# Understanding the inhabitation of the Stonehenge Environs: the interpretative potential of ploughsoil assemblages.

## Volume I: Chapters 1-5

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## Abstract

This thesis has two main objectives. The first is to develop our understanding of the Neolithic and Early Bronze Age inhabitation of the Stonehenge landscape. This is attempted principally through the analysis of the ploughsoil assemblage collected by the Stonehenge Environs Project. Concurrently the second objective is to explore the interpretative potential of ploughsoil assemblages.

Current approaches to the Stonehenge Environs are critiqued and it is suggested that they share a tendency to focus upon contexts of ritual action, which create the appearance of a highly structured landscape. A consequence of this is that the interpretation of monuments is often prioritised whilst ploughsoil assemblages are neglected. It is also suggested that the Stonehenge Environs Project's attempt to rectify this situation through the analysis of surface collected material was hampered by its lack of depth.

Accordingly this project is aimed at discovering what a detailed metrical and technological analysis of the ploughsoil assemblages can reveal. This approach is complimented by a comparison of field survey projects in southern Britain, which provides a regional context of inhabitation.

Ultimately the analysis shows that there is a high degree homogeneity in the surface scatters around Stonehenge. The patterning of this material runs counter to many previous interpretations that have described the landscape as zoned and ordered. Small-scale elements of variation are also highlighted, which relate to the practice of a more systematic form of technology. Finally, the regional analysis indicates the unusual density of surface material in the Stonehenge Environs indicating the intensity of activities in the area. The different aspects of the analysis provide a means for understanding the conditions under which people approached Stonehenge and its landscape.

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# Chapter 1: Introduction: Aims and Objectives

## 1.1 Introduction

This thesis has two main objectives. The first is to test the interpretative potential of ploughsoil assemblages. This will be done through the analysis of a large surface scatter assemblage collected by the Stonehenge Environs Project (SEP) (Richards 1990). Accordingly, the second aim is to develop our understanding of the nature of inhabitation of the Stonehenge landscape. The main contention behind this work is that lithic scatters are an essential source of evidence and that as yet their potential has not been realised. The main reason behind their importance is that they are still the most durable and frequently encountered settlement related material in Southern Britain. If we are to improve our generally poor understanding of the manner in which later prehistoric landscapes were inhabited, then it stands to reason that ploughsoil assemblages represent our most significant means of doing this.

## 1.2 The approach towards ploughsoil assemblages

The approach towards ploughsoil assemblages adopted here differs from most previous analyses in terms of its depth. The last few decades has witnessed a growth in large survey projects, which utilise surface scatters as their main source of evidence (e.g. Schofield 1988; Barrett *et al.* 1991; Shennan 1985; Woodward 1991; Gaffney and Tingle 1989). Accompanying these projects has been a wealth of publications concerning the methodological implications of working with unstratified ploughsoil assemblages (e.g. Hinchcliffe and Schadla-Hall 1980; Haselgrove *et al.* 1985a; Schofield 1991a; c.f. Section 3.5). Much of this work has been focused on assessing the range of factors that affect surface distributions in the ploughzone in order to understand the archaeological significance of the patterns that we retrieve.

However, less attention seems to have been paid to the manner in which the material that is collected should actually be analysed. In this respect there has been a continuation of the problematic 'dots on maps' approach in which the goal of collection and analysis is little more than to date and locate surface scatters (Haselgrove *et al.* 1985b, 2). One of the most revealing aspects of the objectives of such work has been the concentration of analytical effort upon tools or chronological 'type fossils' rather than waste flakes and cores. This is despite the fact that such tools normally represents 1-2% at most of all of the material collected (Schofield 1988, 3).

One feature of the analysis of these types of survey projects is that relatively little emphasis has been placed upon understanding what lithic scatters represent and equally on the extent to which they differ from one another in terms of composition as well as size. As will be discussed (Chapter 2), the SEP (Richards 1990) is one of the survey projects that falls within this general category. In this sense, the lithic analysis carried out by the project is lacking in detail with the greatest concentration paid towards the classification of tools. A corollary of this approach is that the project has left us with only a basic understanding of the ploughsoil assemblages in the Stonehenge Environs and accordingly an impoverished conception of the manner in which the landscape was inhabited.

Utilising the material collected by the SEP the current project seeks to move understanding forward by applying a much more detailed analysis to the lithic assemblage. At the core of this approach is the metrical and technological analysis of debitage. The contention of this methodology is that much more information can be gained from studying this material, which represents the vast majority of the assemblage, than from focusing upon the typological classification of tools. The methodology, analysis and interpretation of this extensive analysis make up a major proportion of this thesis. This work not only seeks to explore the amount of information that can be gained from the detailed analysis of ploughsoil assemblages but also to use this data to improve our understanding of the Stonehenge landscape.

## 1.3 The approach towards the Stonehenge landscape

In respect to the above, the current project differs from most previous interpretations of the Stonehenge Environs (excluding the SEP) in terms of its concentration upon daily rather than ritual practice. The Stonehenge landscape is an area with an unparalleled range and density of Neolithic and Bronze Age monuments. As will be shown (Chapter 2), this has meant that most work has concentrated upon the interpretation of these monuments rather than the lithic scatters in the area. Accordingly, many accounts of the Stonehenge landscape focus upon notions of ritual performance and ritual activity. Concurrently, they have also largely neglected the importance of the wealth of information related to more mundane activities. This means that a one-sided view of the inhabitation of the Environs has been presented. One of the main goals of this thesis is to balance our perspective by considering in more detail the lithic scatters in the area and generating an understanding of how daily activities were articulated with moments of ritual observance. The attempt to understand the full sense of the inhabitation of the Stonehenge Environs is also furthered by placing the landscape within its regional context.

## 1.4 A statement about chronology

The structure of this thesis revolves around the analysis and interpretation of ploughsoil assemblages. This material is by its nature unstratified and derived from palimpsests of activities. Accordingly, dealing with the chronology of this material is and always will be problematic[1]. However, in the current context this is not considered to be totally detrimental to understanding. Firstly, there is some basis for believing that the majority of material in the ploughsoil assemblages is derived from a restricted period stretching from the Late Neolithic to the Early Bronze Age (Section 8.3.4). Secondly and more importantly, rather than searching for a means to improve their chronological resolution it is considered more appropriate to be realistic about the types of information that lithic scatters can inform us.

[1] A full discussion of the chronology of the ploughsoil assemblage occurs in Section 8.3.4.

In particular, in cases such as the Stonehenge Environs where there are very dense scatters, analysis of ploughsoil assemblages will normally only be sensitive detecting either *long-term* or *large-scale* practices. Whilst this may limit the sorts of activities that we can talk about, it by no means denies the significance of the interpretations that can be generated. This is because social and technological change during later prehistory seems to be conservative. The use of monuments, the form of pottery and lithic artefacts all persist for hundreds of years and it is suggested that the length of such material traditions is also reflected in conservatism in the manner in which landscapes were inhabited. If this is accepted then, whilst the chronology of ploughsoil assemblages is coarse, it should still be adequate to identify major changes or major variation in landscape inhabitation. It is towards these aspects that the current analysis is directed. In this respect it should be realised that it is not only the interpretation of ploughsoil assemblages that involves such coarse chronologies.

Often evidence of 'event-like' episodes that can be interpreted from accurately dated stratified deposits are relied upon to provide information about the use of archaeological sites. A good example is the recent publication of the Stonehenge 20$^{th}$ Century excavations and the radiocarbon dating programme that was associated with it (Cleal *et al.* 1995; Bayliss et al. 1997). This work has greatly improved our understanding of the use and construction of the monument. However, it must be realised that within the context of the Stonehenge Environs such excavated and well-dated deposits are relatively rare and restricted to only a handful of sites.

In contrast, the vast majority of the hundreds of funerary monuments in the Stonehenge Environs have not been excavated in modern times and broad chrono-typologies are our only means of understanding their chronology. Yet, these styles of monuments were invariably 'in fashion' for hundreds of years or more and even the active use of some of them is on a similar timescale. Despite this there are few cases in which our general lack of understanding of their detailed chronology is considered an impediment to interpretation.

Similarly, important interpretations are derived from the environmental data in the Stonehenge Environs and yet these too are often only roughly datable. The clearest examples are molluscan sequences, which have been retrieved mainly from the ditches of various monuments. With such data it is suggested that the most important information can be gained from long sequences, which provide information for landscape change and development (Allen 1997, 122). However, it is precisely their length that means that in most cases such sequences are poorly dated. Quite often only the date of the start of a sequence is known and the lengthy periods of subsequent landscape change can only be dated by rough pottery chronologies where such material is available (*ibid.*).

Accordingly, as with these other forms of evidence, the coarseness of the chronology involved in the study of ploughsoil assemblages is not considered a detriment to understanding. However, one effect of this issue is that in order to keep discussions of the other aspects of the archaeology comparable to that of the ploughsoil assemblages the chronology has been kept intentionally loose. Although radiocarbon determinations are presented where appropriate, for the most part chronology will only be referred to in terms of individual periods. Similarly, this also means that in terms of the lithic scatters there can be only a very limited discussion of the chronological development of their associated practices. In this respect, as will be discussed (Section 8.3.4), much of the material may be derived from the Late Neolithic and Early Bronze Age and it is difficult to define activities with a greater chronological resolution.

In respect to the above it will be shown that if lithic scatters are treated as meaningful sources of evidence then significant understandings of the nature of inhabitation of the Stonehenge landscape can be generated.

## 1.5 The structure and content of the thesis

The remainder of this thesis is organised around realising the objectives outlined in this introduction. Chapter 2 outlines the problems behind current approaches to the interpretation of the Stonehenge landscape. On the one hand, most accounts concentrate almost exclusively upon interpreting monuments with the corollary that ritual activity is emphasised at the expense of all other forms of inhabitation. On the other, the SEP sought to rectify the situation through the collection and analysis of the ploughsoil assemblages in the area. This project will be discussed in detail and it will be suggested that it has failed to significantly improve our understanding of the area owing to its lack of analysis and underlying interpretative issues. Ultimately it will be suggested that a more in depth analysis of the material is required to counteract the problems created by both sets of analyses.

In Chapter 3 the reasoning behind the choice of the SEP material, the method of its sampling and the nature of its analysis will be detailed. This is followed by the detailed description and interpretation of the results of the statistical analysis of the assemblage of flakes (Chapter 4) and cores (Chapter 5). The latter chapter also synthesises the significant points from this analysis. In Chapter 6 it is suggested that for a full understanding of the ploughsoil assemblages in the area a detailed spatial analysis of the material is also needed. This is achieved through in depth analysis of the data using a Geographic Information System (GIS).

Chapter 7 moves beyond the focus of the previous chapters and establishes a regional and inter-regional context for the inhabitation of the Stonehenge Environs. This is achieved by comparison of the results of various landscape surveys conducted in southern Britain. An integral part of this chapter is also to outline the various methodological issues involved attempting to conduct such an analysis.

Finally, Chapter 8 brings all of these various strands of analysis together. This involves a full discussion and interpretation of the inhabitation of the Stonehenge Environs from the perspective of the analysis of the lithic scatters. The significance of these results to existing interpretations of the area is also discussed.

## 1.6 Conclusion

Although this chapter is mainly concerned with the objectives of this project it is perhaps apposite to clarify some of the things that it does not intend to do. In this respect, it is not intended to *rewrite*, or to provide a *definitive* statement of the history or 'meaning' of Stonehenge, its landscape or any of the other monuments in the area. There is an unparalleled body of publications that have already sought to do this. This means that rewriting the history of the area and all of its monuments, which should involve working with as much primary information as possible (e.g. Cleal *et al.* 1995), is a prospect beyond the remit of even a project of this size. More importantly, there is little reason to suggest that such an endeavour would be any more or less successful than many previous attempts. It is important to realise that in a landscape that has been the focus of so much archaeological attention, interpretation after interpretation has purported to provide a new understanding of Stonehenge and its surroundings. To a certain extent each seems to replace the other. However, central to this process is that most of these accounts have framed their interpretations as *singular narratives*, which tend to present one possibility whilst closing down all others. This is not the intention of the current project.

Central to the philosophy behind this thesis is that there was not just one but *many* Stonehenge landscapes (Section 2.2.3.1.2). This relates to the differences in which the landscape was, and still is, perceived according to the contexts of the action that took place there. At certain times during the observation of ritual the monuments in the landscape were foregrounded. Aspects of their structure and distribution provide clues that there may have been a sense of formality and spatial order to such practices. However, as the analysis of lithic scatters will show, there were other times when the monuments were shifted out of focus and other practices came to the fore. These types of activities may have been organised quite differently to ritual ones and their interpretation provides a very different means of understanding inhabitation within the Stonehenge landscape.

Given that there were many different Stonehenge landscapes, providing a definitive statement about the area is impossible and rewriting its history is pointless. Accordingly, the goal of this project is to open up new possibilities of understanding the area. In this particular context the importance of this understanding is that it runs counter to many previous interpretations of the Stonehenge landscape. However, it is not hoped that this means that it will in any sense replace them. Rather, the objective is to shift focus from one context to another and in the process the ultimate desire is to provoke debate rather than closure.

## Chapter 2: Scattered Monuments and Monumental Scatters: Current Approaches to the Stonehenge Landscape

### 2.1 Introduction

The previous chapter introduced the objectives of research that are to be investigated within the current body of work. These are twofold. Firstly, the object is to test the interpretative potential of ploughsoil assemblages. In this respect, it has been argued that survey projects have most often failed to provide significant insight into the character of inhabitation of the landscapes in which they have been conducted. In particular, many surveys have either sought only to add further 'dots on maps' (Haselgrove *et al.* 1985b, 2), or have struggled to come to terms with the quantity and complexity of the data that they retrieved (Woodward 1991; Richards 1990). The current project seeks to test the limits of understanding that can be gained from the study of ploughsoil assemblages by applying a much more in depth level of analysis.

However, the current project involves the investigation of a very specific landscape the character of which gives rise to particular research questions. The Stonehenge Environs is an area with a particularly rich and dense distribution of Neolithic and Early Bronze Age ceremonial monuments. Traditionally it is towards these monuments that the interpretation of the area has focused. Accordingly, the current project also provides a context for exploring the potential of lithic scatters to enhance our understanding of what are sometimes called 'ritual landscapes'. Therefore, studying this type of evidence in this type of landscape allows us to investigate the extent to which surface scatters can help us to understand landscape occupation and specifically the landscape setting of Neolithic and Early Bronze Age monuments.

The goal is not to just improve our understanding of one form of evidence (monumental or ploughsoil) but to see how practices within specific (monumental) contexts were articulated with practices that took place in the rest of the landscape. The presupposition of this statement is that we can only properly understand the nature of action within one sphere of life by placing it in context in relation to all others. In this respect, it is suggested that in terms of the combination of monumental and ploughsoil evidence this has not yet been able to occur on anything like a satisfactory level.

Elucidating these problems involved with the interpretation of the Stonehenge landscape is the subject of the following chapter. Firstly, recent accounts of the Stonehenge Environs will be outlined and critiqued with special attention paid to the implications that they have for the way in which the landscape was inhabited. It will be shown that these accounts consistently concentrate upon the discussion of monumental contexts, which leads to recurrent problems of interpretation and a difficulty in conceptualising the relationship between ritual and daily practices. Concurrently it will also be argued that these interpretations are severely weakened by their lack of a detailed consideration of the ploughsoil material. Secondly, the SEP will be discussed and it will be shown how the project has failed to significantly alter our perceptions of the Stonehenge landscape owing to fundamental issues and the lack of depth of the analysis of its assemblages.

## 2.2 Current approaches to Stonehenge and its landscape

Although accounts of Stonehenge and its landscape differ in terms of detail they mostly share a common approach. Furthermore this approach is characterised by the failure to consider all aspects of life or the full range of activities that were conducted in the Stonehenge Environs. The recurrent features of these interpretations are:

1) An emphasis upon either individual monuments (often Stonehenge) or upon the distribution of monuments.
2) The suggestion that the landscape is governed by overarching cosmologies, which create an enduring pattern in the archaeological record.
3) An emphasis upon highly structured and restricted movement and activity in the Stonehenge Environs.
4) Concurrently, the suggestion of ritual proscriptions governing what activities could take parts in certain parts of the landscape involving the description of the landscape as 'zoned'.
5) A failure to consider the ploughsoil assemblages from the Stonehenge Environs in any detail.

6) The failure to integrate understandings of ritual and secular behaviour or to consider how the two could coexist in the same landscape.

The following sections will indicate the persistence of the issues outlined above by discussing the recent accounts of Stonehenge and its landscape.

### 2.2.1 Accounts of Stonehenge

From a review of the literature it is apparent that Stonehenge itself dominates many accounts to the extent that it is treated as an isolated monument rather than one set within a landscape redolent with meaning. Atkinson's (1956) publication based on the work carried out at Stonehenge by himself, Piggott and Stone perhaps set the scene for much of this archaeological 'detective' work and remains typical of an approach that is still applied by many today. It is partly a consequence of the focus of their archaeological investigations but his publication is dominated by the description of the structure of Stonehenge and the sequence and techniques of its construction (*ibid.*). Admittedly, some consideration of the people that may have built the monument is presented, as is the ever-daunting question of *why* it was built. However, what is missing is any detailed consideration of the wider landscape setting of the monument. Where the surroundings of Stonehenge are briefly considered it is only towards some of the nearby monuments, rather than the landscape, that Atkinson directs our attention (*ibid.*, Ch. 5).

Although Atkinson was writing many years ago, much recent work follows a similar pattern. Thus recent papers such as those by Lawson (1997), Bayliss *et al.* (1997), Richards and Whitby (1997) and Green (1997) deal solely with aspects of Stonehenge's structural history or the dating of its phases. Much of this body of work is based upon the idea of Stonehenge as a conundrum of engineering. The majority of it is concerned with the source of the stones or the method of their transport and erection with little consideration of the significance of our findings to understanding people in the past (e.g. Garfitt 1979; 1980; Pavel 1992; Richards and Whitby 1997; Green 1997;

Williams-Thorpe *et al.* 1997). In short, these approaches concentrate on questions of *how* rather than *why* Stonehenge was built.

In addition to these technical accounts of Stonehenge, several have also been presented that concentrate on the role that the monument played in society. Barrett (1994, 40-7) concentrates upon the architectural form of Stonehenge and the manner in which it directs the movement of the body through space. Yet, despite an emphasis upon the phenomenological experience of the monument, he does not discuss how its wider landscape setting also affected this embodied experience.

Bradley (1991; 1998, 91-100) uses Stonehenge to conduct a discussion about the relationship between monuments and the perception of time. He suggests that the form of Stonehenge would have given an appearance of massive continuity and that its appreciation would have involved a different conception of time from everyday affairs. However, he does not discuss the character of the daily practices with which he contrasts Stonehenge in any detail.

Whittle (1997a) discusses Stonehenge and its 'traditions and structures of meaning'. In particular, he situates Stonehenge within longstanding traditions of building circular monuments, timber circles and of building monuments in stone. He does well to contextualise the monument within traditions of monument building; however, he does less well at situating it within wider traditions of landscape inhabitation. Accordingly, whilst we may understanding the historical setting of Stonehenge as an architectural form, we are not encouraged to imagine the conditions under which people actually came to the Stonehenge landscape and encountered the monument itself.

As has been shown, in varying ways many accounts concentrate upon Stonehenge as an isolated monument and hardly discuss its wider landscape setting at all. These interpretations divorce the monument from its context and encourage the belief that the monument can be an object of study in its own right. One of the main objectives of the current project is to show that interpretations of Stonehenge must also involve understandings of its landscape. Integral to such a consideration is the discussion, which this allows, of the manner in which people arrived in the Stonehenge Environs and the full range of the activities that they conducted there.

### 2.2.2 Accounts of the Stonehenge landscape

The accounts in the preceding section are just part of a wider spectrum of approaches that decontextualise the monuments of the Stonehenge landscape. It will be shown that even amongst accounts that venture further out into the landscape there is still a huge emphasis on Stonehenge, and if not, on the other monuments in the area. This *monumental myopia* means that there is a particularly poor level of understanding of the nature of activities that took place *between* the monuments rather than *within* them. Indeed it will be shown that in many cases there is an assumption that the activities that took place within the monuments essentially took place between them as well.

A good example of this approach to the Stonehenge landscape is the work of Parker Pearson and Ramilisonina (1998). They suggest that in the Neolithic and Early Bronze Age there was a fundamental metaphorical association between wood and the living and between stone and the ancestors[1]. Relating the significance of this metaphor to a series of observations concerning other monuments such as Durrington Walls (Wainwright and Longworth 1971) and Woodhenge (Cunnington 1929), they suggest that the shift from a wooden to a stone built structure at Stonehenge represented the giving over of the monument from a place for the living to a place for the dead (or the ancestors).

