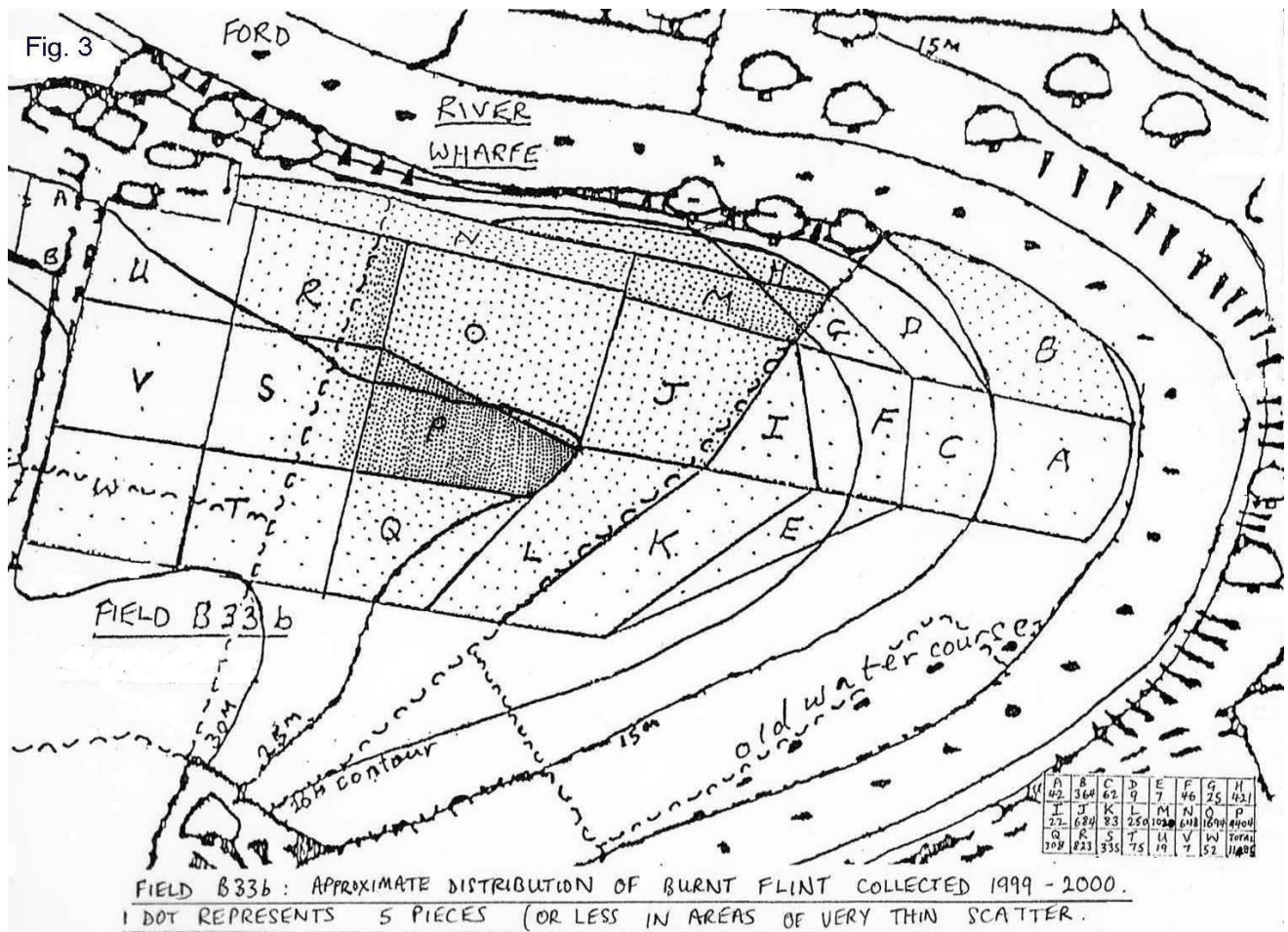
The difficulty in unravelling the site caused by having prehistoric flint mixed up with more modern items in the same ploughsoil, whether they be gunflints, Roman or medieval pottery, or post-medieval manuring finds, was exacerbated by the discovery of masses of burnt flint scattered across it. (Figs. 2 and 3 are sketch maps showing the results of a survey of its distribution in two particular fields.)



The modern field B35c (fig. 2), with the earlier 19<sup>th</sup> century field boundaries superimposed, shows the former area of ancient woodland overlapping plots 2 to 5. Like many in the area, the fields have alternated between arable and pasture, both before and since enclosure times. After the modern amalgamation of the three fields and, more recently, the grubbing out of most of the wood in the early 1980s, it appears that burnt flint had been ploughed across the former field boundary from 'Wood Close' (top left), as it was called on the field names map, into the other two fields and the area of former woodland. This applies particularly in the centre, as the direction of modern ploughing is east west. When the distribution of burnt flint is plotted like this one can see that there was a clear concentration in 'Wood Close' and it was not evenly distributed across the site in a way that might occur if it had been deliberately spread as some obscure agricultural soil-improvement measure if and when there happened to be a cheap surplus at the nearby 18<sup>th</sup> century Flint Mill across the river. The route to Thorp Arch Flint Mill did not come through the site. Instead, supplies of flint from the south of England were brought into the Humber estuary by ship and thence by barge to Tadcaster, from where they were carted to the mill along a well-engineered track north of the river, traces of which can still be seen on the Ebor way today. The flint was heated, finely crushed and transported to the Leeds Pottery, either in barrels as slurry, or in dried cakes.