Furthermore, their argument has consequences for the rest of the landscape as they suggest that during the Late Neolithic and Early Bronze Age two distinct areas developed. One, centred on Stonehenge, is described as the Domain of the Ancestors, whilst the other, centred on the henges with wooden structures at Durrington Walls and Woodhenge, is the Domain of the Living (Plate 45). The implications that this

[1] This metaphor is interpreted using an analogy with the current practices in Malagasy society. The archaeological significance of this analogy has already been questioned by Barrett and Fewster (1998).

interpretation has for the inhabitation of the landscape is clear and is summed up in the statement that during the Early Bronze Age:

> "The living will have visited Stonehenge, no doubt, at certain moments to meet the ancestors, to communicate directly to them. Yet, outside the moments of building, the monument and its immediate surroundings were probably left largely alone...in terms of human action, little or nothing happened..." (Parker Pearson and Ramilisonina 1998, 318-9).

Therefore, the associations that they posit between 'the ancestors' and the land surrounding Stonehenge have major implications for the activities (or lack of them) that took place there and accordingly the nature of its inhabitation. There is also a contrast between two distinct areas of the landscape in which very different practices took place and in this sense the landscape has begun to be seen as zoned. Furthermore, whilst they make a reasonably clear statement about what occurred in the 'Domain of the Ancestors', they do not discuss the types of activities that occurred in the 'Domain of the Living'. Hence, discussion of ritual activity and ritual exclusion is prioritised at the expense of the interpretation of evidence of daily practice.

Although his interpretation of the area is very different, Tim Darvill's (1997) recent account also presents the idea of highly structured and restricted activity in the landscape around Stonehenge. He suggests that over time the development of four successive yet distinct cosmological schemes can be distinguished in the form of the different constructional phases at Stonehenge. He argues for example that the layout of the bank and ditch in Phase 1 may have symbolically represented the surrounding landscape with the course of the river Avon mirroring the position of the entrances at Stonehenge (Plate 46). In the final constructional phases the concentric circles of Sarsen trilithons and Bluestone settings add a further dimension to the allegiances of the alignments and axes displayed in the monument (Plate 47). His suggestion is that the ordering of space and therefore the axis of Stonehenge is an encoding of a much wider felt cosmological scheme, which is evidenced at a series of different levels from the decoration on pottery, to the organisation of a house right up to the distribution of monuments in the landscape (*ibid.*, 173). Hence, it is argued that the axes that he defines have as much effect in the landscape as they did within the monument itself.

For example, the 'linear quadruple partitioning of space', which it is felt is witnessed in Phase 3i of the monument, is also argued to (and must according to the logic of the argument) find expression in the distribution of artefacts and monuments in the landscape as a whole. Therefore, it is suggested that this is why:

> "...the highest proportion of Beaker Age burials (58%) lie in the western sector...over 85% of Grooved Ware find spots lie in the eastern sector, while 62% of Beaker pottery find spots lie in the north and west sectors. Flint mining and extensive flint-knapping are known only in the eastern and southern sectors" (Darvill 1997, 186).

Accordingly, with Darvill's interpretation, it can be seen that again, though from a different perspective, the landscape is described as zoned with activities being restricted only to certain locations. Whilst the suggestion is that this ordering of space was due to a cosmological scheme that structured life at a series of different levels, the material that he uses to display this relationship is derived overwhelmingly from the structure of monuments or the artefacts found within them. As there is an apparent geometrical pattern to the features of Stonehenge, it is inevitable that this approach transplants the same structured pattern onto the landscape as a whole. However, the ploughsoil assemblages in the Stonehenge Environs are not considered in any detail and therefore the relationship between the organisation of ritual and daily life has been assumed rather than investigated.

Julian Thomas (1991) has presented a slightly different history of the same area. Unlike the previous accounts, he does not concentrate on Stonehenge so overwhelmingly that the landscape can only be viewed in its terms. Indeed the narrative that he draws out relies equally on many different aspects (though still mainly monumental) spread across the landscape. However, like the other accounts the degree of formality of this landscape is again heavily emphasised.

Thomas describes a historical trajectory in which two separate and distinct areas of the landscape develop. Their origins lie in the two roughly separated groups of long barrows in the area, one associated with settlement evidence in the form of lithic and pottery scatters near the river Avon and the other lying to the northwest associated with Robin Hood's Ball causewayed enclosure (*ibid.*, 145). Over time, the distinction between the activities that were carried out in these areas grew. In the Middle Neolithic this distinction was increased by the construction of the two cursus monuments, which stood between, separated and delineated these two areas indicating the increasingly conflicting practices that were taking place, with:

> "...domestic activity on the one hand [the south-eastern area], the enclosure and its association with the exotic, the distant and the marginal on the other [the north-western area]" (*ibid.*, 146).

This division in the landscape is suggested to have continued to develop for almost 1000 years during which time it was strengthened by the construction of Stonehenge Phase 1, Coneybury Henge, Woodhenge, Durrington Walls and the timber palisade to the north of Stonehenge. Ultimately this system of order is suggested to falter around the time that Stonehenge started to be used as a cremation cemetery (the dead in an area previously for the living) and when Beaker pottery start to appear in a series of different contexts which cut across previous divisions (*ibid.*, 151).

Since the publication of the SEP (Richards 1990) and the 20th century excavations (Cleal *et al.* 1995) enough has changed that many of the assumptions of Thomas' argument have been undermined. In particular, the chronological distinction, which he suggests in order to draw apart two distinct groups of long barrows, is no longer valid (*ibid.*, 475), as is the chronology that is suggested for Stonehenge itself. Equally, the SEP has indicated that material, which may relate to some sort of 'settlement' has been found spread diversely across the whole area (Richards 1990), not just to the southwest as Thomas suggests.

However, the important point is that in Thomas's work, as with previous accounts, there is a heavy emphasis on the ordering of the landscape. There are felt to be distinct *zones* within the landscape, there are separate areas where distinct practices took place, practices which could not be reconciled with each other (Thomas 1991, 150). Accordingly, as before there is a consistent emphasis on the structured and restrictive nature of practice in the landscape.

In 1999, Julian Thomas published a revised edition of 'Rethinking the Neolithic'. Within this, the section on the Stonehenge area changed significantly and therefore warrants discussion here. Thomas (1999, 165-7) directly answers criticisms of his original publication and takes into account the more recent additions to our understanding of the area. This principally involves accounting for the revised dating and sequencing of Stonehenge (Cleal *et al.* 1995; Bayliss *et al.* 1997), the improved understanding of the environmental sequence of the Environs (Allen 1997) and the published findings of the SEP (Richards 1990).

One of the principal additions to Thomas' (1999) revised account is an explicit desire to incorporate material from both ritual and daily practices. This realisation comes from and leads Thomas to, a consideration of the ploughsoil assemblages collected by the SEP (Richards 1990). Indeed his account is notable for the detail in which it discusses the quotidian aspects of life in relation to the monumental, especially in comparison to the other accounts already mentioned.

However, despite many good points, the overall direction of the argument is more or less the same as before. In particular, the landscape is still seen to have an order to it. It is described as heterogeneous (Thomas 1999, 174) and the original description of the landscape as 'zoned' [2], is defended. His amendment of the term to 'a progressive process of internal differentiation of the landscape' is typical of the more circumspect language used in the revised passage in comparison to the previous account (*ibid.*).

[2] Attacked by Cleal in Cleal *et al.* (1995, 476).

The elements of landscape differentiation in his account follow a similar pattern to before. First, there is a north-south division in the landscape principally defined by the distribution of long barrows and the positioning of Robin Hood's Ball. This is later emphasised by the construction of the Stonehenge Cursus and the Palisade Ditch. Second, there is a later east-west division defined mainly by the differences between Stonehenge compared to Durrington Walls and Woodhenge. This pattern is also found amongst the difference in the deposition of artefact types (often in pits) especially Peterborough Ware, Grooved Ware and Beaker pottery.

In addition, as part of the discussion of these distinct areas of the landscape, there is still some emphasis on the controlled or restricted nature of movement within the landscape. Hence, the Stonehenge Cursus is described as monumentalising a "pattern of east-west movement across the landscape" whilst also serving "to inhibit the movement of people and livestock between north and south" (Thomas 1999, 171). Stonehenge Phase 1 is described as "a means of orientating movement within a landscape" (*ibid.*, 172) and the Palisade Ditch is discussed in similar terms.

One of the good points about Thomas's work (*ibid.*) is that, unlike many other accounts, there is also a consideration of daily life and the manner in which this articulated with moments of ritual. The (astronomically) cyclical observation of ritual events are described as being 'integrated into cyclical patterns of herding, hunting, gathering, harvesting and craft production' and being 'imbricated in one another' (*ibid.*, 182-3). As discussed, the evidence from the SEP is also considered in comparative detail. Accordingly, some elements of this work are close to the direction that will later be adopted here (Chapter 8). Hence, populations are suggested to maintain some mobility even during the Early Bronze Age. In addition, the conditions under which people arrived in the Stonehenge landscape are also discussed, as is the manner in which both ritual and daily events could occur within the same landscape. One aspect that is essential to understanding such issues, which is missing from Thomas's work, is the comparison of the inhabitation of the Stonehenge landscape with that of other contemporary landscapes. Making such comparisons is attempted for this project through the comparative analysis of the different landscape survey projects (Chapter 7).

In addition to these accounts there have been many others that offer different perspectives of the landscape sequence in the Stonehenge environs. Almost without fail, they concentrate primarily on the monumental and most of them carry assumptions of an organised and restricted pattern of movement within the landscape. Bradley (1993, 53) has applied similar emphases in describing movement along the Cursus as a journey from an area of the living (east) to an area of the dead (west).

Similarly, Woodward and Woodward (1996) discussing the circular distribution of EBA round barrows also suggest that movement around this landscape may somehow have been directed by these monuments to conform to a circular patterning in a tradition that involved "voluntary or controlled limitation of access" around certain areas (*ibid.*, 289). Indeed this paper inspired a GIS based analysis of the Stonehenge landscape recently published by Exon *et al.* (2000). As with many examples presented so far this work was based almost entirely upon monumental evidence. Furthermore, they suggest that

> "...the spatial relationships between monuments could ... be conceptualised, and studied, in a manner similar to that usually reserved for formal or enclosed ritual space." (Exon *et al.* 2000, 2).

This is an *explicit* statement that their analysis proceeds in precisely the manner that I have criticised other accounts for doing *implicitly*. They take the attitudes and connotations of interpretations developed through the analysis of monumental architecture and transplant them onto the landscape as a whole. It is because of this that discussions of the Stonehenge landscape are full of suggestions of zonation, proscribed order and restricted movement. It appears that this posture is adopted whole-heartedly and uncritically by Exon *et al.* (*ibid.*).

Accordingly, they picture movement and action in the Stonehenge landscape as highly structured and restricted, for example suggesting that:

> "In highly charged landscapes, like that around Stonehenge, paths and tracks may have a *liturgical* role. They may guide the observer through a *directed* sequence of *movements* and spatial relationships, perhaps

> emphasising links with past landscapes, or relationships between groups, and indirectly restating the importance of social or power relationships through repetitive movement *in a prescribed manner*." (my emphasis) (Exon *et al.* 2000, 8).

Like many other accounts they also stress the idea of a zoned landscape when they say that:

> "...monuments might well represent concepts of ritual space in a manner in which they can be used to define or block access to parts of the landscape, act as dramatic symbolic boundaries for sacred zones, or form areas of monumental landscape protected by a *cordon sanitaire* of the special dead." (Exon *et al.* 2000, 2).

In this statement, we find clear echoes of Parker Pearson and Ramilisonina's (1998) suggestion that parts of the landscape were left alone or avoided by the living inhabitants of the area. In the present case, the criticism is not that this is impossible, but most definitely that this needs to be proved by attention to the range of material available for us to study. As we have seen the lithic scatters in the area are our only real means of assessing such statements. Exon *et al.* (*ibid.*) make assumptions about the nature of activity in this landscape and yet give only passing reference to the work conducted by the SEP (Richards 1990). This neglect is all the more reprehensible, as the artefact database from the SEP was one of the two sources of digital data with which they started the project (*ibid.*, 18). The other was the Wiltshire County Council Sites and Monuments Record of the archaeological sites and monuments in the area. It is clear that they paid great attention to one and not the other

### 2.2.3 Discussion: monumental myopia and ritual landscapes

Many recent accounts of the Stonehenge landscape have now been discussed. In some respects, these interpretations differ from each other yet there are also many similarities. Chief amongst these similarities has been the consistent emphasis upon monumental contexts and as a corollary, the structured and restricted nature of the inhabitation of the landscape. The issues raised by the preceding discussion are particularly clearly defined in discussions of Stonehenge because the area has such a dense population of monuments. However, they also have wider relevance to the study of later prehistory because the presence of upstanding monuments and the lack of stratified material relating to settlement is a feature of southern Britain in general.

A particular problem seems to occur when interpreting what are often called 'ritual landscapes'. One of the major problems with this term is that the proposition of 'ritual landscapes' often implicitly suggests that no 'non-ritual' activities took place there. For example, a typical suggestion is that:

> "...[Stonehenge], like other major monuments of the later Neolithic of the third millennium BC, belonged to a sacral landscape, not to a major settlement concentration." (Whittle 1997a, 145).

However, there is no clear discussion as to why it should be assumed that one form of activity should preclude the other. The most obvious factor that affects this assumption is the dichotomous relationship between the ritual and the secular that is implicit in many interpretations (e.g. Bradley 1998). Yet, the nature of any such relationship is historically specific and therefore, as is the emphasis of the current project, this should be a matter of investigation rather than assumption.

Another feature of many of the arguments that have been discussed, which indicates the unequal relationship imposed between ritual and daily life, is the consistent emphasis upon restricted and ordered movement and practice in the landscape (e.g. Parker Pearson and Ramilisonina 1998; Darvill 1997; Exon *et al.* 2000). The emphasis of such statements is that activity in the landscape was of basically the same nature as that which took place within the monuments and that activity in both contexts involved the observation of ritual. Hence, activity in the landscape is fundamentally imagined to be ritual in character despite the massive evidence for lithic working provided by the ploughsoil assemblages in the area.

Another related issue is that several accounts seem to treat the geometrical distribution of monuments within the Stonehenge landscape as some kind of 'mind map'. Some seem to think that a cosmology that can to some extent be witnessed within the structure of a monument *must* somehow be directly mirrored in the organisation of the landscape as a whole (e.g. Darvill 1997). This organisation does not only include the distribution of monuments but also the distribution of practice. Thomas concurs with this position in his statement that:

> "Durrington [Walls] displays in microcosm a set of rules of classification which was applied to the landscape as a whole" (Thomas 1991, 150).

In cases where the reading of monuments are not so literally transplanted onto the landscape the ritual character of monuments is still transported in the manner in which the inhabitation of the land is described. As we have seen this has been the case with Thomas (1991) and Parker Pearson and Ramilisonina (1998) who have suggested rigorous proscriptions were in place over exactly where in the landscape people could go and what they could do when they got there. These ideas are most clearly indicated by recurrent descriptions of the Stonehenge landscape as 'zoned'.

#### 2.2.3.1 Reconciling ritual and secular practices

As suggested, the main problem with most of the accounts mentioned so far is that in what is thought of as a 'ritual landscape', the density of monuments has meant that a discussion could be generated that talked of developments at a landscape level whilst only incorporating monumental material. Hence, one could talk about the sequence of development of the *landscape*, whilst really only discussing the sequence of the *monuments*. It must be understood that both are very different projects.

Whilst people may sometimes discuss the topography of the land between the monuments, the overriding impression is that the monuments *are* the landscape. The suggestion is that they exist as entities separate from the conditions under which people built them and subsequently encountered them. This implies that they can hold integrity purely in relation to each other and that the land between them was only a means to move 'ritually' between one monument and another. Any concept of the landscape as actually lived in, worked in and experienced on a daily basis is lost, as is any idea of the conflicting temporalities of these surfaces. There must be a concept of the land between, not as a meaningless space or blank form (Cartesian space), but as a topography of human activity. These ideas are best understood using Ingold's (1993) concept of the *taskscape*.

#### 2.2.3.1.1 Understanding landscapes as taskscapes

For Ingold, the idea of the *taskscape* is closely linked to his career-long project of understanding the way in which people perceive their environments and its constituents (Ingold 2000). Central to this approach is the adoption of what Ingold has termed the 'dwelling perspective' (Ingold 1993, 152; c.f. Ingold 1995). This is not only a manner of situating subjects phenomenologically, but of concurrently also understanding that the:

> "...landscape is constituted as an enduring record of (and testimony to) the lives and works of past generations who have dwelt within it, and in so doing, have left there something of themselves." (Ingold 1993, 152).

Accordingly, understanding 'dwelling' involves an acceptance that people are fundamentally historical beings (Gadamer 1979), and equally, that they live in a close dialectical relationship with their environments. The nature of this relationship is therefore a duality between environment and organism. This position is essential in order to break down the dualism between culture and nature, which is central to understanding all of Ingold's work (e.g. Ingold 2000).

The taskscape is really the *landscape* in *process*. It is an environment that is lived in and through rather than resided on. Through the dialectical character of the relationship between environment and person, it transforms us just as surely as we transform it, to the point where, as a duality, the two are effectively inseparable. The perception of the taskscape also occurs through the temporality with which a landscape is inhabited (Ingold 1993).

Ingold's (*ibid.*) exposition of the importance of the temporality of the landscape leads eventually to his description of Bruegel's '*The Harvesters*' (Plate 48). The painting is one of a series portraying a landscape and the activities that took place within it at monthly points during the agricultural cycle (*ibid.*, 164). Ingold's concern with landscapes and temporality clearly influences his choice of the paintings he uses to illustrate his point. Although some rest whilst others work, the picture is clearly of a landscape in the process of becoming. The relationship between people and the environment is also a close and nurturing one. People are tending to the environment and in return, it not only provides food but also shade and even somewhere to rest ones aching back. It is also noticeable that the built structures in the painting are very much in the background. Ingold (*ibid.*, 169-70) stresses that these structures, such as the church hiding behind the trees, are every much as part of this environment as the rest of the landscape. They do not somehow stand outside of the environment but are within it, and as with all other things, the church's:

> "...biography...consists in the unfolding of relations with its human builders, as well as with the other components of its environment, from the moment the first stone was laid." (Ingold 1993, 170).

Like the animate parts of the environment, the church is also subject to the effects of the passing of time. Therefore, in a sense, it is also a historical entity.

However, in the current context, the importance of this point is that in the composition of the painting it is not the buildings where people live or worship that are placed in the foreground, but the part of the landscape within which they sweat and toil. Certainly, in the time when the picture was painted the inhabitants would have spent as much and probably more time dwelling amongst the fields and trees as they would have within four walls. Equally, if landscapes are fundamentally perceived through action, and houses are a place of rest, then it is out in the fields that people forged their closest ties to their environment[3]. From these types of understandings of the range, character and temporality of the inhabitation of the landscape it can be appreciated that during different times areas of a landscape and areas of life can shift in and out of focus according to differing contexts of action.

The significance of this discussion lies in its relationship to our understandings of the Stonehenge landscape. Firstly, the temporality with which it was inhabited is of central importance to any understandings of how it was perceived. In this sense, it is essential to be able to understand the Stonehenge Environs as a *taskscape*. We need to place ourselves in a position where we can imagine the Stonehenge landscape in a *process of becoming*. As Ingold (1993; 1996a, 135; 1996b, 111) has suggested this process is one of action and reaction as well as one of tending to an environment with an intimate knowledge of its affordances.

In order to be able to understand the manner in which the landscape was inhabited it is first necessary to comprehend the contexts of the actions that took place within it. As the upstanding and visible archaeology of the area indicates, much action in the Stonehenge Environs took place within or close to architecturally monumental contexts. At certain times in these particular locations activity may have been focused around the performance of ritual. However, as Bruegel's painting reminds us, there were also many times when these locales and/or the ritual practices with which they were associated were *shifted* very much to the *background*. These occasions may often have been times of work but they were also times for socialising, and relaxing. The tacit choreography and temporality of such quotidian activities represent one of the means through which society could be both reproduced and transformed (Edmonds 1997; n.d.). As the lithic

[3]Besides this, we still ignore at our peril the contexts of action in one sphere of life compared to another. This is because such different aspects of life should be properly understood to be merged into one another as the concerns met within one arena inevitably lead us to know how to act in another (Barrett 1994, 134). In any eventuality, in phenomenological terms, all such spheres of life are subsumed within one; our 'being-in-the-world' which is a state that precedes all others and precludes any possibility of gaining an objective knowledge of the world (Gadamer 1979; Heidegger 1962).

scatters analysed for this project will show, many of these types of activities took place *outside* in the landscape as well as *inside* the monuments.

2.2.3.1.2 Stonehenge: a contested landscape

Given that the concern has now shifted towards understanding how to resolve the occurrence of both ritual and secular activities within the same landscape it is worth finishing this section by discussing the work of Barbara Bender (1992; 1993; 1998). The principle difference between her account and other interpretations of the area is the multivocality with which it is presented. This is particularly true of her book 'Stonehenge making space' (*ibid.*) in that transcripts of dialogues, which she held with not only archaeologists, but also a wide range of other interested parties, take up a large part of the book.

Bender also brings a sense of multivocality through her own arguments, which are often open ended, and more designed to provoke thought and debate than to bring closure (*ibid.*). In addition, the account does not follow a simple chronological order. Instead, the sequence is gone through several times over, each time picking upon a different element of the landscape. What is offered is therefore a series of possibilities. The effect of this type of presentation is to remind the reader that there are currently, and always have been, many ways of perceiving and therefore inhabiting this landscape. The further element that she adds is that conflicting perceptions can make this a 'contested landscape', one constantly open to renegotiation (Bender 1993). This therefore makes Stonehenge a powerful metaphor, ripe to be picked and used politically through appropriation of its symbolism. Her description of the manner in which this has been the case for the last few hundred years leads to the realisation that this potential also existed in the prehistoric past.

In this manner, Bender (1998) opens up the idea of there not being a single Stonehenge landscape but a series of crosscutting ones dependent on context. Therefore, even synchronically the area was and still is inhabited in many different ways. This simple realisation is counter to many of the previous accounts presented so far as they have tended to present a singular narratives based around ritual observance and proscriptively ordered inhabitation.

One of the other elements important in the approach of 'Stonehenge making space' (Bender 1998) is the idea that this was a peopled landscape. This particularly comes across in Bender's dialogue with Mark Edmonds (Bender and Edmonds 1998). Edmonds is keen to talk of the type of experiences that may have been involved in people coming to the Stonehenge landscape. For him this experience is grounded in the daily affairs of people's lives such as the movements of herds of cattle, the working of stone and even the labour involved in the construction of monuments (c.f. Edmonds 1999). Clearly Edmonds (Bender and Edmonds 1998) also believes that Stonehenge was the site of seasonal gatherings of quite widespread communities. This means that compared to other times of the year the experience of the people who came to Stonehenge may have been most remarkable because of the sheer amount of people in one place at one time (*ibid.*, 77).

As can be seen, Bender's work on Stonehenge and its landscape differs from many previous accounts. In this respect, some elements of her narrative are more in keeping with the perspective that is adopted here. In particular, the idea of the possibility of their being 'many' Stonehenge landscapes suggests that it is wrong to label the area a 'ritual landscape' just as much as it would be to describe it as a purely quotidian one. The emphasis of the landscape being 'peopled' is also close to the current project in that surface scatters speak of dense and busy places between the monuments. Leading from both of these ideas is also the realisation that we should not place rigid division between spheres of ritual and daily life. Whereas several previous authors have tended to describe the landscape as zoned, a process that draws the monuments out of the experience of daily life, talking of Stonehenge Phase 1 Bender suggests that:

> "Clearance, flint working, planting and grazing washed up to the very edges of the monument." (Bender 1998, 55).

In this single sentence, Bender evokes an image of life that is missing from most accounts of the Stonehenge landscape. Considering that evidence for flint working is also present in primary contexts from many monuments in the area one could also suggest that such daily practices not only washed up to the edges of monuments but right through them, drenching them in the remnants of human activity. Acceptance of this process must include acceptance of the permeability between ritual and daily life. It is only with this perspective that we can understand both the monuments and the lithic scatters in this area.

## 2.3 Landscape survey in the Stonehenge Environs

The accounts of the Stonehenge landscape that have been discussed so far have mostly been interpretations based upon syntheses of previous work. The main criticism of this work has been their reliance upon evidence from ritual monuments at the expense of understanding material relating to daily life. As has been suggested the main source of evidence that relates to quotidian life in the Stonehenge landscape are the lithic scatters that lie on the surface of ploughed fields. Some early investigations of this material were conducted but they are extremely limited in extent and analytical detail and principally relate only to the work of Laidler and Young (1938) on the King Barrow Ridge. Accordingly, our current understanding of this material is totally reliant on the publication of the extensive fieldwork carried out by the Stonehenge Environs Project (Richards 1990). Not only does this project currently provide our only real understandings of the lithic scatters in the area but it is also from its collections that material was drawn for analysis by the current project. Hence, detailed criticisms of the project are essential as it not only forms the only major 'non-monumental' approach towards the interpretation of the landscape but also because it represents the starting point from which the analysis and interpretation of the current project proceeds.

### 2.3.1 The Stonehenge Environs Project

The SEP was originally set up in response to the survey of Stonehenge and its environs by the RCHME (1979) and Ellison's (1980) policy for archaeological investigations in Wessex (Richards 1990, 4). One of the priorities identified by the latter document was the study of 'Neolithic and Bronze Age settlements and their associated landscapes' (*ibid.*). The stimulus behind the prioritising of fieldwork in Wessex came about partly from the recognition of the dramatic extent of erosion that modern agriculture was causing to archaeological landscapes (Woodward 1991, 2). There was also an awareness of the general paucity of evidence relating to settlement activities in Wessex. Through the growth of field survey and fieldwalking in the 1960s and 1970s, it seemed that the situation could now be addressed by collection and analysis of ploughsoil assemblages.

It was within this environment that the SEP was initiated by the then Wessex Archaeological Committee primarily funded by the Department of the Environment (Richards 1990, 4). Due to the nature of the inception of the project, its remit was not only to *research* themes of settlement and subsistence. It was also to evaluate the location, extent and condition of the surface scatters (and other archaeological material) to allow a plan to be put in place for their future *management* (*ibid.*).

The archaeological objectives of the SEP were to move beyond previous interpretations of the landscape, which had realised it to be archaeologically rich, but had most:

> "...often subjected [the landscape] to analysis in terms of social, economic, political and religious power, but ...[these interpretations were]... all based on the ritual and funerary aspects of the visible monuments." (Richards 1990, 9).

Accordingly, the SEP was to act as a corrective in this monument dominated area by showing that:

"...the area is also unique in terms of its prehistoric settlement record, demonstrating a range and density of human activities hitherto unstudied and essentially unknown." (*ibid.*).

Given the central themes of subsistence and settlement the principal source of material that was to be investigated was the lithic scatters in the area. These were to be assessed through a multi-stage approach starting from broad location, moving through increased definition and ultimately ending in sample excavation (*ibid.*, 11). In practice, this meant that the investigation of surface scatters occurred through two distinct levels of survey. These were an 'Extensive Surface Survey' and an 'Intensive Surface Survey'. The latter was a part of an integrated approach designed to ultimately lead to excavation. In effect, the extensive survey was designed to locate the extent of surface scatters and the intensive survey was designed to characterise them. As will be discussed, the successes of this two-stage approach were severely limited meaning that the relationships between the two levels of survey were never fully realised or understood.

Another affect of this approach is the radical difference between the extents of the coverage of the two levels of survey. The extensive survey covered an area of 752.5 ha. (*ibid.*). In comparison, the intensive survey retrieved material from less than 2ha. and over 1.5ha. of this came from one sample area on the King Barrow Ridge. Therefore, only the extensive survey covers enough of an area to understand the nature of inhabitation at the level of the Stonehenge landscape. It is for this reason that the material from the extensive survey was selected for further analysis for the current project (Section 3.2). Accordingly, the following discussion will also concentrate upon this part of the project. Findings from the intensive survey will be drawn upon where relevant.

#### 2.3.1.1 The Extensive Survey of the Stonehenge Environs Project

The extensive surface collection by the SEP covered a significant proportion within the boundaries of the defined survey area (Plate 1). As can be seen, although the project survey area extended the RCHME's (1979) definition of the Stonehenge Environs to include Robin Hood's Ball, the extensive survey occurred in a coherent block of the landscape some distance to the south of the causewayed enclosure. The principal factor behind the location and extent of the collection sample areas[4] was the land-use at the time of collection. Hence, this dictated not only the size and shape of the sample areas that were investigated, but also those areas that were not. The main impact of this is that large areas, such as much of the Stonehenge Triangle, could not be investigated through fieldwalking as they were within areas of permanent pasture.

The extensive survey was aimed at retrieving roughly a 10% sample of the surface material by collecting from 50m long runs spaced at 25m intervals (Richards 1990, 11; Plate 49). The post-collection analysis of this material involved sorting it into one of the following eight categories:

1) Core
2) Core Fragment
3) Flake
4) Broken Flake
5) Burned Worked Flint
6) Retouched Flake
7) Scraper
8) Other Tool

In addition, a record was made of all morphologically and chronologically distinctive tool types. In this respect, the most detailed analysis of the extensive survey assemblages was reserved for tools rather than lithic debitage. Whereas no distinctions were drawn between different types of flakes or cores, each tool was individually recorded according to standard typologies. Such an approach is typical of the majority of comparable landscape survey projects (e.g. Woodward 1991, Barrett *et al.* 1991), which prioritise the analysis of tools over debitage. With these types of projects, beyond any detailed classification of debitage, it is even less common to conduct any form of metrical analysis.

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[4] Throughout this thesis, SEP sample areas are referred to according to their original project numbers, which appear after the name of the sample area in brackets, e.g. The Ditches (77). The location of the sample areas can be ascertained by reference to maps such as Plate 1 where the sample area numbers appear in the middle of the sample areas.

Therefore, it was on the basis of the simple classification of debitage and the typological analysis of tools that all quantification and analysis of the SEP's extensive surface collections proceeded. The analysis of these data takes place on the following levels:

1) The distribution patterns of all material and of individual categories of material.
2) Functional assessments of individual landscape 'zones' based upon the ratios of different categories of material.
3) Chronological assessment of the scatters based primarily on distinctive tool types.

Perhaps, because no computing resources were available (Richards 1990, 15), very little statistical analysis of the data from the assemblages was undertaken. This means that the majority of inferences about the assemblage are based upon analysis of distribution maps (e.g. Plate 42). These maps dramatically show the full density and extent of lithic producing activities within the Stonehenge landscape. However, considering the size of the assemblage and the length of the project, they are of limited use in providing a more detailed understanding of the range and composition of the activities represented in the scatters. To a certain extent, this type of interpretation is provided by a functional assessment. However, because the initial categorisation of the material was so limited so to is all subsequent analysis of it. The functional assessment is based upon an idealised division of the *chaîne opératoire* of lithic artefacts into three stages, each with hypothetical characteristics (Richards 1990, 15-19; Table 2.1).

| | Stage 1<br>Procurement/reduction (Industrial) | Stage 2<br>Reduction (Manufacture) | Stage 3<br>Use/discard (Domestic) |
|---|---|---|---|
| Spatial Attributes | Extensive and possibly nucleated, topographically based | Nucleated | Variable according to context |
| Assemblage Composition | Hammerstones, 'tested' nodules, flawed cores, high % of primary flakes | Hammerstones, cores (esp. exhausted ones), high % of broken and/or unutilised flakes | High % of retouched and utilised flakes, tools, burnt worked material, tool variability |
| Chronologically Diagnostic Attributes | Few | Platform technique and consequent reasons for core abandonment, specific 'blank' production | Wide range of individual items and recurrent retouched forms (i.e. tools) |

Table 2.1: The hypothetical stages of the reduction sequence used by the SEP and their expected characteristics (Richards 1990, 18-9).

It is on the basis of the densities produced by the distribution plots and the ratios of the different analytical categories of material, interpreted according to the stages of production outlined in Table 2.1, that the material from the extensive survey is interpreted. Ultimately, it seems that the composition of assemblages did not closely conform to prediction. In particular, the middle category (Stage 2) was the most difficult to identify as its material definition fell between the other two. This meant that the interpretation of the material was differentiated only into 'industrial' (Stage 1) or 'domestic' (Stage 3) categories, or a combination of the two.

#### 2.3.1.2 The synchronic interpretation of the surface survey

Now that its principal means have been described, it is necessary to discuss the interpretation presented by the SEP. The initial discussion of the distribution pattern of the extensive collection was undertaken without an attempt to provide a chronological distinction. This involves the characterisation of six reasonably distinct zones within the Stonehenge Environs identified through the relative densities of surface material in these areas (Richards 1990, 19; Plate 43):

1) A zone sparse in lithic material and peripheral to major activity as represented by monument clusters.
2) A zone with a high monument concentration, surrounded by concentrations of lithics, but with a notable absence/low density of lithics.
3) An area of consistently high concentrations of lithic material centred around a dry valley system and with specific nucleated concentrations within the wider distribution.
4) An extensive area of consistently high concentrations again with focal points within it. The overall distribution of this area is split by the Cursus with its southern half lying close to the west of Stonehenge.
5) A zone of broad concentration with some higher values, situated on the ridge top between Stonehenge Bottom (a dry valley) to the west and the Avon valley to the East.
6) An area of comparatively less dense yet consistent distribution mainly situated upon the King Barrow Ridge and also towards the Avon Valley to the east.

Moving on from the discussion of the broad pattern of the total assemblage of all worked flint, more detailed interpretations are provided through analysis of the distribution of the different categories into which the material had been initially sorted. This analysis is allied with the tripartite division of site function, presented in Table 2.1, to provide an interpretation of the different activities represented by the lithic scatters. In addition, more detailed information is produced for material from six sample areas. This information represents the mean core weight and the proportions of primary, secondary and tertiary flakes (Richards 1990, Table 7). However, whilst this information represents a slightly more detailed level of analysis its veracity must be questioned. The material examined in this way is the basis for the more detailed interpretations presented by the SEP of the differences between lithic scatters form different sample areas. However, the data thus analysed come from only six of thirty nine sample areas. They are also judgementally selected sub-samples of varying proportions of the assemblages from those areas. Hence, it is not possible to tell how closely they reflect the wider patterns within the parts of the landscapes that they are taken to represent.

Owing to the scale of the analysis and most importantly its lack of detail, interpretations of the character of activities witnessed in the lithic scatters are vague and generalised. For example, mainly based on the distribution of cores, two broad 'lithic resource zones' (basically for procurement and initial reduction) are suggested (Richards 1990, 22-4). The first is located mainly as Area 3 above (Plate 43) and runs from The Diamond (59) and The Ditches (77) southeast to Well House (83) and Rox Hill (82). The second is the area north of the Stonehenge Cursus. In contrast to these areas, the material from King Barrow Ridge (57) and King Barrow Ridge Addit. (81) is felt to be characterised by a lower core: tool ratio, high tool: waste ratio and also by a slightly lower average weight of core (argued to potentially be the result of curation of raw material away from source). For these reasons the area is suggested to have a more 'domestic' emphasis. Ratios of primary, secondary and tertiary flakes, which it is felt, would provide corroborative evidence of the basic distinction between 'industrial' and 'domestic' are found to be inconclusive. Rather than taking this to question the validity of the distinction between such practices Richards (*ibid.*) dismisses the pattern as a function of collection conditions[5].

Within the broad zones of activity outlined above lies the basis of many future understandings of the character of settlement within the Stonehenge landscape. Although inconclusively, the SEP makes general distinctions between an area of 'domestic' activity based around King Barrow Ridge in the west and 'industrial' activity in the east (both to the north of the Stonehenge Cursus and in the southeast between Wilsford and Rox Hill). In many subsequent accounts of the area, it is the link between King Barrow Ridge and 'domestic' activity that is maintained (e.g. Bender 1998, 55; ). This 'westerly' orientated view of domestic activity, obviously also influenced by the presence of Durrington Walls, is found in many other accounts not directly related to the work of the SEP. For example, Parker Pearson and Ramilisonina (1998) see it as the centre of the area for the living, whilst Bradley (1993, 53) describes movement along the Stonehenge Cursus from west to east, as a journey from an area of the living to an area of the dead.

In addition to the types of analyses that have already been discussed, the SEP also discuss the distribution of flint tools. Within their tripartite functional division of the reduction sequence (Table 2.1) tools are taken to directly represent domestic activity. However, even more so than the other aspects of the assemblage, their distribution does not seem to fit the simple division between 'industrial' activity to the west and 'domestic' activity to the east. The result of this is the suggestion that in several areas within the 'lithic resource zones' the 'industrial' was to be found side by side with the 'domestic'. This is suggested for the North of Cursus (52), the northern part of the Stonehenge Triangle (54), Winterbourne Stoke Crossroads (50), The Diamond (59) and The Ditches (77). As before, there seems to be an uneasy relationship between expected assemblage compositions based upon idealised models of settlement and subsistence activities and the actual pattern of the surface material that was collected.

[5] Richards (1990, 22-4) suggests that primary flakes are under-represented because they have one entirely cortical surface and therefore may have been missed during surface collection.

2.3.1.3 The chronological interpretation of the surface survey

The SEP also provided some attempts to discuss the distribution of the material in terms of chronological periods. However, owing to the unstratified character of ploughsoil assemblages this aspect is particularly problematic. The project hoped that the problem could be addressed by the analysis of material from a range of dated stratified contexts to identify a suite of chronologically sensitive technical attributes (Richards 1990, 18). However, the degree of technological variation between assemblages from early and late Neolithic contexts proved insufficient to warrant the approach and ultimately it was abandoned.

Therefore, the avenues open to investigate the chronology of the broad zones of activity that had been identified remained limited. Given this, there is still a need in the final interpretation of the report, which is inevitably period-based, to discuss the lithic scatters accordingly. To do this several different lines of evidence are utilised. Firstly, where possible the results of some of the surface assemblages collected as part of the intensive investigation were combined with the results of the extensive collection. Some of this intensively collected material had analysed in more detail allowing insight into the probable date of activity in some locations. In addition, activity in certain areas was also identified through other non-monumental sources. These mainly comprise of either the location of excavated sub-surface features such as pits, or from spreads of occupation debris sealed under banks and mounds excavated at monuments such as Durrington Walls (*ibid.*, 265; Wainwright and Longworth 1971). Where possible, surface collected pottery was also used to date activity. However, diachronic changes in fabric type played a significant role in the generally poor survival and retrieval rates of later prehistoric pottery limiting the usefulness of the technique.

In addition to these non-monumental sources, the final interpretation of the SEP relies heavily on traditional sources of dating information from the excavated monuments in the area. In this sense, the overall landscape sequence, within which the lithic scatters are fitted, still relies very much upon monumental evidence despite the objectives of the SEP to indicate the importance of a parallel source of archaeological material.

| Period | Chronologically distinctive tool types |
|---|---|
| Early Neolithic | Ground flint axes/fragments, flint axes/fragments, stone axes/fragments, leaf shaped arrowheads, microdenticulates, backed blades, truncation elements, Class 1,2,3 & 5 scrapers |
| Late Neolithic | Various forms of petit tranchet derivative (PTD) arrowheads, rods/fabricators, Y-shaped tools, discoids, Class 4 scrapers |
| Early Bronze Age | Barbed and tanged arrowheads, plano convex knives, borers, Class 6&7 scrapers |
| Late Bronze Age | Class 10 scrapers |

Table 2.2: The chronologically distinctive tool types identified by the Stonehenge Environs Project (Richards 1990, 18).

The last and most commonly used method to provide a chronology for the lithic scatters was the presence of chronologically distinctive tool types. In practice, it was found that the range of tool types that were commonly found and securely attributable to individual periods was quite limited (Richards 1990, 18; Table 2.2; c.f. Section 8.3.4). In order to improve this situation, with the aid of a range of dated examples excavated from various features, there was an attempt to produce a scraper typology of ten chronologically and morphologically distinct classes (Riley 1990). However, the expedient nature of the production and use of many scrapers led to a degree of homogeneity of form that meant that the typology could only be used as a chronological indicator with a degree of caution (*ibid.*; Richards 1990, 265).

As Table 2.2 shows, the range of tools used to distinguish individual periods is limited. In addition, several of the types, such as microdenticulates and Y-shaped tools, were present in very small numbers further restricting the range of tool types that were of use (Table 8.1). Despite this, the concentration of analytical detail applied by the SEP is on the assemblage of tools rather than debitage and this is a common approach within the study of ploughsoil assemblages. There are several recurrent problems with this approach, which need to be addressed.

Firstly, lithic scatters are an unstratified palimpsest of material accrued over essentially unknown periods of time. Therefore, there are several unquantifiable factors involved in the study of this type of material. Tool types are often used to try to make the unquantifiable quantifiable but the approach is misleading. This is because within lithic scatters, tools most commonly represent only a minor fraction of the material. For example within the SEP assemblage, flake tools represent only about 3% of all worked flint. In addition, many of these flake tools are miscellaneous retouched forms meaning that the proportion of typologically distinctive pieces is much smaller. Given the range of unknown variables within the analysis of lithic scatters it is incorrect to try to provide singular interpretations of either their function or chronology based upon such a small proportion of their material. Indeed, the very desire to do this indicates the persistence of the belief that scatters can be treated in the same manner as sites (c.f. Foley 1981a; 1981b). It is essential to realise from the beginning that lithic scatters generally do not represent singular activities but a range of activities carried out diachronically rather than synchronically. It is only by being realistic about the basic character of the material that is being examined that understanding can proceed.