Another reason for being sceptical of its agricultural use is that burnt flint is inert and unlikely to break down chemically in the soil. The pieces we recorded ranged in size from 7 cm nodules to 0.2 cm particles. (See fig. 4.) Whether it has been gradually broken down by repeated mechanical percussion, like that from modern power harrows in particular, is a matter of conjecture. It is well known that heat aids the process, as our own re-

enactment experiments have shown. We have found that too much heat for too long can reduce the flint almost to powder. Heat at the right level would have been used in prehistoric times to make the flint easier to knap. Alternatively, the thermal shock of plunging heated nodules in liquid, either for prehistoric cooking or to break them down for crushing as temper in pottery, could be a reason for finding burnt flint on the site.



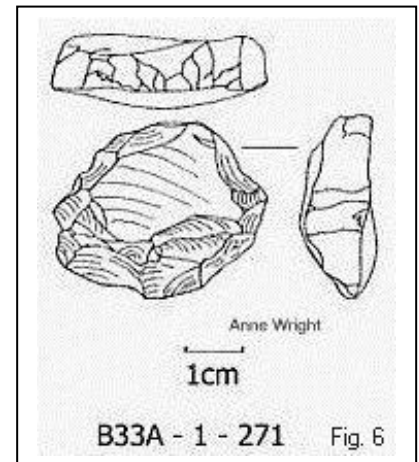
In fact, a rim sherd of Romano-British 'dalesware' pottery was found on the flint knapping area with pieces of burnt flint in its fabric. One could even speculate that the concentrations shown in Figure 2 and the intense one in Plot P in Figure 3 suggest ploughed-out 'burnt mounds', or some other kind of hub or focus of activity. However, the quantity and extent made us wonder instead about the possible periodic burning of scattered flint in later times after it had been brought to the surface by ploughing. Stubble burning is thought by some not to produce a high enough temperature, though the burnt flint found (see fig. 4) ranges from the whiter hue associated with high temperatures to the grey blue produced by much lower heat. Woodland-clearance bonfires or rubbish burning might have been sufficient. Field B35c (fig. 2) was once a large area of woodland. It is still bordered by remnants which our archaeobotanical surveys have shown to be ancient and the sinuous hedge line running east west along the bottom of the field has an ancient pedigree, judging by the range of shrub and ground flora species persisting within it. This hedge line appears to have been the southern edge of the wood at some time in the distant past. We needed some way of dating the burnt flint to help answer these questions.

### Luminescence Dating Project

In 2002 the Yorkshire Archaeological Society kindly stepped in to help by giving the group a grant to pay for dating of samples from the site. Possibilities were discussed with Dr E.J. Rhodes at the Luminescence Dating Laboratory, University of Oxford. Although there are difficulties with thermoluminescence (TL) dating of burnt flint from the plough soil, as it is not known how long they have been exposed to gamma rays after being brought to the surface, it was decided to try a pilot dating. Two surface nodules were submitted, with an accompanying soil sample for measuring water content in the surrounding plough soil, one from Plot 1 in Field B35c (fig. 2, left) and one from Plot 14 in Field B35a (fig. 2, right), the main flint knapping area and location of one of the test pits mentioned above. As a comparison, the piece of burnt clay discussed earlier, from the lower layers of a test pit in the same Plot 14, was also submitted for optically stimulated luminescence (OSL) dating. The TL dates for the burnt flint nodules were AD 1493 + or - 200 in Field B35c and 2677 BC + or - 1320 in



Field B35a. As the report indicates, the dates obtained for the burnt flint samples should be treated with caution and regarded as range finder dates, but, although the margin for error with the prehistoric date is wide, the samples are sufficiently far apart in time to suggest that the research was on the right track. It was decided to use some of the money from a Local Heritage Initiative grant during the next year to explore further the possibility of post-manufacture burning of burnt flint artefacts in a surface context. We therefore submitted a late Neolithic scraper that was bulky enough to allow an inside section to be obtained from it for TL dating. We chose one (figs. 5 and 6) which our flint consultant, Don Henson, thought appeared to have been heated beyond the point useful for knapping and might indeed be an example of burning post-manufacture. It had been found in fieldwalking about 50 metres west of the flint knapping area. In 2005 we received the result of the thermoluminescence dating of the Neolithic scraper, which had produced an interesting 'post-manufacture' burning date of AD 1193 + or – 190 years.



Clearly, the earliest of the three burnt flint dates agrees with known prehistoric activity on the site, whereas the two medieval dates may result from later phases of woodland clearance and suggest that some of the large amount of burnt flint spread across the site may have a similar cause. It is impossible to say what proportion without systematic and expensive testing. These results suggest, however, that there may well have been other flint-working areas on site (see Plot P, Fig 3 and Plot 1, Fig 2) where the flint waste has been burnt later and is therefore no longer recognised as debitage.

Investigations have continued as part of the LHI project, including aerial-photograph and geophysical surveys leading to the recent excavation of a prehistoric pit complex, all of which point to the site being an important focus of prehistoric activity.

**Malcolm Barnes, 2005.**

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