Secondly, only a restricted range of distinctive types is employed to try to assess the function and chronology of scatters. Within the SEP, a spectrum of tools from different periods is represented (Table 2.2) and in the discussion of the project these tools come to stand for activity of specific periods. Yet, for chronologically distinctive tools to have been produced in the past there has to have been a tradition for working flint into restricted, recurrent and widespread forms. This is the basis of our typologies today. However, there is no discussion by the SEP of the fact that technological traditions, and therefore attitudes towards the production of formal tools, changes greatly over the timescale of the analysis. For example, the differences are most clear between the later Neolithic and the later Bronze Age. As Table 2.2 shows, the range of chronologically distinctive tools present within the SEP material for the latter period is highly restricted compared to the later Neolithic. This is because whereas the production of tools in the late Neolithic is characterised by extensive use of retouch to produce standardised forms, formal tool production is more or less absent by the Late Bronze Age when technology became almost entirely *ad hoc* (Edmonds 1995). Although to a lesser extent, subtle differences in the conventions regarding the production of tools, occur between all of the periods under analysis. The important thing to realise is that because of this, the lack of recognisably later Bronze Age tools in the Stonehenge landscape, may tell us more about changing attitudes towards the working of stone than the relative frequencies of lithic producing activities in the period. Rather than approaching lithic scatters with a simple 'date and locate' mentality we should instead be trying to see what they can tell us about the reproduction of society through routine practice.

Thirdly, in a similar vein, not only does the character of production change diachronically, but so too do traditions of the use and discard of stone tools. In addition, the SEP uses different types of tools to define activity from different periods. For example, there were differences over time in the extent to which tools were either used expediently or were actively curated. Therefore, hypothetically, the same amounts of activity in different periods would produce significantly different amounts of actual tools. This would affect the patterning retrieved by the SEP with the possibility that some periods and some types of activity would be either under- or over-represented.

Hence, there are many reasons why tool types are not well suited to being the sole source of evidence used to assign both function and chronology to lithic scatters. They should only be used in this regard as a compliment to the analysis of debitage. Tools are often used to suggest what types of activities lithic scatters represent. However, it should be obvious that the debitage from lithic scatters is material derived from repeated episodes of flint working. Therefore, the material itself is evidence of activity. Understanding the choreography of lithic producing practices should be our first and most achievable goal when attempting to analyse lithic scatters. This can only be done by proper consideration of the debitage from ploughsoil assemblages.

### 2.3.1.4 Criticisms of the Stonehenge Environs Project

The interpretation of the extensive survey by the SEP was based upon a very simple form of classification and analysis based upon the eight categories into which all of the material was sorted. No metrical or technological analysis was applied on any of the debitage and the tools were prioritised through the application of a standard typological classification. This attitude is typical of many landscape survey projects that, compared to excavations, see unstratified lithic scatters as an inferior form of evidence worthy of only cursory inspection (Ammerman 1981, Bowden *et al.* 1991, 107). Within the SEP this belief is replicated as, even including the material collected by the intensive investigation strategy, detailed investigation of material was not carried out upon any ploughsoil contexts. Instead, the most in depth analysis was only applied to groups, which related to 'single phases of flint reduction, or to short phases of deposition, preferably with datable associations' (Richards 1990, 213). The consequence of this approach is that it suggests that the only realistic aim in the analysis of ploughsoil assemblages is to date and locate them. Despite the fact that this 'dots on maps' approach has been criticised for some time (Haselgrove *et al.* 1985b) it is still present within many landscape surveys. Yet, the beliefs upon which this attitude is based, remain assumptions until a more detailed analysis has been applied to scatters to test whether the approach is warranted. Testing this approach is a central component of the current study.

2.3.1.4.1 The scatter, the site and the off-site

Also implicated in issues about the necessary level of analysis to be applied to ploughsoil assemblages is the problematic relationship between the surface scatter and the site. In the early history of survey, surface scatters were thought of as eroded sites whose main use was to locate an appropriate place for excavation (Ammerman 1981, 63). Gradually, it was realised that the direct connection between the two could not be assumed. This realisation came about partly through an understanding from ethnographic studies that it could not be guaranteed that artefacts were predominantly used or discarded on 'domestic' sites (Holgate 1988, 35-7; Schofield 1991b, 117). At the same time the whole notion of the 'site' was brought into question as it was realised that looking for sites through scatters assumed that activity was organised across the landscape as a discontinuous distribution (Schofield 1987, 275; 1991b; Bowden *et al.* 1991, 107). Instead, it was suggested that the study of artefact scatters and subsistence activities were better served by understanding activity to be continuously distributed across the landscape in varying densities (Foley 1981a; 1981b). This 'off-site' approach has been widely adopted, however, conceptual problems still seem to remain concerning exactly what we are looking for when we study artefact scatters. These problems are clear from the work conducted by the SEP.

Although, in discussion Richards (1990, 25) shows awareness of the principles of 'off-site' archaeology, the approach is not specifically adopted by the project. Indeed, the term 'site' is used to refer to areas of surface activity that are regarded as 'spatially defined' (*ibid.*). In this respect, one of the principal objectives of the extensive survey was to identify such areas in order for them to be investigated through the intensive survey strategy (*ibid.*, 11). This strategy was designed to ultimately lead to excavation from the ploughsoil down to any subsoil features. This is another indication that these areas were thought of and treated as sites. The nature of this process suggests several beliefs:

1) That the scatters defined by the extensive survey could be easily categorised by detailed investigation of a restricted sample of the most spatially discrete of them.
2) That the activities represented by the scatters could be defined by whatever activities were witnessed in any subsoil features excavated beneath them.
3) That, therefore, the scatters were essentially the eroded components of sites.
4) That stratified material/evidence from sites are of higher archaeological value than unstratified surface scatters.

The suggestion that these beliefs lie behind the work carried out by the SEP is backed up by the relative depths of analysis applied to the lithic assemblages. Detailed analysis of assemblages was reserved for stratified groups of material. In some cases during the intensive survey the specific aim was to investigate scatters through total surface collection on a small grid followed by excavation of a sample of the ploughsoil. Yet the analysis of the assemblages collected in this manner was of the same basic level of categorisation as had occurred for the material collected for the much larger extensive survey (Richards 1990, Ch. 5; c.f. Section 2.3.1.1).

In contrast, despite the fact that the object of some intensive investigations was to study scatters, when a stratified assemblage was located in subsurface features beneath the ploughsoil, an in depth analysis was applied to the material. This situation is best illustrated by the intensive investigation of the scatter on Wilsford Down (W31) (Richards 1990, 158-171). The location of the survey and excavation was determined by the extensive survey, which it had been thought had identified a dense and discrete concentration of activity. The area was defined on the surface and a transect through it was sampled and excavated from the ploughsoil down to the natural bedrock. It seems that there were expectations of discovering sub-surface features. However, none were found, although, natural periglacial subsoil features in which material had accumulated were located. It is suggested that:

> "The interpretation of what was initially considered to be a coherent and relatively well-defined area of activity is inevitably constrained by the absence of strictly stratified deposits..." (Richards 1990, 163).

Yet, considering that it was a lithic scatter that was under investigation it seems that this type of situation should have been expected from the beginning rather than been a constraining influence to interpretation. Such an eventuality surely indicates a misconstrued methodology in the first place. In addition, the material from the subsoil hollows is treated as if it comes from cut features and a detailed analysis of the material from them is conducted[6]. In contrast, the assemblage of over 21,000 lithic artefacts from the ploughsoil, representing 86% of the assemblage from the investigation, is essentially ignored (*ibid.*, 164). Considering that the aim of the investigation was to study the scatter, the difference in the treatment of the two sets of material seems puzzling. However, it can be understood if it is suggested that the original belief was that by excavating and analysing what lies beneath lithic scatters one can best characterise the scatters themselves. That this approach is flawed is indicated by the lack of success that the SEP had in characterising the scatters in the Environs. The approach that is adopted in the current project is that characterisation can best be achieved by actually analysing the material from the scatters themselves.

[6] In the defence of the SEP, some of the material from these subsoil features is suggested to have been *in situ*, a feature that had been recognised in the field.

2.3.1.4.2 The industrial and the domestic

The foundation of the functional interpretation by the SEP rests upon the division of material into either 'domestic' or 'industrial' categories (Richards 1990, 18-19). These idealised categories are mutually exclusive in the discussions within the SEP report. There appears to be an assumption that such categories of activities must have been as conceptually and physically separated as they have become today. For example, this is shown in the ascribed 'lithic resource zones' around Wilsford Down and to the north of the Stonehenge Cursus, within which 'domestic' material was somewhat unexpectedly found (in the form of concentrations of tools). Despite the presence of both categories of material in the same locations, the 'domestic' is only described as being either directly correlated or peripheral to 'the main industrial areas' (Richards 1990, 24). This description indicates that the two forms of activity are still thought to be separated from each other. This is because, in order for there to be a 'correlation', there needs to be two conceptually separate and different objects in the first place. There is no realisation that such a simplistic division should not be taken for granted as it must also involve assumptions over what represents the 'home' or the 'domestic' as opposed to the 'industrial'.

In this respect, Brück (1999, 60-4) reminds us that categories such as 'ritual', 'domestic' and 'economic' are historically contingent notions. This means that our use of such labels should be questioned from the first instance (Tilley 1999, 11). It must be realised that modern Western society has formulated the concepts of the industrial and the domestic in a particular way. Central to these concepts is that they have become mutually exclusive spheres of practice, each associated with specific locales. Reviewing ethnographic sources, Brück suggests that in many societies there is no spatial separation between such practices (1999, 60-4). That this may well have been the case in the past is supported by the range of materials present in different types of archaeological contexts such as henges, pits and artefact scatters. Although, conceptually we draw these contexts apart, they often contain quite homogenous ranges of material. Classically 'domestic' artefacts such as flint, pottery and quern stones are found commonly in all contexts. This pattern indicates the inadequacy of our implicit categorisation of sites and suggests that certain types of activities were commonly carried out in a range of contexts (*ibid.*). Therefore, there may have been entirely permeable boundaries between spheres of life that we now hold apart. Under such conditions, we must question the applicability of terms such as 'industrial' and 'domestic'. Rather than assuming that distinct 'zones' within the landscape should belong to practices that define one or the other, it should be a matter for investigation. The detailed analysis presented in subsequent chapters will assess these issues but already the distribution of tools in comparison to cores and other debitage suggests that this was not the case. Beyond this, we should also question our desire to separate activities into such apparently insoluble categories, particularly when this process becomes the main goal of archaeological interpretation.

#### 2.3.1.4.3 The Stonehenge Environs Project in relation to other accounts of the Stonehenge landscape

Already in this chapter, many accounts of the Stonehenge landscape have been criticised for concentrating too tightly on monumental contexts at the expense of evidence of daily practice. Yet, despite the SEP concentrating on the lithic scatters in the area there are some similarities between theirs and the other accounts already mentioned. In particular, whilst many monument-based interpretations involved the notion of restricted practice, ordered movement and a distinctly zoned landscape (e.g. Parker Pearson and Ramilisonina 1998; Thomas 1991; Darvill 1997; Woodward and Woodward 1996) so to does the SEP (Richards 1990). The only difference is that what are on the one hand, zones of ritual seclusion, are on the other, zones of economic practice. There is further similarity in that, with the suggestion of mutually exclusive 'domestic' and 'industrial' practices by the SEP, both ritual and economic zones are restrictive in the sense that only limited practices are imagined there. In addition, it is stated that during the late Neolithic:

> "It can be suggested, however, that Stonehenge Bottom, the major north-south dry valley, may have acted as a conceptual if not physical barrier to separate zones of activity, emphasis, and association." (Richards 1990, 270).

This passage clearly has many similarities to the other accounts that have already been presented in this chapter. It provides the same concepts of zones and conceptual barriers or *cordon sanitaires*, which impede movement and activity within the Stonehenge landscape.

2.3.1.5 Summary

The basic level of analysis conducted by the SEP has led to an equally basic level of interpretation. This approach allows no discussion of what those activities consisted of, how tightly defined they were, the concerns which the relative structuring of routine activities addressed or the effect that the organisation of practice had on society.

In effect, there is still only a rudimentary understanding of what the lithic scatters in the area represent. There is little detail of the differences within and between scatters resulting in the problem that the diversity of the character of the inhabitation of the landscape cannot be understood in any detail.

When the material is discussed in the final interpretation of the SEP report (Richards 1990, Ch. 10), these problems persist as an attempt is made to assign a chronological structure to the material. As has been discussed above this attempt rests upon a severely restricted range of diagnostic tool types. In effect, this means that the interpretation of the surface collections in the final discussion is not about the collection at all, but about little more than the distribution of those few tools which are chronologically distinctive.

In addition to the above, there is no understanding of the character of the lithic scatters around Stonehenge in comparison to any other landscapes. Hence, one cannot tell whether activity there was unusual or typical compared to other landscapes. The lack of detailed analysis and discussion also means that there can be no discussion of either the scale or composition of activities. The result is that one is left with very little idea of the nature of inhabitation of the Stonehenge landscape in all respects. The only major contribution provided by the project has been to show that there is settlement in this landscape but this could have been proved without the need to retrieve such huge quantities of material.

## 2.4 Conclusion

The current chapter has discussed the recent accounts of the Stonehenge landscape. Many interpretations have been criticised for concentrating too tightly on monumental contexts and the problems that this has created for our understandings of the area have been outlined. It has been suggested that in order to provide a balance to narratives, which focus on ritual action in the landscape, it is necessary to take account of the evidence that exists between the monuments as well as within them. This material exists mainly in the form of surface scatters of worked flint. The ploughsoil assemblages have been the focus of investigation for the SEP (Richards 1990), but it has been shown that the quality of analysis and interpretation of this material has been severely limited.

Accordingly, before other interpretations can make full account of quotidian life within the Stonehenge Environs it is first necessary to examine the lithic scatters in far more detail. In particular, we must be able to talk of the scale and composition of flint working activities in the Stonehenge landscape. In addition, it is not enough to understand variation within this specific landscape but also to be able to make contrasts with other contemporary landscapes. It is only then that we can understand the conditions under which the area around Stonehenge was inhabited and under which the monuments in the area were approached.

The next step in the current project is to put in place a methodology to carry out the objectives outlined above. Primarily, these objectives will be met through the analysis of the ploughsoil assemblages collected by the SEP. In addition, comparisons will also be made with the results of collections from other landscapes. It is to these issues that the next chapter turns its attention.

# Chapter 3: Methodology

## 3.1 Introduction

Given that the original goal was to test the interpretative limits of ploughsoil assemblages, the material from any number of projects could have been chosen for analysis. Indeed, it could be argued that original collection of material would have been the most obvious choice. This is because it would not only allow total control over the choice of landscape to be analysed, but also over the conditions of collection. However, despite the importance of these factors the limited resources and length of the current project would not allow for both the extensive surface coverage of collection and the essential analytical detail. In addition, it was also felt that there was a real need to improve understanding of the ploughsoil assemblages that have already been collected from important prehistoric landscapes[1].

The need for further analysis of the material is often stressed in project reports and yet it is a call that most often goes unanswered. It seems unlikely that English Heritage or any other similar organisation is going to take responsibility for such research, especially when the projects were conducted under their name in the first place. Despite this, the often-large assemblages from such projects sit in museum archives waiting for further study that in some cases may never come. Considering all of these factors, it seemed that a PhD was the ideal context within which to attempt the analysis of material that had already been collected and published. Of course, the basis of this was the understanding that publication had far from exhausted what the material had to tell us.

Given the above, the choice was from which project to study material. Aspects that required consideration were:

1) The extent of existing archaeological knowledge of the area, including environmental data.
2) The proportion of the survey area covered by collection.
3) The location and extent of sample areas.

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[1] For example, the South Dorset Ridgeway (Woodward 1991) and the Stonehenge Environs (Richards 1990) have collected large quantities of material from key Neolithic and Bronze Age landscapes. Yet, it may be argued that they have told us little about the occupation of these areas than was already known.

4) The spatial resolution of the collection grid.
5) The quality of the collection (e.g. types of material collected).
6) The quality of the processing and storage of both the paper and finds archive of the project.

Given these criteria, it soon became clear that the SEP (Richards 1990) was the best choice. Obviously, Stonehenge the landscape is of huge importance to the study of later prehistory in southern Britain. Similarly, the extent of knowledge of the area in general is comparatively good. For the current project, it is of equal importance that the SEP's collection of surface material was also of high quality. In particular, compared to many landscape surveys (e.g. Woodward 1991; Shennan 1987; Ford 1987a), the SEP collected from a high proportion of a focused survey area (c.f. Section 2.2.3.1.1). Although, the collection grid (25m x 50m) (Plate 49) could have been improved[2], it was still considerably better than many other projects (e.g. Woodward 1991; Shennan 1985). Therefore, it was believed that the material from the SEP would allow an unparalleled opportunity to study (close up) the range and variation of inhabitation of a prehistoric landscape. It was understood that this quality of understanding must be sought if it was to be possible to investigate the nature of the *taskscapes* in the area (Section 2.2.3.1.1).

## 3.2 The selection of material for analysis

As described in detail in Section 2.3.1, the SEP (Richards 1990) investigated the ploughsoil assemblages in the area through a multi-staged approach. This involved the collection of surface material utilising an extensive and an intensive survey strategy. The former collected on a 25m x 50m grid whilst the latter often collected on a grid as small as 5m x 5m. However, despite the obvious gains of the much higher spatial resolution of the intensive surface collection, this phase of the investigation was extremely limited. Whereas, the extensive survey covered 752.5 ha. of the Stonehenge Environs, the intensive surface collection covered less than 2 ha. As the primary focus

[2] For example, it would have taken little more effort to increase the spatial resolution by collecting from a 25m x 25m grid rather than a 25m x 50m one. Since the SEP (Richards 1990), Wessex archaeology now carry out all collections in the Stonehenge Environs on a 25m x 25m grid (Wessex Archaeology 2002) and the SEP's director has suggested that this should also have been the basis of collection for the project itself (Richards pers. com.).

of the investigation was to be the analysis of inhabitation at the level of the landscape, it was clear that the extent of coverage of the intensive survey would not be sufficient. Accordingly, despite the poor spatial resolution of the extensive survey, the material from this phase of the SEP was selected for further analysis.

### 3.2.1 The selection of material from the extensive survey for analysis

In the past, many projects (e.g. Woodward 1991; Richards 1990; Holgate 1988) have dealt with the large quantities of surface collected material that they collected by concentrating effort on the typological analysis of tools. This has meant that the major proportion of assemblages, consisting of debitage (taken here to mean flakes and cores), has gone largely unstudied. This situation also exists in the analysis of the SEP (Richards 1990; Section 2.3.1.1). The current project is directed at testing the interpretive potential of ploughsoil assemblages. In addition, the aim is to understand the spatial organisation (if any) of the *chaîne opèratoire*. Therefore, the analysis of debitage is not only considered to be complimentary to the analysis of tools but essential for the understanding of the topography of stone working practices in the landscape (c.f. Schofield 1988, 31).

In addition, the SEP (Richards 1990) had already created a typological catalogue of the tools within the extensive survey assemblage. Therefore there was no immediate need to add to their analysis of tools. Owing to these factors, the analysis for the current project was directed towards the waste flakes and cores collected by the extensive survey by the SEP. This analysis could be conducted without any contact with the tools from the assemblage as they had been boxed and stored separately.

Some problematic issues are raised by analyses that focus solely on either tools or debitage (Conolly 1999, 12-13). This is because these types of analysis involve assumptions not only concerning what the categories represent (i.e. waste vs. non-waste) but also (typologically) what types of artefacts should be assigned to one category rather than another. In practice, the difficulties of applying such terms are indicated by artefact categories such as utilised flakes, which are not only difficult to recognise[3] but also potentially have features of both debitage and tools (c.f. Section 4.1.2.2). In this light, there is no *a priori* reason why tools should be excluded from the type of technological analysis applied to debitage and equally why debitage should not be assessed for typology and function as tools are. However, despite the acceptance of these problems the tools from the SEP are only included in the current analysis by the use of the project's tool catalogue. The major reason for this is the major logistical problems implicated by any other type of analysis. Unlike the debitage, the tools were individually bagged, meaning that in order for them to have been part of the overall sampling strategy (see below) they would have had to be individually removed, recombined with the rest of the material, sampled, analysed, retrieved and then rebagged. This simple practicality would have made the sampling process unfeasibly time consuming and considering that it was towards the technological analysis of debitage that the emphasis of the project was directed, the approach outlined above was considered appropriate.

### 3.2.2 The sampling strategy for analysing material from the extensive survey

Although the debitage from the extensive survey was selected for analysis, not all of it could be included as it consisted of just under 100,000 flakes and cores. Therefore, a sampling strategy was required to select a sub-sample for further analysis. It was decided that a proportion of roughly 20%-25% of the assemblage would be ample both as a representative sample of the assemblage and as a reasonable quantity of material to analyse within the scale of the project. Yet, decisions still had to be made concerning how to select this sample. Two clear possibilities arose:

[3] As with many forms of classification in the study of lithic technology, the recognition of utilised flakes involves a judgement on whether the form of the edge of a flake represents either unintentional post-depositional damage, wear caused by the utilisation of an unmodified flake or preparation of a flake by retouch.

1) The analysis of all of the material from a selection of individual sample areas[4] adding up to 25% of the whole assemblage.
2) The analysis of 25% of material from all sample areas.

The major problem with the first possibility was that it would involve the analysis of material from only a restricted selection of sample areas. Therefore, from many sample areas no material would be analysed. This would mean that much of the extensive spatial coverage would be lost. As the different sample areas differed greatly in terms of the density of material retrieved from them, it would also be difficult to select the sub-sample. Accordingly, it is likely that at least part of the sample would have to be selected judgementally. As such decisions could only be made on the basis of existing understandings of the material, which are suggested to be insufficient, this also seemed unsatisfactory.

In order to maintain the total spatial coverage of the original project, it was decided to analyse 25% of all of the material from all sample areas. The strategy involved the random selection of a consistent proportion of material from each collection run (i.e. every collection point at 50m intervals spaced 25m apart). Based upon the number of runs producing different frequencies of worked flint (Plate 50) it was calculated that by randomising the pieces from a collection run and by analysing the first and every fifth subsequent piece, roughly a 24% sample of the whole assemblage would be achieved. The reason why this needed to be calculated was that the varying amounts of flint from collection runs affects the size of the sample that can be taken from them (Fig. 3.1). Hence, if only one piece is present the sample would represent 100% of all pieces from the run, whereas if there were five pieces the sample would be 20%, and so on. As can be seen (Fig. 3.1) there is a general trend that the samples from collection runs with fewer artefacts yield slightly higher proportions of the material. This was considered desirable as it provided a basis for understanding some of the large areas within the Stonehenge Environs, such as Normanton Down, which have consistent values of less than 10 pieces of worked flint per run (Plate 42).

[4] The SEP collected material from thirty-nine sample areas of varying sizes.

## 3.3 The analysis of debitage

Once the procedure for selecting material had been chosen it was necessary to decide the basis for its analysis. Considering that the original study by the SEP only involved the simple classification of material into categories such as flake or core, any form of analysis would represent an improvement (c.f. Section 2.3.1.1). However, the choice of the types of analyses to be applied needed to be directed towards specific research questions. The definition of such questions was limited by the lack of existing understanding of the material and the character of ploughsoil assemblages in general. Hence, there was a potential to direct analysis towards a few key attributes recorded to answer specific questions (e.g. cortex on flakes used to assess areas of production vs. consumption). However, as the success of such techniques was far from certain there was also a need to cast a relatively wide net designed to characterise the broader technological patterns of lithic reduction.

Accordingly, the analysis was directed towards understanding the spatial variation in the character of lithic technology and the techniques of reduction. To a certain extent, the objective was to reconstruct the configuration of the *chaîne opératoire* at a landscape level. The *chaîne opératoire* is a term that relates to 'the series of operations which transforms a substance from a raw material into a manufactured product' and furthermore to the continued transformations that occur through the use of an object until its eventual deposition (van der Leeuw 1993, 240; Pelegrin 1990). In contrast to previous approaches to technology, the concept of the *chaîne opératoire* perceives technology as a dynamic process realised through movement and action (a sequence of gestures) (Schlanger 1990). The study of the *chaîne opératoire* most often begins with an attempt to reconstruct a gestural chain, which functions, flows, relates and accordingly reveals the details of the techniques of manufacture (*ibid.*). In practice, analyses that utilise this approach rely heavily upon context and especially refitting to establish the level of understanding that is required (e.g. Pigeot 1990; Schlanger 1996). Due to this, the technique has been applied most commonly to well-stratified sites that have been carefully excavated and recorded. For the same reasons the idea has found little application in the study of ploughsoil assemblages. Yet, whilst the level of analytical resolution required to understand the full details of the *chaîne opératoire* maybe impossible to attain, the wider concepts are still invaluable. In particular, the concept of technology as a dynamic and fluid process realised through action can be maintained and is essential to understanding issues of technological choice (Lemmonier 1993). In addition, also maintained is the importance of the study of the techniques of reduction and the spatial organisation of the different phases of the sequence (Edmonds 1990). Although the concept has traditionally been used to investigate variation in these aspects at the level of the site, it should be equally possible to make broader assessments at the level of the landscape.

The choice of this approach largely determined the type of analysis that was applied to the debitage. The form of this analysis involved recording through a mixture of typological and (categorical and metrical) attribute analysis. It was also split according to the analysis of flakes and cores, the two categories of debitage. The full details of the analysis are contained in Appendix 1, but a summary is necessary here.

### 3.3.1 The analysis of flakes

The attributes what were measured on flakes were as follows:

1) Length of flakes
2) Breadth of flakes
3) Weight of flakes
4) Flake bulb type
5) Flake butt type
6) Flake termination type
7) Flake scar orientation
8) Flake class
9) Raw material type
10) Extent of cortex coverage
11) Flake type
12) Flake shape
13) Flake profile

As suggested, the selection of attributes was designed to cast a relatively wide net capable of characterising the broad character of the technology and the part of the reduction sequence represented by different lithic scatters. Some attributes, such as length, breadth and weight were selected to indicate the general morphology of individual flakes. This information was also recorded in an alternative manner through a broad assessment of the shape (in plan) and the profile of flakes. Others, such as flake butt type, flake class and flake scar orientation were selected to provide more detailed information about the character of core reduction and the nature of techniques, such as the preparation of flakes prior to removal. The stage of the reduction sequence present in different locations could be assessed through comparisons of a series of these attributes as well as more specific information such as the extent of cortex covering the dorsal surface of flakes. Alternatively, more specific techno-typological observations could also be made by recording the presence of distinctive technological products, such as thinning flakes or core preparation flakes through the attribute flake type.

During the analysis, many issues were raised concerning the applicability of the various attributes and their individual categories. These findings are referred to in the relevant sections of Chapters 4, 5, and 6, which detail the results of the analysis.

### 3.3.2 The analysis of cores

Like that of flakes, the analysis of cores involved the recording of both metrical and typological attributes. Metrically, the weight of cores as well as the maximum and average length (and number) of complete flake scars remaining on them was measured. The main form of typological analysis was the application of Clark's core typology (Clark *et al.* 1960)[5]. However, unlike the analysis of flakes, the recording of cores also involved the recording of observations through written description (c.f. Section 5.1.1). It was felt that this was necessary due to the variety and complexity of the information that could be gained from the analysis of the cores. These observations were organised around the description of the character of the raw material, the extent (or lack of) preparation of striking platforms, the extent and type of production and the reasons (if any) behind core rejection[6].

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[5] See Section 5.2.5.1 for a detailed discussion of the use of Clark's core typology.

[6] See Section 5.1.1 for discussion of the issues involved in the use of verbal description to record cores.

## 3.4 Comparing the Stonehenge Environs with other landscapes

The analysis of assemblages collected by the SEP (Richards 1990) was only one part of the analysis conducted for the current project. It was also felt that in order to gain a better understanding of them, it was necessary to be able to compare the assemblages (and therefore the nature of inhabitation) with those collected from other landscapes. This meant comparing the material from the collections in the Stonehenge landscape with those from some of the other major landscape surveys conducted in southern Britain over the last few decades (e.g. Woodward 1991; Schofield 1987; 1991c; Sharples 1991a; Ford 1987a; 1987b). It was quickly realised that the direct comparison of assemblages by lithic analysis would be impossible due to the time involved. Therefore, the comparison had to be restricted to published results. The benefit of this approach was the ability to select from a wide assortment of projects that had been conducted in a variety of different types of landscapes, both geologically and archaeologically.

As the publications used for the analysis are from a disparate group of projects conducted to fulfil different objectives under different conditions, there are many methodological issues involved in any attempt to compare their results. These implications are so important to understanding the results of the analysis that they are discussed in detail as part of Chapter 7, which discusses this part of the project.

## 3.5 Methodological issues of ploughsoil assemblages

Much of the development in the study of ploughsoil assemblages over the last few decades has been concerned with the investigation of methodological issues (e.g. Hinchcliffe and Schadla-Hall 1980; Haselgrove *et al.* 1985a; Schofield 1991a). This body of work has looked critically at the effect of the plough on archaeological deposits (e.g. Lambrick 1977; 1980) and the range of factors that go to create the surface distribution of material (e.g. Haselgrove 1985; Healy 1987; Boismier 1991). Essentially, much of this work has sought to assess how these processes affect our ability to infer past activities from surface collection. The range of factors most covered in the literature can be divided into three categories:

1) Past depositional behaviour: those factors influencing the original formation of archaeological deposits. As the type of deposition (e.g. in pits, middens or directly onto the land surface) cannot be assumed, it is necessary to investigate the way in which different types influence what material is eventually incorporated into the ploughsoil (e.g. Haselgrove 1985; Healy 1987).
2) Post-depositional processes: these include the range of factors altering the original spatial patterning of material after its deposition. These vary from the action of the plough to the degree to which landscape processes may either destroy patterns or create artificial ones (e.g. Schofield 1988; Clark and Schofield 1991; Allen 1991).
3) Retrieval conditions: the conditions under which surface material is collected also influence any patterns that may be subsequently identified in it. The factors that need to be considered include lighting, crop coverage, the experience of field walkers and the type of collection grid (e.g. Shennan 1985; Haselgrove 1985).

The large amount of work involved in the investigation of the problems outlined above has been essential because the study of ploughsoil assemblages is a relatively new field, which has developed significantly over the last twenty years. Accordingly, prior to this research there was only a rudimentary understanding of how ploughsoil assemblages were formed and what they represented.

Despite this, these methodological issues are of limited relevance to the current project. Their impact on the assemblages collected by the SEP (Richards 1990) must of course be assessed. However, because the current project involves the analysis of material that has already been collected, there is limited scope for either detailed investigation or mitigation of these issues. This is because the assessment of the issues outlined above most normally involves specific methodological objectives that must be accounted for from the inception of a project.

However, it may be suggested that problems connected with past depositional behaviour are minimal within the Stonehenge Environs. In this respect, two main issues need to be considered. The first is that deposition occurs in different types of features such as pits or middens, meaning that material may exist at different levels beneath the topsoil. As the depth of ploughing is limited, this may mean that material that was deposited on the land surface would be over-represented in comparison to material that had been buried deep in subsoil features (Healy 1987). The second issue concerns the problematic relationship often inferred between surface artefact concentrations and 'sites'. This is not only because large concentrations of material can be generated by activities which take place 'off-site' (Foley 1981a; 1981b; Haselgrove 1985, 14), but also because locations of artefact use are not necessarily the same as locations of artefact discard (Foley 1981a, 165; Entwistle and Richards 1987, 19).

Concerning the first issue, excavation of lithic scatters by the SEP indicates that there is only limited potential that large quantities of material have not entered the ploughsoil because they are sealed in subsoil features. However, in areas such as the King Barrow Ridge (Richards 1990, 109-23), subsoil features were located under lithic scatters. Roughly twenty shallow pits were found, all of which were quite shallow features (less than 0.5m). Comparison between ploughsoil material and that from the pits indicated a similar situation to that identified by Healey (1987) at Spong Hill, Norfolk. Whilst the tools found within the ploughsoil are generally Late Neolithic in date, the material from the pits is mostly Early Neolithic with material from two primary contexts giving dates of 3650-3340 BC (OxA1396) and 3370-2930 (OxA1397) (Richards 1990, 114-6). Despite this the extent of the problem, which could potentially lead to the overrepresentation of late compared to early Neolithic material, is most probably limited. One of the major factors behind this is the generally shallow depth of soil overlaying chalk bedrock in the area around Stonehenge[7] combined with the insubstantial nature of those pits that have been found to survive. The combination of the two suggests that in most locations ploughing will have incorporated material from all but the deepest of subsurface features into the ploughsoil. Furthermore in other areas, like Wilsford Down (*ibid.*, 158-71), excavation revealed the ploughsoil to directly overlay the abraded surface of the natural chalk and no cut features were located. In all detailed investigations conducted by the SEP, the proportion of material in the ploughsoil was greater than that from subsoil features by a massive margin.

[7] Test pitting, mainly around the Stonehenge Bottom/Spring Bottom dry valley system indicated that the depth of soil overlying bedrock did not exceed 0.4m (Richards 1990, 210).

Considering the extent of flint sources in the area and the quantity of lithic debitage it is quite probable that the majority of material was never placed into pits or other subsoil features. Hence, it is suggested that the possibility that certain types of activity might be under-represented because the material remains sealed within subsoil features is limited.

Concerning the second issue, the possibility that locations of the use of artefacts may not necessarily be the same as locations of discard, is also not considered to represent a serious obstacle to interpretation. This is because, despite ethnographic studies showing that attitudes towards the disposal of waste tend to vary considerable between societies, even where locations of discard are not the same as locations of use they are usually located close to each other[8] (Holgate 1985, 53; 1988, 35-7). Therefore, it is suggested that, assuming a similarity of location between use and discard, the presence of debitage products in the ploughsoil assemblages can be taken to infer the presence associated knapping episodes in the vicinity (even if not in the same exact location). Regardless of any understanding of attitudes towards the disposal of waste, given the poor spatial resolution of the data it would be unwise to do otherwise.

Post-depositional processes also affect the distribution of materials on the surface. The action of the plough displaces material laterally and horizontally. However, experiments have shown that over time transverse displacement is minimal (i.e. around 5m) (Boismier 1991, 17). Areas in which affects are greatest are where the movement of the plough is combined with slope facilitating erosion and soil creep with the cumulative tendency for material to move downhill. However, in the Stonehenge Environs it is expected that these effects would be minimised, as although it is undulating, the majority of the landscape west of the Avon valley is relatively flat. This should mean that in this area the effects of the lateral displacement of material by the plough should be minimised (c.f. Gingell 1980). As with the differences between the locations of use and discard of artefacts, the problem is lessened further by the level of spatial resolution of the collected surface material. The plough also alters surface composition through vertical displacement of the material with the potential for larger artefact categories to

[8] Holgate (1988, 36), quoting Hayden and Cannon (1983, 159), suggests that in non-urban communities refuse generally remains within a two-minute walk of its point of origin.

be over-represented on the surface (Boismier 1991, 18; Clark and Schofield 1991). However, although this may mean that certain artefact types such as cores may be over-represented the relative proportions within artefact categories/sizes classes tend to reflect the proportion from the ploughsoil as a whole. It may also be expected that over time the effects of this size sorting will obtain an equilibrium meaning that if analysis is conducted on this basis meaningful comparison between different lithic scatters can be made.

The other major post-depositional effects upon surface populations are colluvial and alluvial landscape processes (Holgate 1985, 53; Allen 1991). These can have serious consequences as they have the potential to mask considerable areas of the landscape. Yet, within the survey area it can be suggested that these issues do not need to be considered. This is because in many parts of the Stonehenge landscape the ploughsoil directly overlies abraded bedrock. In addition, alluvial processes are confined to the Avon valley, which is almost entirely outside of the area of collection and topographically separated from it. Furthermore, it was a notable surprise that the programme of dry valley investigation conducted by the SEP to locate areas of colluvial deposition, found none (Richards 1990, 210-11). This absence has since been confirmed by subsequent augering in the area and seems to defy immediate explanation (Allen 1997, 120). Despite this, the lack of colluvial deposits means that there is little potential that they could mask significant areas of prehistoric activity.

The last set of issues that need to be taken into account are the effects of retrieval conditions on the spatial patterning of collected surface material. These factors, particularly those concerning visibility (light and crop coverage) and the differential abilities of field walkers, are the most difficult to quantify. This is because most attempts to assess the effects of them involve specific methodologies or experiments conducted during field survey projects (e.g. Shennan 1985; Haselgrove 1985). As the analysis was to be conducted on material already collected by the SEP the implementation of such strategies was impossible. However, in this respect it should be noted that the SEP report does not suggest that these issues were significant in assessing the surface patterning of collected material. In only one case, at South of Cursus (85), is it suggested that material was collected under unsuitable conditions making the results of work in this area invalid.

Hence, it can be suggested that, although there are many important methodological issues to be taken into account when assessing the significance of surface distributions of material, they are not thought to represent serious problems in the Stonehenge Environs. Having made this assessment, the data from the surface collections can be treated as meaningful representations of past lithic working activity and analysis can proceed on this basis.

## 3.6 Conclusion

This chapter has put in place a methodology for studying the nature of inhabitation in the Stonehenge landscape. This has involved the selection of material from the ploughsoil assemblages collected by the SEP and the means of its analysis. Equally important to this approach is the ability to compare the nature of occupation in the Stonehenge Environs with that from other areas and the means of doing this has also been outlined. Lastly, the methodological issues, which concern all ploughsoil assemblages, have been discussed. Whilst, given the nature of the current project, mitigation of these concerns is difficult, a general assessment has been made and it is suggested that they do not represent serious problems in the context of the Stonehenge landscape.

Now that the nature of the analysis has been explained, the following chapters deal with the results that it generated. These provide in depth accounts of the analysis of debitage both statistically (Chapters 4 and 5) and spatially (Chapter 6). Following these chapters are the results from the comparison of material from the Stonehenge Environs with published data from other landscapes (Chapter 7).

# Chapter 4: The Analysis of Flakes: Searching for Patterns Through Statistical Analysis

## 4.1 Introduction

The previous chapter outlined the methodology used to investigate the organisation of technological practice within the Stonehenge landscape. The basis of this methodology was the analysis of material collected by the extensive survey conducted by the Stonehenge Environs Project (Richards 1990). The chapter also detailed the nature of the sampling strategy used to select material for analysis and the techniques of lithic analysis that were used to record the flakes and cores (c.f. Appendix 1). The present chapter moves on from this to describe the results of this analysis. First, the basic success of the sampling strategy is discussed followed by a detailed discussion of the resulting data. The discussion of the data primarily revolves around their description and the statistical analyses applied to characterise their shape and to detect any significant pattern within it. Statistical techniques only form part of the approach towards understanding this complex dataset. Chapter 6 moves on from this method to discuss the use of GIS to map the spatial patterning of the material in more detail.

### 4.1.1 Data presentation

Most of the data presented in this chapter refer to assemblages from individual sample areas. As material was collected from 39 sample areas and many different attributes were measured, it is not practical in this and the following chapter to present all of the results, charts and graphs that were produced during the analysis. Therefore, decisions have had to be made to present a representative overview of the results backed up by description and presentation of graphic aids where appropriate.

4.1.2 The sampling strategy

As discussed in Section 3.2.2, a strategy was used to sample the assemblage from the extensive collection of the Stonehenge Environs Project designed to select a standard proportion of material from each individual run or collection unit. The method chosen was also aimed at retrieving a 20%-25% sample of the assemblage as a whole. The exact sample fraction differed for each collection unit due to the varying quantities of material found within them (Section 3.2.2).

In practice the sampling procedure worked well and did not unduly slow the process of analysis. It is now necessary to consider in a little more detail whether this process was successful.

4.1.2.1 The basic numbers

The extensive collection from the SEP retrieved 102,175 pieces of worked flint, 93,777 were recorded as flakes (including flake tools) and 8,398 as cores or core fragments. The sampling of the SEP material resulted in the analysis of 20,697 flakes and 1,672 cores, which totals 22,369 pieces of flint[1]. This means that the sampling strategy resulted in the recording of just over 20% of all the material from the SEP. However, it must be remembered that the tools within the assemblage were physically separated from the rest of the material and not included in the sampling or analysis (Section 3.2.1). According to the SEP archive, there were 3,384 tools within the assemblage meaning that minus this portion the sampling strategy retrieved 23% of all flakes and cores, well within the desired sampling fraction.

At a slightly more detailed level, the analysis recorded 23% of all flakes and 20% of all cores. The reason behind the slight discrepancy between the sample fraction for flakes and cores is unclear although due to the nature of the sampling system it depends on the relative proportions of flakes to cores within individual collection units. This discrepancy also highlights another slightly more problematic factor concerning consistency between

[1] All of the data from the analysis of flakes and cores are presented on CD ROM (Appendix 3) in separate Excel spreadsheets.

successive phases of analysis. As suggested, the cores recorded for the current analysis represent 20% of the number of cores recorded by the SEP, however during the course of my analysis I also kept an informal count of those cores that did not fall within the sample frame. The results of this were that including the cores recorded in the analysis I counted 7,297 cores in the SEP assemblage. There is an obvious difference between this figure and the 8,398 recorded by the SEP that demands some explanation.

In considering the difference between the amount of cores measured by myself and the SEP it is first necessary to point out that the amount of cores that I recorded represent 23% of the total pieces which I recognised as cores. These figures at least bring the sample fraction in line with that of flakes not only indicating the success of the approach but also the consistency of my own observations within the analysis. However, this in itself does not explain a difference of over 1,000 cores between two analyses of the same material, in order to do this we must consider questions of classification.

### 4.1.2.2 When is a core not a core?

In the case that has been outlined above it is clear that there has been a major difference in how cores, which seem to be a straightforward category of material, have been classified. Typical definitions of cores are:

> "A block of raw material from which flakes, blades, or bladelets have been taken, in order to provide blanks for tools." (Inizan *et al.* 1992, 84).

> "A nucleus or mass of rock that shows signs of detached piece removal. A core is often considered an objective piece that functions primarily as a source for detached pieces." (Andrefsky 1998, xxii).

The crux of the matter is that cores are understood to be objective pieces from which desired products, flakes or blanks, have been removed. Although such a definition may seem unambiguous, it is important to realise that like all acts of classification it requires an act of judgement or interpretation.

In order to proceed it is first necessary to realise that the 1,000 cores identified differently between my own and the SEP's analysis were most likely categorised by me as flakes rather than cores. The reasoning behind this is that all of the material in the SEP archive is worked flint. Accordingly, those pieces which I did not recognise as cores must have been recorded as something; given that no core tools remained in the assemblage these pieces must by default have been recorded as flakes. Considering this, it is likely that the pieces, which have been identified differently, must be pieces which lie on the classificatory boundary between flakes and cores. Although cores made on nodules are relatively easy to recognise as cores, this recognition is not so easy when dealing with cores that have been made on flakes. In this respect, the assemblage of material under study in the present analysis contains large flakes that have been reworked as cores. Many of these have only a few subsequent removals taken from them. Owing to the generally unsystematic nature of this technology, the exact intentions behind such actions can be hard to read. In such cases, it is very hard to distinguish between a large flake that has had an edge roughly retouched or backed and one that has had a few flakes removed from it with the intent of producing flakes or blanks. In any case, it is likely that neither definition can strictly be termed incorrect leaving the relative merits of each case very much a matter for debate and discourse.

It is suggested that it is in precisely such cases that the majority of differences in identification have occurred and such a possibility should certainly lead us to critically examine the validity of our technological and typological categories (which can often be too rigorous or uni-functional) and the statistical comparability of our data. In this light, a particular problem arises through the narrowing of possibilities that defines the act of classification. This happens as the analytical categories that we use tend to be mutually exclusive. In the case at hand, the artefact under study must be classified as either a flake or a core. As cores and flakes are recorded differently, the artefact must be assigned to one or other category. In addition, such recording is carried out with an eye on subsequent statistical analysis in which it is necessary that 'fuzzy' categories be avoided as they make quantification difficult. Where problems of classification occur there is a tendency to generate increasingly complex definitions. However, this approach may not clarify the situation and still retains the problem of having to fit artefacts within single categories. We can see why this is problematic if we consider a core made on a flake; through its journey along the *chaîne opératoire,* this block of flint has crossed several classificatory boundaries. After removal from a core, it becomes a flake. At some point after this stage, it is picked up again and reworked. If this reworking is minimal, we might classify it as a retouched flake or even a rough core tool, yet at some point through the degree of removals it changes from this category to become a core. From the archaeologist's perspective, at every point these changes are only a transformation in terms of the interpretation of the intentions of the *knapper* by the *analyst.* As the intentions of the knapper concerning the objective piece may have been fleeting, fluid and ill defined, it is problematic to retrospectively apply a single archaeological classification. This situation is worsened when dealing with unsystematic technologies where there are not such clear and embodied traditions concerning how technological acts should be performed. Accordingly, by insisting on mutually exclusive categories we both limit and direct the nature of our understanding. Furthermore, as acts of classification are fundamentally interpretative, there is an inevitable potential for inconsistencies when two different analysts record the same material.

#### 4.1.2.3 Other problems of classification

The preceding discussion has outlined some of the problems associated with the classification of artefacts and it is clear that this area comes to the fore in cases such as this where an assemblage has been reanalysed. These issues are highlighted again with another aspect of the assemblage, this time relating to the classification of broken or complete flakes and cores.

Of the material recorded by the SEP 57% of the flakes were recorded as complete as were 69% of the cores. However, from my own analysis 94% of the flakes were recorded as complete as were 93% of the cores. As before there are obviously major discrepancies between these figures, which need to be accounted for. The first factor is that the figures just mentioned for the SEP data do not come from the SEP archive but from the database created from the archive by English Heritage for application with their Stonehenge GIS database. The significance of this is that within the English Heritage database there are some inconsistencies (e.g. it records 95,746 flakes and 9753 cores rather than 93,777 flakes and 8398 cores recorded in the SEP archive); this means that the figures may not be exact although the difference is significant nevertheless.

As with the previous section it is likely that the discrepancies between my data and the SEP's relate to differences in the categorisation of material. In terms of cores, a particular difficulty lies in the recognition of something as broken or fragmented when its definition is predicated upon the removal of pieces from it. Unless a core is broken along a fault or thermal fracture it is likely that it will break as a conchoidal fracture, which necessarily leave negative flake scars. Under such circumstances, it is hard to know how to differentiate between this type of flake scar and other flake scars which relate to the removals of desired products. As with many issues this recognition is made more difficult by the often-unsystematic nature of core reduction and the heavily patinated and plough-rolled state of the material in the ploughsoil around Stonehenge. In addition, in the absence of careful core preparation it can be difficult to differentiate between a core that has broken during or after use and a core made on a nodule, which was itself, already fragmented or contained natural flaws.

In terms of broken or complete flakes, the situation is slightly different owing to the character of the material. Classification of complete flakes generally relies upon the presence of all major flake attributes such as the butt, bulb and termination. Given that due to the character of the material such flake characteristics are quite consistent, it is generally easy to recognise complete or broken flakes. In this respect, it is important to stress that the definition that the SEP used to categorise flakes as complete is not known as it is not present in the report or archive. For example, it is not known whether hinged and step fractured flakes were classified as complete or not. In my analysis both categories were recorded as complete where as, for example, Andrefsky (1998, 87) suggests flakes with step terminations should be regarded as broken.

Regardless of the SEP's criteria for recognising a flake as complete, differences can still occur in how strictly they are applied. In this respect, it is necessary to consider the normal condition of ploughsoil material, which is generally worn by the effects of weathering and the plough. For the thin and brittle edges of flakes, this can result in edge damage giving the flakes a rolled appearance with rounded and abraded edges. This can make it very difficult to recognise utilised or retouched flakes from edge damaged ones (Section 4.3.9.3; Appendix 1). This is shown by the large differences in the figures for the proportion of utilised flakes within individual sample areas contained in the SEP archive and those recorded by the current analysis. Indeed there is a slight negative correlation between the two sets of figures with sample areas recorded as having high proportions of utilised flakes in the SEP analysis registering low proportions in my own. These differences highlight the difficulties inherent in working with flakes that are badly worn and weathered.

Under such conditions it is not only difficult to recognise certain attributes on a flake but it is also common for small amounts of flakes, particularly edges and terminations to be fractured, abraded and lost. The problem that this creates is that by convention certain attributes such as length, breadth, weight, cortex coverage and flake shape are not recorded on broken flakes as the character of the flake in its original complete state is not known. Accordingly, from such flakes very little information is gained. If my classification of broken and complete flakes had agreed with that of the SEP, these data would not have been recorded for 43% of the assemblage (the proportion recorded by the SEP as broken). The possibility of losing so much information was considered potentially problematic, as the analysis carried out for the current project was conducted on a sub-sample of the assemblage, which is itself a sample of the population of the ploughsoil. Due to this, a decision was made that flakes that were obviously missing only minor portions, such as the tip of a termination, were recorded as complete. This decision was made as it was felt that any inaccuracies incurred would be minor in comparison to the increase in information gained. In addition, in extreme cases where it was difficult to tell whether a piece of flint was a worked flake or not, or where particularly degraded and small chips, chunks or flake shatter were selected by the random sampling process, pieces were returned and another was randomly selected in its place. Importantly the method of selection was applied consistently throughout the project.

Furthermore, differences in the proportions of broken compared to complete flakes is indicated even within the SEP as analysis of material from intensive collection at King Barrow Ridge (W59) recorded 66% of flakes as complete whereas at Fargo Wood I (W32) the figure was 74% (Richards 1990, 116; *ibid.*, 69). Variation between projects conducted in the same landscape is also shown by recent surface collection by Wessex Archaeology (2002), which recorded 77% of flakes from ploughsoil contexts as complete. Lastly and most importantly, for some sample areas, an informal record was kept of all of the cores that did not fall within the sample frame. This indicated that there were significant differences between the tallies for complete and broken cores between my own and the SEP's analysis that were, therefore, unrelated to the sampling process.

Although the differences that have been outlined concerning the numbers of broken and complete flakes and cores are large, an explanation has been put forward. If nothing else, these problems raise issues of the nature of categorisation and problems of the comparability of data from separate projects (c.f. Chapter 7). Such problems are inherent in archaeology and partly derive from the character of the material with which we have to work. Concurrently, the total eradication of such issues is an unlikely goal and the first target must be consistency within rather than between projects; of course, this does not deny the importance of clear definitions of analytical categories to aid comparison. Internal analytical consistency is particularly important when dealing with an assemblage of the size and character of that from the SEP where archaeological analogues are not readily available. In this situation, given the size and spatial extent of the assemblage, there is an inevitable reliance upon analysis of *internal* assemblage *variation* to provide *interpretation* (Section 4.2.1). In this manner, if there is internal analytical consistency, the data thus produced ultimately validates itself. Such consistency has been achieved by the current analysis and this will be stressed by the character of the data that is presented in this and the succeeding two chapters.

## 4.2 The statistical presentation of data

The rest of this chapter outlines the results of the statistical analysis which involved several different techniques directed mainly towards breaking down the large and complex dataset derived from the lithic analysis. Most of the techniques used here are different methods of summarising the basic shape of the data and of recognising differences within this pattern. This approach is mainly orientated towards the analysis of variation between individual sample areas. The reasons behind this approach are outlined below.

### 4.2.1 The search for variation

As was suggested in Section 4.1.2.3, the most important approach to the analysis of the data from the lithic analysis is the search for *internal* variation. It is first necessary to consider why this is the case.

Under normal circumstances, it might be suggested that a fruitful approach would be the comparison between the data from this and other comparable projects. Indeed, this approach is undertaken extensively in Chapter 7, which also shows that whilst significant conclusions can be drawn, they are limited by difficulties of the comparability of data. Limits are also imposed by the general lack of understanding of what lithic scatters in other areas represent. More importantly, the level of analytical detail applied in the recording of the material for this project surpasses that of nearly all comparable landscape surveys. Therefore, comparison with other projects can only ever be partial.

It might also be suggested that an approach based on comparison with data from more detailed analyses conducted upon stratified deposits is possible. However, this approach has been attempted several times, not least by the SEP (Richards 1990, 18) and the South Dorset Ridgeway Survey (Woodward 1991, 14-16); in both cases it was unsuccessful. Two main problems were encountered with this approach. The first was the lack of well-stratified deposits from all of the periods that might be represented in lithic scatters. The second was that when material from such deposits was analysed, the general lack of technological variation between the early and late Neolithic mitigated against the differentiation of ploughsoil assemblages on this basis.

Therefore, it was expected that the most successful approach towards the analysis of the data recorded for this project would be the analysis of variation internal to the assemblage. Given the size of the assemblage and the extent of the landscape from which it was recovered, it was expected that data derived from it could essentially provide its own datum or baseline. In other words, it was expected that isolating elements that varied from the overall character of the data would provide a means to identify variation in the organisation of practice. For example, although it is not possible or reasonable to say how many heavily cortical flakes are required to identify an area as a flint extraction site, this might reasonably be suggested for an area that has twice as many cortical flakes in proportion to all other areas.

Given that the principal aim of the analysis was the detection of internal variation, decisions had to be made concerning how to divide the data for analysis. The most obvious approach when comparing one aspect of an assemblage with another is to orientate divisions according to time and/or space. However, differentiating most ploughsoil material chronologically is essentially impossible. This means that dividing the assemblage in order to make comparisons between its constituent parts must be done on a spatial basis. Accordingly, the majority of the analysis in this chapter concerns comparisons of different parts of the assemblage divided according to the 39 sample areas from which it was originally collected. In this respect, the character of the data for the assemblage as a whole is treated as a kind of datum and variation from this pattern in individual sample areas is assessed.

## 4.3 The statistical analysis of data for flakes

### 4.3.1 Flake weight

As will be seen, the distribution of the weight of flakes is quite typical of all of the metrical measurements from the analysis. In general, there are many similarities between the bar charts for different sample areas and they can be described as one group (Figs. 4.1 and 4.2). The overall shape of the distributions are similar with the peak in nearly all cases at around 10g although in a few cases this peak appears either side at 5g or 15g. In addition, they all have a right skewed distribution and are quite heavily leptokurtic meaning the distributions have long tails, in this case stretching to the right. The length of the tails shows that there is a reasonably high degree of dispersion to the weight of flakes although this dispersion is consistent with the frequency of flakes falling off as the 100g mark is approached. In most cases, there is also a small group of heavier flakes recorded weighing above 100g. The consistent range of flakes of different weights indicates that in all sample areas flakes of a wide range of sizes were produced. This perhaps suggests that a range of activities, from initial extraction to eventual production of nodules, were practiced in all sample areas.

Although not always present, the last consistent feature is the occurrence of a very slight subsidiary mode peaking at around 60g, which can be seen in cases such as Winterbourne Stoke Crossroads (50), Durrington Down (65), The Diamond (59), Well House (83) and Woodhenge (60)(Fig. 4.1). It might be expected that such a subsidiary mode represents a discrete group of flakes from a distinct part of the reduction sequence. In order to assess this possibility the data from the areas in which this pattern occurred were selected and a cross-tabulation between weight and other relevant categories (e.g. amount of cortex, flake scar orientation, flake type etc.) was applied. Unfortunately, this approach did not produce conclusive results and the flakes weighing between 60g-80g did not appear to differ significantly from the remainder of flakes in terms of other attributes. The most obvious option was that these flakes represented groups of heavier flakes involved in the roughing out of cores but this was not the case as they were not more cortical than other flakes. The only slight pattern that was detected was a slight tendency for these flakes to be covered in about 25% cortex and to be classified as side or distal trimming flakes. It is possible that this is what this sub-group of flakes represents, but it must be stressed that the suggestion is only tentative.

The initial impression gained when comparing the distributions shown on the bar charts for flake weight is the high degree of similarity exhibited between the different areas.

This pattern is confirmed by comparison of the mean values and standard deviations for flake weight from individual sample areas (Table 4.1). In considering this, it should be remembered that although the fields that this material was collected from form a coherent block of the landscape around Stonehenge, it still comes from an area measuring roughly 8km x 6km with associated variations in topography and archaeology. Given this, the degree of similarity was initially considered surprising as it had been expected that differences in technological practice could be mapped across such a comparatively large area of the landscape.

However, when considered in more detail the distributions shown by the bar charts can be split into two main groups: those with a smooth distribution curve such as at Stonehenge Triangle (54), The Ditches (77), Fargo Road (63) and North of Cursus (52) form one group (Fig. 4.1). Those with a more fragmentary distribution such as at Lake Bottom (89), Sewage Works (66), Normanton Gorse (61) and Wood End (90) form the second (Fig. 4.2). However, these two groups also share many similarities in shape and dispersion. Closer inspection reveals that the second more fragmentary group is totally comprised of fields from which relatively small amounts of material were collected. The number of flakes recorded from these sample areas was generally less than 100 pieces compared with the hundreds or even thousands of pieces collected from the fields represented in the first group (Table 4.1). This suggests that there are not really two groups at all. Instead, there seems to be a general rule that larger the number of flakes from an area generates smoother and more similar distribution curves. Far from suggesting that the two groups represent two distinct populations (or sets of practices), this suggests that they are both samples of the same population. Where the sample is smaller, it is less representative and therefore the smoothness of the curve begins to fragment and break up.

| Area Name | Area No. | Total No. of Flakes Measured | No. of Complete Flakes | Mean Weight of Complete Flakes (g) | Standard Deviation | Mean Length of Complete Flakes (mm) | Standard Deviation |
|---|---|---|---|---|---|---|---|
| Winterbourne Stoke Crossroads | 50 | 838 | 788 | 26.4 | 25.3 | 46.3 | 16.1 |
| Coneybury Hill | 51 | 1448 | 1315 | 22.2 | 21.3 | 42.8 | 13.5 |
| North of Cursus | 52 | 2148 | 2047 | 22.2 | 21.3 | 44.2 | 15.1 |
| Stonehenge Triangle | 54 | 1714 | 1566 | 18.6 | 18.6 | 42.8 | 14.6 |
| South of Stonehenge | 55 | 398 | 375 | 24.5 | 31.8 | 46.1 | 14.3 |
| Normanton Down | 56 | 94 | 87 | 23.9 | 20.7 | 46.9 | 12.7 |
| King Barrow Ridge | 57 | 834 | 788 | 20.6 | 17.8 | 44.7 | 12.8 |
| The Diamond | 59 | 751 | 696 | 23.7 | 24.4 | 47.3 | 15.8 |
| Woodhenge | 60 | 580 | 545 | 25.2 | 22.0 | 43.2 | 13.7 |
| Normanton Gorse | 61 | 90 | 82 | 18.7 | 19.5 | 44.0 | 14.6 |
| Cursus West End | 62 | 608 | 579 | 19.9 | 16.9 | 42.1 | 13.2 |
| Fargo Road | 63 | 770 | 724 | 20.2 | 19.2 | 44.0 | 14.2 |
| Horse Hospital | 64 | 594 | 555 | 22.5 | 20.6 | 46.7 | 14.4 |
| Durrington Down | 65 | 631 | 612 | 23.7 | 21.3 | 45.6 | 14.4 |
| Sewage Works | 66 | 116 | 113 | 21.8 | 21.8 | 43.0 | 15.6 |
| Normanton Bottom | 67 | 481 | 452 | 24.6 | 27.8 | 45.2 | 15.9 |
| West Field | 68 | 771 | 733 | 22.6 | 19.1 | 44.5 | 13.8 |
| King Barrow Ridge East | 69 | 513 | 475 | 21.8 | 26.4 | 41.4 | 14.2 |
| Nile Clump | 70 | 261 | 248 | 19.2 | 16.9 | 41.9 | 13.2 |
| Railway | 71 | 676 | 612 | 20.7 | 21.6 | 42.1 | 13.8 |
| Home Fields | 72 | 716 | 667 | 20.7 | 20.9 | 40.3 | 12.9 |
| Whittles | 73 | 178 | 166 | 20.2 | 21.7 | 39.9 | 13.5 |
| Pig Field | 74 | 110 | 105 | 21.6 | 19.0 | 43.4 | 13.2 |
| Bunnies Playground | 75 | 302 | 279 | 19.8 | 18.1 | 43.8 | 13.8 |
| Destructor | 76 | 116 | 108 | 19.5 | 20.1 | 42.0 | 14.8 |
| The Ditches | 77 | 523 | 492 | 18.0 | 20.6 | 40.6 | 15.6 |
| Spring Bottom | 78 | 1147 | 1047 | 21.0 | 19.5 | 41.1 | 13.9 |
| Aerodrome | 79 | 172 | 163 | 16.9 | 17.6 | 40.4 | 12.3 |
| Ammo Dump | 80 | 139 | 135 | 20.1 | 22.9 | 42.3 | 16.9 |
| King Barrow Ridge Addit. | 81 | 99 | 90 | 21.9 | 19.5 | 41.7 | 11.9 |
| Rox Hill | 82 | 845 | 804 | 26.0 | 25.3 | 45.2 | 14.9 |
| Well House | 83 | 250 | 242 | 49.7 | 58.8 | 58.7 | 22.4 |
| Luxenborough | 84 | 360 | 336 | 22.3 | 28.4 | 43.2 | 15.9 |
| South of Cursus | 85 | 106 | 94 | 25.3 | 23.7 | 44.9 | 13.0 |
| Rox Hill (unsown) | 86 | 467 | 445 | 24.0 | 23.1 | 41.9 | 14.0 |
| New King | 87 | 385 | 326 | 16.0 | 17.0 | 38.2 | 13.4 |
| Normanton East | 88 | 329 | 301 | 22.9 | 20.9 | 44.9 | 14.6 |
| Lake Bottom | 89 | 44 | 38 | 23.1 | 24.0 | 44.1 | 12.3 |
| Wood End | 90 | 93 | 85 | 20.3 | 18.0 | 44.4 | 14.3 |
| Total | - | 20697 | 19315 | - | - | - | - |
| Mean | - | - | - | 22.2 | 22.8 | 43.7 | 14.7 |

Table 4.1: The mean weights, lengths and standard deviations of flakes per sample area.

Despite the degree of homogeneity between areas in the bar charts for weight, one area has a very different character. Well House (83) is a relatively small collection area containing a particularly high density of material and is located on the slopes of a dry valley in the south of the study area. The unusual character of the material in this area was evident during the lithic analysis and will be returned to repeatedly. The data for flake weight shows clear differences with the material from the other sample areas (Fig. 4.2; Table 4.1). Although the distribution of material is comparable for flakes under 50g, there is a clear emphasis towards heavier flakes. The previously mentioned slight subsidiary mode at around 60g is exaggerated at Well House (83) showing a higher proportion of flakes of this weight. Even more striking is the amount of flakes weighing more than 100g, which as a category form the highest peak on the chart.

This clearly indicates that at Well House (83) there is a much higher proportion of heavier flakes than in other areas. The analysis of cores indicates that this pattern partly relates to the large size of nodules and concurrently cores in this particular part of the landscape (Section 5.2.1). Whether facilitated by the character of the raw material or not, the data for flake weight also show that there was a generally different approach towards the reduction of nodules at Well House (83) than in other areas.

### 4.3.2 Flake length and breadth

Although there is slightly less uniformity than with flake weight, there are still many similarities between the data for flake length and breadth from different sample areas (Table 4.1; Figs. 4.3 and 4.4). In general, the data for flake length and breadth are more normally distributed than flake weight although they are still slightly right skewed. They are also less leptokurtic than the data for weight indicating a tendency for a more central distribution with less dispersion. The peak for flake length nearly always lies at either 40mm or 45mm whilst the peak for flake breadth lies at 30mm or 35mm. This indicates the general predominance of broad flakes.

As with flake weight there is also the tendency for the more fragmentary distributions to be derived from those sample areas where relatively few flakes were collected. Hence, some of the same sample areas used in Figs. 4.1 and 4.2 are presented again here and the differences between the smoothness of the distribution curves are as evident for flake length and breadth as for flake weight (Figs. 4.3 and 4.4).

Although there is slightly less homogeneity for flake length and breadth than for weight, the data from Well House (83) still stand out. This is to be expected as there is an obvious relationship between flake weight, length and breadth. At Well House (83) there is a clear group of longer flakes and as well as a tendency for slightly broader flakes (Figs. 4.3 and 4.4). As reflected in the large group of flakes above 100g there is also a significant group of material of a higher length and breadth than witnessed in other sample areas.

4.3.3 Length:breadth ratios

The length:breadth ratios for individual flakes have also been calculated and histograms of the frequencies of these ratios have been produced for individual sample areas. As they involve the ratio of both length and breadth, length:breadth ratios do not give an indication of the size of flakes but of their basic morphology. The shape of the data for this attribute show marked similarity to the other metrical attributes in terms of distribution but mostly in terms of the similarity between sample areas. In particular, the histograms show the most likeness to the data for flake weight as the distributions are right skewed and leptokurtic (Fig. 4.5). In most cases, the peak of the distribution is at a length:breadth ratio of around 1.2, indicating the domination of broad flakes. The right tails of the distributions, which relate to the ratios of more elongate flakes, peter out at a ratio of around 3.0 or above although there is some variation within this pattern. As with flake weight there are also a few cases with a slight subsidiary mode, which at Aerodrome (79), Ammo Dump (80), South of Stonehenge (55), The Ditches (77), Nile Clump (70), Pig Field (74) and Well House (83) appears at a length:breadth ratio of around 2.6 (Fig. 4.5). It should be noted that of these areas Aerodrome (79), Ammo Dump (80) and Pig Field (74) are represented by comparatively small assemblages. Indeed, as is the case with the previous attributes, there is a tendency for the relatively unusual distributions to come from areas with small assemblages. These are represented by what appear to be fragmentary versions of the distributions of material from other areas (compare Fig 4.2 and Fig. 4.5).

The presence of a slight subsidiary mode at a length:breadth ratio of 2.6 indicates the presence of blade-proportion flakes in certain areas. However, flakes of these proportions can be produced unintentionally from even *ad hoc* reduction strategies so their presence cannot be taken as evidence of blade production *per se*. Furthermore, length:breadth ratios only give a broad assessment of flake morphology and therefore, whilst these flakes are relatively long and thin, they are not necessarily regularly shaped blades (i.e. roughly parallel sided elongate flakes). An alternative record of the presence of blades was made during the analysis, which took into account their overall morphology as well as the ratio between their length and breadth (Sections 4.3.9.4 and 6.4.3.1). This indicates that those areas with relatively high proportions of blades are not necessarily the same as those that have been identified here as having a slight subsidiary mode representing flakes with a length:breadth ratio of around 2.6. Hence, it is likely that the pattern referred to here does not relate to areas where focused blade production occurred rather than the unintentional production of slightly elongate flakes during other types of core reduction.

In the assemblage as a whole the data for length:breadth ratios indicates a dominance of broad flakes. This is also indicated in comparison to other assemblages from excavated sites. For example, 41% of flakes from the Early Neolithic assemblage from primary contexts at Windmill Hill had length:breadth ratios equal to or greater than 2.5 (Smith 1965, 90; Wainwright and Longworth 1971, 162). At the Late Neolithic site excavated by Smith (1965) at the West Kennet Avenue the proportion is 21%, whilst amongst the material excavated from the Southern Circle at Durrington Walls the figure is 11% (Wainwright and Longworth 1971, 162). These figures indicate the general shift from narrow to broad flakes between the earlier and later Neolithic. In this respect, the assemblage from the SEP is even more dominated by broad flakes with only 3% of flakes having length:breadth ratios equal to or greater than 2.5. This gives a potential, though extremely tentative, suggestion of the chronology of the ploughsoil assemblage (Section

8.3) and also indicates the relative dominance of a broad flake producing technology within the material from the Stonehenge Environs.

4.3.4 Flake cortex coverage

In keeping with the attributes already mentioned the bar charts for flake cortex coverage exhibit a degree of similarity, although not to the same extent. In nearly all cases the proportion of flakes in each category decreases inversely to the amount of cortex covering the dorsal surface of the flake. In other words, there are more flakes with 0% cortex than there are with 25% cortex, more flakes with 25% cortex than there are with 50% cortex and so on (Table 4.2). This patterning is as expected as cortex is found only on the outer surface of a flint nodule. This not only means that a small proportion of a nodule is comprised of cortex but also that the productive phase of a core occurs only after its removal.

| Cortex Coverage Category | Minimum Proportion of Assemblage | Maximum Proportion of Assemblage | Difference Between Minimum and Maximum |
|---|---|---|---|
| 0% | 39% | 65% | 26% |
| 25% | 10% | 35% | 25% |
| 50% | 6% | 17% | 11% |
| 75% | 4% | 17% | 13% |
| 100% | 1% | 12% | 11% |

Table 4.2: The minimum and maximum proportions of each category of flake cortex coverage from individual sample areas.

In terms of cortex coverage, some sample areas exhibit significant differences from the typical pattern (Fig. 4.6). Several areas have a high percentage of flakes with a low proportion of cortex on their dorsal surface. Wood End (90) has a high proportion of flakes with 0% cortex though surprisingly a relatively small amount of flakes with 25% cortex. Normanton Gorse (61) is one of the most unusual areas with the highest proportion of flakes with 0% cortex as well as the lowest proportion of flakes with 25% and 100% cortex. Bunnies Playground (75) has a high proportion of flakes with 0%

cortex and a correspondingly low percentage of flakes with >50% cortex. At the other end of the scale, several sample areas also have a relatively large amount of flakes with high proportions of cortex. Woodhenge (60), Nile Clump (70) and Cursus West End (62) all have a high proportion of flakes with >50% cortex. Within this group Nile Clump (70) has the highest proportion of flakes with 100% cortex, whilst Cursus West End (62) has the lowest proportion of flakes with 0% cortex. Whilst these previous two groups of areas exhibit biases towards flakes with either a large or a small amount of cortex two areas stand out for different reasons. In general there seems to be a close positive correlation between the different categories of flakes with >50% cortex but at Sewage Works (66) despite the highest proportion of flakes with 75% cortex from all of the sample areas there is a small proportion of flakes with 100% cortex. Equally unusual is the situation at Well House (83) where despite there being one of the highest proportions of flakes with 0% cortex there is also one of the highest percentages of flakes with 100% cortex.

In light of the discussions of the previous attributes, it is apparent that there is a lesser degree of homogeneity apparent in the data for cortex coverage. However, the extent of this variation is still relatively limited. For example, no sample areas produced assemblages dominated by heavily cortical flakes. Therefore, no sample areas had assemblages that would be expected from specialised 'industrial' activities such as the primary extraction and initial roughing out of cores of the type suggested by the SEP (Richards 1990, 18-9). Instead, whilst aspects of variation have necessarily been stressed here, the relative proportions of the different classes of flake cortex coverage are reasonably consistent between different sample area assemblages. This tends to suggest the presence of the full range of reduction sequence within each sample area rather than a landscape divided according to 'industrial' or 'domestic' activities. Furthermore, there seems to be little spatial patterning to those areas that do differ from the norm. None of these sample areas is adjacent or form coherent blocks of the landscape. Another factor worth considering is that as with previous attributes some of the sample areas which show unusual patterning are those from which relatively few flakes were collected. This is the case at Wood End (90), Sewage Works (66) and Normanton Gorse (61). However, it must be stated that unlike the previous attributes there are still several areas showing unusual character that cannot result from the collection of a relatively small assemblage.

4.3.5 Flake scar orientation

The flake scar orientation attribute records the direction of the flake scars, which are the negative impressions of previous removals, remaining on the dorsal surfaces of a flake. With this information, it is possible to assess to some extent the character of core reduction. For example, single platform cores will produce mainly flakes with flake scars running in one direction following the axis of the flake, whilst bifacial working of a core tool will produce debitage with flake scars running in multiple directions. Equally, the difference between single and multi platform cores is shown by the directions of flake scars witnessed on the dorsal surface of flakes.

The relative proportions of the two most common flake scar categories in the assemblage reaffirm the relationship between the directions of flake scars on flakes and the types of cores from which they are produced (Table 4.3). The cores will be the subject of discussion in the next chapter but suffice to say that the most common types of cores are those with single platforms followed by those with two and then three platforms (Table 5.3). This pattern concurs with the proportions of flake scar categories in that the most common category are flakes with scars running only in the direction of the removal of the flake (mostly equated with single platform cores). The second most common category, flakes with scars running at right angles, correlates with the high proportion of rotated cores with two or more platforms. Given that the different types of cores are more equally represented (c.f. Table 5.3), it is surprising that flakes with scars running only in alignment with the flake are so dominant in relation to those with scars running at right angles to the direction of the removal of the flake. However, it should be realised that after rotation of a core only the initial flakes removed will bear flake scars from flaking surface created by the previously used platform. After these removals, a new flaking surface will have been created. Hence, even after core rotation most flakes will still only have scars running in the same direction as the axis of the flake.

| Flake Scar Orientation Category | Minimum Proportion of Assemblage | Maximum Proportion of Assemblage | Average Proportion of Assemblage |
|---|---|---|---|
| 0 (indeterminate) | 4% | 20% | 9% |
| 1 (same axis as striking platform) | 61% | 76% | 70% |
| 2 (opposed: 2directions) | 0% | 9% | 3% |
| 3 (right angle to axis of flake) | 4% | 20% | 13% |
| 4 (multiple directions) | 0% | 9% | 4% |
| 5 (opposed: 1 direction) | 0% | 4% | 1% |

Table 4.3: The minimum, maximum and mean proportions of each category of flake scar orientation from individual sample areas.

Beyond indeterminate flakes and the categories that have already been discussed (categories 1 and 3 in Table 4.3) the remaining categories of flake scar orientation only form a small percentage of the assemblages. Few flakes have flake scars running in an opposed direction. These flakes are similar to those with flake scars running at right angles to the axis of the flake (category 3 flakes), in that both are normally representative of attempts to rejuvenate cores by rotation. The difference is that the turning of a core 180° in order to rejuvenate it is more characteristic of a considerate and careful core reduction strategy that is particularly witnessed on blade cores. With this type of core, where even-sided elongate flakes were being produced, the advantage of this technique is that the flaking surface does not need to be prepared again as the crests remaining on the previous one can still be used to guide further removals from the opposite end of the core.

Equally, few flakes show signs of flake scars running from multiple directions. Such flakes are probably most characteristic of bifacial working such as core tool reduction. The low occurrence here is in keeping with the general lack of material suggestive of bifacial reduction. As Neolithic flint axes are produced through bifacial reduction, the suggestion is that there are no sample areas within the survey where specialised axe production was prevalent. The recording of flake type backs this up, as thinning and finishing flakes (by-products of biface manufacture) are only present within the assemblage in very small numbers (Sections 4.3.9, 6.2.6 and 8.2.3).

The data in Table 4.3 give some idea of the level of homogeneity present in the assemblage. For the most part the bar charts for individual sample areas concur with this (Fig. 4.7). There are similar proportions of flakes with the different flake scar categories between quite widely spread areas, assemblages of different sizes and sample areas with quite different densities of surface flint.

Of course, this does not mean that there some area do not differ from this pattern. As we have seen with several other attributes, the data from Well House (83) for flake scar orientation are slightly unusual. In particular, there is quite a high proportion of flakes in the indeterminate category, the category for flake scars running in the same direction as the axis of the flake and for opposed flake scars (Fig. 4.7). There are also correspondingly small proportions of material with flake scars at right angles to the axis of the flake.

In light of the results from other aspects of the analysis, it is likely that the high proportion of indeterminate flakes at Well House (83) is connected with the high proportion of flakes with 100% of their dorsal surface covered in cortex (Section 4.3.4). In addition, the technology at Well House (83) is generally more controlled and systematic with more single platform cores, which correlate here with the high proportion of flakes with uni-directional flake scars. Furthermore, the high proportion of flakes with flake scars running in opposed directions may perhaps indicate that these single platform cores were sometimes rejuvenated by rotating them 180°. At Well House (83), there is also the lowest incidence of flakes with flake scars running at right angles to the axis of the flake. Unlike the previous example of core rotation, these are flakes indicative of the process of easy but uncontrolled core rejuvenation. Therefore, the lack of these flakes here points to a different approach towards core rejuvenation and probably platform maintenance than in the majority of areas covered by the SEP. Similar patterns are also found at The Ditches (77), an area that shares much in common with Well House (83) (Section 5.6.2.2).

The area producing the most unusual data for flake scar orientation is Lake Bottom (89) (Fig. 4.7). In the assemblage from this area only three of the six categories of flake scar orientation are represented. However, it must be noted that as with several of the previous attributes, this unusual distribution occurs in an area from which very few flakes have been collected. Indeed this area yielded the fewest flakes out of all the sample areas in the Stonehenge Environs Project (Table 4.1).

Although, category 1 flakes represent the highest proportion of flakes in all sample areas, there tends to be more variation between sample areas in the proportion of category 3 flakes. As already mentioned this category represents flakes with flake scars running at right angles to the direction of the flake. There are particularly high proportions of these flakes at Bunnies Playground (75), Rox Hill Unsown (86), Winterbourne Stoke Crossroads (50) and Wood End (90) (Fig. 4.7). Of these areas only Bunnies Playground (75) has a particularly small assemblage. This area also has the lowest proportion of category 1 flakes. It is noticeable that a relatively high proportion of category 3 flakes, representing rotation of cores, does not necessarily accompany low proportions of category 1 flakes, which represent single platform reduction. Indeed the four areas, which have just been mentioned, are evenly split with the first two having a low proportion of category 1 flakes whilst the latter two sample areas have average percentages of category 1 flakes. However, the occurrence of relatively high proportions of category 3 flakes does provide evidence of core rotation. In this assemblage, this type of core rotation is generally the product of unsystematically worked multi-platform cores.

### 4.3.6 Termination type

#### 4.3.6.1 The relationship between termination types and efficiency

In the present analysis, four termination types have been recorded; feathered, stepped, hinged and plunging (Plate 61). The shapes of the terminations or distal ends of flakes are mainly determined by the angle between the flaking surface and platform, the angle of the blow and the force with which it is struck (Andrefsky 1998, 28). It is generally understood that removal of flakes that have been struck in the desired fashion will result in flakes with feathered terminations. Equally, the other categories of terminations are often thought to be undesirable, the products of mishaps during the reduction process (e.g. Crabtree 1968; Karimali 1994, 224-5; Torrence 1986, 161; Durden 1995, 418). Striking a core with too little force, or after loss of the flaking angle, tends to produce flakes that end in step or hinge fractures, whilst too harsh a blow tends to create flakes with plunging terminations. All three of these possibilities can be seriously problematic. Hinge and step fractures can create unwanted ledges on the flaking surface, which can have the effect of increasing the flaking angle or of receding the platform edge, both of which tend to lead to a recurrence of the problem. In the worst cases this can lead to the total loss of the striking angle making further working of a platform impossible. The effects of plunging terminations can be equally deleterious. The extent of the 'plunge' depends upon the strength of the blow and how deeply into the platform the blow is struck. Flakes that plunge deeply into the core can actually remove large parts of a core's opposite end, again potentially making a core unworkable.

For the reasons just outlined, stepped, hinged and plunging terminations are often thought of as undesired 'accidents' in lithic analysis. This has been taken to the extent that in some cases the frequencies of these terminations have been used as measurements of the level of skill or specialisation represented in an assemblage (Karimali 1994, 224-5; Torrence 1986, 161; Durden 1995, 418). However, the use of such an approach should be treated with some caution. Firstly, there is no universal scale of reference that can equate a certain percentage of termination 'accidents' with a certain level of skill. The ease with which a material is worked depends on the interplay between the chosen method of reduction, the ability of the knapper and the qualities of the material that is being worked. Therefore, it is not just the skill of the worker that is at play. Perhaps more importantly, it should be realised that the whole process of equating termination types with skill levels implies a 'natural' tendency in the past to strive towards the highest levels of skill possible in technological practice. This certainly is enshrined in the principle of efficiency and the maximisation of profits for the minimisation of cost, which enshrined in the ecological approach advocated by Torrence (1986). Based upon a purely functional understanding of technology, her approach assumes that it will naturally evolve, improve and become more efficient over time. The point that this was not the case in the past is adequately made in the assemblage currently under consideration that is derived from a period during which the quality of craftsmanship within most lithic technology declines considerably. We do not need to see this as part of the rise of other competing and superior forms of technology (such as bronze), so much as understanding it as a period of great change for the roles within society that the practice of these technologies played. Given that the practice of technology is heavily implicated in the daily reproduction of society, there is no reason to elevate functional understandings of technology above all others.

Cores *were* worked very differently in the Early Neolithic than the Early Bronze Age. However, the lack of control exerted over the reduction of cores typical of the latter period cannot be simply equated with a loss of skill levels. The appearance in the Late Neolithic of elaborately retouched tools and the levallois technique indicates that these skills were still possessed by some. It may not be so much the loss of skill as the loss of the everyday contexts of performance that is of significance. Clearly, over this period there were not only changes in the shapes of cores produced but also in understandings of the ways in which things should be done. Accordingly, we should look to see which aspects of social reproduction affected or were affected by this shift in *habitus* (Bourdieu 1977). In this respect, it is important to realise that any loss in the quality of craftsmanship in lithic technology during the Late Neolithic and Early Bronze Age relates to much more than just changes in the amount of care taken in striking a core. It also involves differences in ideas of the number of platforms that should be used; in how prepared they should be, in whether surface or quarried flint should be used and ultimately in the type of end products that were being worked towards. Thus, to equate the incidence of hinged or plunging terminations with a certain level of skill is to misunderstand the extent to which technology is embedded in all spheres of life. Therefore, any alterations in technological practice are inextricably linked to alterations in all areas of social life and *vice versa*; the understanding of one must be a contemplation of the other.

In this light, it should be realised that notions of hinged and plunging terminations as 'accidents' depend greatly on the character of the reduction sequence. Those accounts that have advocated this idea (Crabtree 1968; Karimali 1994, 224-5; Torrence 1986, 161) tend to be concerned with highly formalised technologies such as obsidian prismatic blade production. Within such technologies, it is essential to maintain a cylindrical core with long uniform, parallel-sided ridges, which are used to guide subsequent removals (Crabtree 1968). Therefore, the occurrence of hinge, step or plunging terminations can be seriously problematic often resulting in the abandonment of the core. However, within other technologies such as the unsystematic multi-platform reduction that occurs within the Stonehenge Environs the occurrence of such features can easily be followed by rotation of the core and continued production. In this respect, there is less of a necessity to avoid such problems in the first place meaning that less care needs to be taken to prevent them from happening. The occurrence of such features does not necessarily indicate a lack of skill, as it is much less of an issue in the first instance.

On a more practical level, it should also be realised that the occurrence of certain termination types should not necessarily be correlated with 'undesired' products. In particular, the production of flakes with plunging terminations may be deliberate for a number of reasons. Sometimes a flake might be required to plunge into a core intentionally to remove an unwanted feature such as a section of an opposing platform (Inizan *et al.* 1992, 93; Plate 58). Perhaps more common is the desire to produce flakes with slightly plunging profiles (and therefore thicker distal ends) for the production of tools such as scrapers. In such cases, the production of plunging flakes is certainly desired and requiring of more rather than less skill.

Accordingly, in the present analysis the occurrence of certain termination types are not taken to be direct measurements of the level of skill in an assemblage. Alternatively, like many other attributes they are considered as an additional means of characterising an assemblage. The significance of relative proportions of different termination types can only be properly considered in relation to other supporting aspects of the assemblage.

4.3.6.2 Spatial variation in termination types

From the data presented so far, a familiar pattern of general homogeneity with some subtle differences has begun to emerge and the situation is no different when considering termination type. The basic proportions of the different categories for termination type are presented in Table 4.4 and the majority of sample areas vary little from the mean proportions for each category (Fig. 4.8). As is to be expected by far the most common category of termination type in all sample areas is feathered. The second largest category is hinged terminations whilst both stepped and plunging terminations make up minor, often negligible, proportions of the material.

| Termination Type Category | Minimum Proportion of Assemblage | Maximum Proportion of Assemblage | Mean Proportion of Assemblage |
|---|---|---|---|
| 0 (Indeterminate) | 1 % | 12 % | 3 % |
| 1 (Feather) | 58 % | 87 % | 80 % |
| 2 (Step) | 0 % | 5 % | 2 % |
| 3 (Hinge) | 5 % | 21 % | 13 % |
| 4 (Plunging) | 0 % | 7 % | 2 % |

Table 4.4: The minimum, maximum and mean proportions of each category of Termination Type from individual sample areas.

As has been the case with previous attributes there are some sample areas with slight differences from the average distribution. In particular, Ammo Dump (80), Horse Hospital (64), Lake Bottom (89) and South of Cursus (85) have relatively high proportions of flakes with feathered terminations (Fig. 4.8). Within this group Lake Bottom (89) and South of Cursus (85) have the highest proportion of feathered terminations of all of the sample areas. In the case of the latter, this is complimented by the lowest proportion of hinged terminations. Within the aforementioned group, there is also little pattern in respect to the proportions of the other categories of flake termination. However, in all cases there is a below average proportion of flakes with hinged terminations, at Pig Field (74) there is also a high proportion of flakes with plunging terminations.

In reverse to the last observation, at Normanton Gorse (61), Rox Hill (82), South of Stonehenge (55), Whittles (73) and New King (87) high proportions of hinged terminations are found alongside lower proportions of feathered terminations (Fig. 4.8). In all of these cases, except at New King (87), there are average proportions of both stepped and plunging termination types. It is New King (87) which has the most unusual assemblage, not only does it have a high proportion of hinged terminations but also the lowest proportion of feathered terminations by over 10% and the highest proportion of both stepped and plunging terminations. This would normally be taken to indicate a lack of core control or pre-determination of flake shapes in relation to other areas. However, this is not the expected pattern at New King (87) as this area produced relatively elongate flakes with a high length:breadth ratio as well as cores of more systematic character than most other areas (Section 5.6.2.2). It is possibly that this unusual pattern is due to the shape of the New King (87) sample area. For unknown reasons, this is actually comprised of two spatial discrete areas, which are separated by 100m or more (Plate 1). Accordingly, it is possible that the apparently contradictory features of the technology from this sample area relates to two different forms of technology being practiced in two distinct areas (Section 6.1.1).

It has been noted with previous attributes that sample areas with untypical assemblages are often those that yielded relatively small amounts of flint. In light of this relationship it should be mentioned that, for termination type, of the ten sample areas highlighted as being unusual, six come from the bottom twelve areas in terms of the amount of flint collected. These areas are Ammo Dump (80), Lake Bottom (89), Pig Field (74), South of Cursus (85), Normanton Gorse (61) and Whittles (73). However, it should also be noted that New King (87), the area with the most unusual proportion of termination types, is not one of these areas.

### 4.3.7 Flake class

Flake class is a method of flake classification first suggested by Gingell and Harding (1981) that records the relationship between "the point of percussion and any dominant crests on the face of the core" (*ibid.*, 76). The significance of recording this attribute lies in the fact that the crests on the face of a core guide the force of a removing blow as it travels through the core. Hence, the relationship between the placement of the blow and the ridges can predict and determine the morphology of the resultant flake. Concurrently the flake class attribute provides information on two related issues: on the one hand, it records information on the broad morphology of flakes, on the other, it records the regularity (or lack of) with which blows are struck on the platform in relation to flake scar ridges. Accordingly, this latter point means that the attribute provides some measurement of the degree of care taken to control the shapes of flakes by the careful placement of blows on the platform.

| Flake Class Category | Minimum Proportion of Assemblage | Maximum Proportion of Assemblage | Mean Proportion of Assemblage | Standard Deviation |
|---|---|---|---|---|
| 0 (Indeterminate) | 1 % | 12 % | 4 % | 2.08 |
| 1 (Point of percussion behind a crest) | 14 % | 36 % | 25 % | 5.68 |
| 2 (Point of percussion to one side of a crest) | 9 % | 39 % | 22 % | 6.83 |
| 3 (Point of percussion between two ridges) | 1 % | 20 % | 10% | 4.75 |
| 4 (Uncrested/flat/cortical) | 15 % | 66 % | 40% | 12.97 |

Table 4.5: The minimum, maximum, and mean proportions and standard deviation of each category of Flake Class from individual sample areas.

4.3.7.1 Flake class category 4

Unlike the other attributes, which have already been discussed, there seems to be a considerable degree of variation between sample areas in terms of the proportions of different flake class categories (Figs. 4.9 and 4.10). This in itself is unproblematic as it is through the analysis of variation that interpretation is expected to proceed. However, the degree of variation, as measured by standard deviation (a measurement of dispersion), is not evenly distributed between categories (Table 4.5). As can be seen, the degree of dispersion of individual flake class categories is biased towards category four. In other words, there is much more variation between individual sample areas in the proportions of category 4 material than there is for any of the other categories (Figs. 4.9 and 4.10). As this level of variation is not present in any of the variables discussed previously, it warrants some further consideration.

According to Gingell and Harding (1981, 76) category 4 material represents flakes that are uncrested, having a flat or cortical dorsal surface. In this sense, they are essentially flakes for which the relationship between ridge and point of percussion cannot be recorded because it does not exist. However, there is a slight problem with the definition of this category; where as the other categories of flake class refer to one specific category of flake, category 4 refers not only to cortical flakes but also to flakes with flat dorsal surfaces. In addition, there may be varying reasons why the dorsal surface of a flake may be flat. Accordingly, unlike the other categories, category 4 tends to lump different types of flakes together meaning that a high incidence of this category may represent several different possibilities. Unfortunately, this is not a problem that Gingell and Harding (1981) address but considering the wide variation in the proportions of this material and considering the extent to which it dominates the assemblages from many sample areas it needs some explanation here.

The first factor to note is the data presented by Gingell and Harding (*ibid.*) in the paper where they first presented this method of classification. The data they present vary chronologically coming from three sites; Windmill Hill (Early Neolithic), Dean Bottom (Early Bronze Age) and Bishops Cannings Down (Middle Bronze Age) (Plate 53). As suggested, flake class is closely related to flake morphology and by comparing their classifications with length:breadth ratios, the flake class data is shown to follow the accepted diachronic shift from narrow to broad flakes (*ibid.*). In other words, flake classes that generally produce broader flakes become more common over time (Plate 53). Significant within this shift is that these classes are category 3 flakes (with the point of percussion between two ridges) and category 4 flakes, which as they are unridged, tend to produce short broad flakes. Comparison between Plate 53 and Figs. 4.9 and 4.10 shows that the data presented by Gingell and Harding is broadly comparable with some of that presented here and that in their data category 4 material also represents a reasonably large proportion. However, the latter category is the largest in only one of their three examples and in that case only by a minimal degree. None of the examples shows anything like the proportions of this material that are witnessed in many areas within the Stonehenge Environs such as Destructor (76) or Horse Hospital (64) (Fig. 4.9).

The reason behind these observed differences maybe manifold. Firstly, the higher proportion of category 4 flakes in the material from the Stonehenge Environs may indicate more numerous flakes with cortical dorsal surfaces than in the sites presented by Gingell and Harding (*ibid.*). However, they also note that these flakes may also represent flakes with unridged dorsal surfaces and that these may result from flattened core faces resulting from a loss of knapping control (*ibid.*, 76). In this light it should be noted that the analysis of the material from the Stonehenge Environs has revealed a high proportion of flakes from rotated cores which consequently have flake scars and therefore ridges running at right angles across their dorsal surface. These flakes are necessarily assigned to category 4 as the point of percussion is neither behind nor to one side of a ridge but at right angles to it. In addition, the method of core reduction is best characterised as unsystematic and *ad hoc*. There are also many cores abandoned after only a few poorly controlled removals, which as Gingell and Harding (*ibid.*) suggest, promotes the production of category 4 flakes with unridged dorsal surfaces.

The above suggestion can be backed up by reference to cross-tabulation of different flake attributes. Cross-tabulation of flake class and cortex coverage confirms that compared to other types, category 4 flakes are more likely to be covered in high proportions of cortex. If not heavily cortical they are also more likely to have flake scars running at right angles or in multiple directions across the dorsal surface. However, despite these trends, there is still a large proportion of flakes that cannot be explained in this way.

The data from these cross-tabulations is equivocal but they do indicate that about half of all category 4 flakes result from either the presence of heavy cortex on their dorsal surface or are derived from rotated cores. The suggestion is that the high proportion of these types of flakes in the Stonehenge landscape is symptomatic of the common occurrence of cortical flakes, rotated multi-platform cores and equally of the associated unsystematic and uncontrolled nature of the reduction sequence.

In addition to the explanation above, it can be shown that the relationship between flake class and flake morphology is maintained in the current analysis. In Fig. 4.9, it can be seen that those categories which are supposed to produce the longest flakes (categories 1 and 2) have the highest mean length:breadth ratios. Equally, category 3 and 4 flakes perform as expected in that they produce the broadest of flakes. The maintenance of this relationship and the results of the cross-tabulation indicate that the unexpected proportions of the data for this attribute are not the result of differences in classification. Therefore, the results presented here are suggested to be significant.

4.3.7.2 Spatial distribution of flake class data

In the proceeding discussion some of the data for flake class has already been presented, it is now necessary to reveal it in more detail. Category 4 flakes are the most common within the overall assemblage representing 37% of all material (Fig. 4.9). However, there is considerable variation between the relative proportions of material from individual sample areas. Visual comparison of the bar charts of this data indicate two main groups:

1) The first group is similar to the shape of the data for all flakes and the data presented by Gingell & Harding (1981) (Fig. 4.9 and Plate 53). They have more category 1 flakes than category 2 and more category 2 flakes than category 3 flakes and varying amounts of category 4 flakes. This broad group consists of 29 of the 39 sample areas, however, there is also considerable variation within this group. In particular, there is major variation in the proportions of category 4 flakes. At one end of the spectrum, there are areas that are dominated by category 4 flakes such as at Destructor (76), Lake Bottom (89) and South of Cursus (85) (Fig. 4.9). The other end of the spectrum has assemblages where the longer flake classes (1 and 2) represent a higher proportion of the material (Fig. 4.9). Within this latter group, the areas most dominated by the longer flake categories are Woodhenge (60), The Diamond (59), Cursus West End (62) and King Barrow Ridge (57).
2) The second group is comprised of assemblages where there are more category 2 than category 1 flakes although the relative proportions of the other categories are similar (Fig. 4.10). Category 4 flakes represent the highest proportion of flakes in all of the examples in this group, which can be characterised by the comparative dominance of flakes produced without the intentional placement of blows necessary to produce

elongate flakes. Typical examples of this group are North of Cursus (52), Aerodrome (70) and Nile Clump (70).

A few assemblages do not fit within this broad grouping. One of these is Normanton Gorse (61) where unusually there are similar proportions of all flake classes. It should be noted, that the assemblage in this area is particularly small (Fig. 4.9). Sewage Works (66) and West Field (68) have very similar distributions, which are heavily dominated by the longer flake categories (1 and 2) of which there are similar proportions (Fig 4.9). Again, it should be noted that Sewage Works (66) has a small assemblage.

### 4.3.8 Butt type

During the analysis, the butt types of individual flakes were recorded. The different butt type categories refer to technological information concerning the character of the platform in the location of the point of percussion, which becomes the butt of the resultant flake. Accordingly, butt type categories record the presence or absence of platform preparation and maintenance. Some of these categories, such as crushed or cortical butts reflect a disregard for platform preparation, whilst others, such as trimmed or punctiform butts indicate intentional alteration of the platform to facilitate the removal of a flake.

| Butt Type Category | Frequency | Proportion of total assemblage |
|---|---|---|
| 0 (indeterminate/absent) | 914 | 4.4 % |
| 1 (Plain) | 16706 | 80.7 % |
| 2 (Faceted) | 748 | 3.6 % |
| 3 (Thermal) | 47 | 0.2 % |
| 4 (Dihedral) | 425 | 2.1 % |
| 5 (Cortical) | 1221 | 5.9 % |
| 6 (Punctiform) | 74 | 0.4 % |
| 7 (Crushed) | 241 | 1.2 % |
| 8 (Trimmed) | 302 | 1.5 % |
| 9 (Trimmed and Faceted) | 19 | 0.1 % |
| Total | 20697 | 100.0% |

Table 4.6: The frequency and proportion of all Butt Type categories from all flakes analysed.

From the data for flake butt type, it can be seen that the most common categories are plain, cortical or indeterminate butts (Figs. 4.11 and 4.12; Table 4.6). Both cortical and crushed butts show a lack of care preceding flake removal in that cortical butts indicate the absence of a prepared platform whilst crushed butts suggest the use of a degraded platform, which has not been rejuvenated. On the other hand, plain butts do not necessarily show a lack of care as they are just flakes that have been removed from prepared platforms that show no signs of further maintenance. This may suggest that a platform has been used without maintenance until it is no longer productive. However, it may also suggest that the level of control over previous removals means that no further maintenance of the flaking angle was necessary.

In contrast to the above cases, several butt types indicate definite platform maintenance. Faceting indicates the presence of removals into the platform whilst trimming relates to removals from the platform down across the top of the flaking surface (Plate 64); both relate either to slight alterations of the platform angle or to removals of small flaws along the edge between the platform and the striking surface. Flakes with punctiform butts are flakes with particularly careful preparation (heavy trimming) preceding removal. They are normally associated with the production of blades and the degree of preparation results in flakes with very small, well-trimmed butts (Inizan *et al.* 1992, 81). Dihedral butts are a slightly more difficult category in that they represent flakes where the point of percussion (previously on the platform) lies immediately upon a ridge (or arris) created by the intersection of two flake scars (*ibid.*, 80). As such, these types of butts may indicate careful placement of a blow upon an intentionally created ridge. However, they may equally represent the chance landing of a blow upon a raised and exposed portion of the platform. Accordingly, it is hard to judge whether this category of butt type should be treated as meaningful evidence of butt preparation or whether it represents an inevitable and unintentional event. Fine judgement between two eventualities can sometimes be made during analysis according to a particular reading of an artefact but in this case, such impressions are subtle and therefore hard to quantify.

From Table 4.6 it can be seen that within the assemblage, the most common form of platform maintenance is faceting followed by dihedral butt types, whose ambiguous character has already been discussed. The next most common form of butt preparation is trimming, whilst punctiform and trimmed and faceted butts are relatively uncommon. It is unsurprising that faceting is the most common form of butt preparation as it is also one of the simplest forms of platform maintenance. Although, it is notable that trimming, which represents a similar and equally uncomplicated technique, occurs in only half as many cases.

As suggested, plain-butted flakes dominate the assemblage and represent about 80% of all recorded material (Table 4.6). This proportion is consistent between individual sample areas with the vast majority having between 75%-85% of flakes with plain butts. A few areas deviate from this pattern with Normanton Gorse (61), The Ditches (77), Well House (83) and New King (87) having less than 70% of flakes with plain butts. New King is the most extreme of these cases with only 58% of flakes with plain butts.

As plain-butted flakes dominate the assemblage so heavily, it is easier to assess the relative proportions of the other butt types by excluding plain butts from the bar charts (Figs. 4.11 and 4.12). Once this has been done, the proportions of butt type categories from sample areas indicate more variation than most of the previously discussed variables excluding flake class. However, it must be remembered that by excluding flakes with plain butts from the charts, the variation between the remaining categories is exaggerated. There are also many more categories for this attribute compared to those already discussed.

Despite the above, the most common shape to the data for butt type resembles the proportions of material presented for the assemblage as a whole (Fig. 4.11). Within this pattern, cortical butts are generally the most common category followed by indeterminate flakes, flakes with facetted butts and then flakes with dihedral butts. The remaining butt type categories tend to make up more minor proportions of the assemblages although within these trimmed and crushed butts are the most common. Winterbourne Stoke Crossroads (50), North of Cursus (52), Stonehenge Triangle (54), Well House (83), Normanton Bottom (67), Woodhenge (60) and King Barrow Ridge (57) are all typical of this group of material and show the degree of variation that exists (Fig. 4.11). As suggested there is less homogeneity in the data for this attribute than for those that have been previously discussed so there are many areas which do not fit into any broad grouping. For example, New King (87) has relatively low proportions of flakes with cortical butts whilst Aerodrome (79) and Nile Clump (70) have high proportions of this material (Fig. 4.12). The Ditches (77) has high proportions of flakes with punctiform butts, The Diamond (59) is associated with flakes with trimmed butts and West Field (68) has high proportions of both trimmed and facetted butt types (Fig. 4.12). As will be discussed later (Section 5.6.2.2), relatively high proportions of prepared butt types is one of the features that distinguishes the group of areas in which a more systematic technology appears to have been practiced.

### 4.3.9 Flake type

Flake type is an extremely varied category aimed mainly at recording the presence of technologically or typologically distinct artefacts. Some of these, such as thinning flakes, core rejuvenation flakes and distal trimming flakes, are flakes distinctive of particular technological processes or reduction sequences (Appendix 1). Other flake type categories record the presence of retouch on flakes, whilst others record the presence of recognised tool types. Accordingly, it is a techno-typologically mixed category that covers a wide range of types of artefact derived from a variety of stages of the reduction sequence that are produced for many different reasons. A particular problem lies in the recording of tools within this category. This is because the original analysis of material by the Stonehenge Environs Project concentrated upon tool types (Section 2.3.1). Consequently, tools were recorded and *stored* separately from the rest of the material. This means that the few tools recorded during the course of the current analysis were those that had been missed during the analysis by the SEP. Therefore, this portion of the assemblage is totally unrepresentative, meaning that it is of no use in the current analysis. As a result, the tools recorded during my analysis are not discussed here. However, the data have been added to the tool catalogue from the SEP archive, which I have accessed onto computer record and are discussed in Chapter 6. This means that the present analysis is only concerned with the following flake type categories:

0) Indeterminate
1) Core Rejuvenation Flake
2) Thinning/finishing Flake
3) Preparation Flake
4) Side Trimming Flake
5) Distal Trimming Flake
6) Side and Distal Trimming Flake
7) Miscellaneous Trimming
8) Scraper Retouch Flake
9) Bipolar Flake
11) Misc. Retouched/utilised flake
12) Chunk or Chip
13) Misc. Bifacially Retouched Flake
14) Blade
16) Retouched Blade
20) Crested Blade Flake

Of the above categories, several are represented by a very small number of cases. Thinning flakes, miscellaneous bifacial retouch and crested blade flakes are each represented by less than thirty cases in the entire assemblage. Bipolar flakes were absent in the assemblage. Whilst no scraper retouch flakes were recorded in my analysis this is in part due to the fact that they were recorded as special finds by the SEP and were thus recorded and boxed separately with the tool assemblage. Due to the very small numbers of these categories of flakes that were recorded, they are not discussed in detail in the present analysis although their distribution will be discussed later (Section 6.2.6).

#### 4.3.9.1 Core rejuvenation flakes

Core rejuvenation flakes are also present in relatively small numbers with 55 examples from the assemblage as a whole. Two distinct types of rejuvenation flakes were recognised during the analysis of material. The first is the core rejuvenation tablet, which is a common form where a platform is rejuvenated by a single thick flake or tablet aimed at removing the top of the platform. The second type is a rejuvenation flake struck at right angles *across* the striking surface. This type does not remove the whole platform but instead takes away the upper part of the striking surface and the edge of the platform along with any hinge fractures, edge recession or overhang that may have impeded further reduction (Plate 77). This second category requires a degree of judgement in its recognition as similar flakes can be produced during the initial stages of a reduction sequence where a core has been rotated 90° for further production from a new platform rather than intentional rejuvenation of an existing one. This possibility is indicated in the Stonehenge Environs by a refitted knapping sequence excavated from the ditch fill of

Amesbury 42 long barrow where these types of flakes were produced unintentionally during core rotation (Harding 1990b, 103).

Of the 55 core rejuvenation flakes in the assemblage only 10 are examples of rejuvenation flakes struck at right angles to the striking surface. Due to the small number of rejuvenation flakes their distribution in terms of individual sample areas will not be discussed here, however their precise location will be examined in detail in Section 6.2.6.1.

4.3.9.2 Preparation and trimming flakes

Preparation and trimming flakes are discussed together as they are all categories of flakes related to the initial preparation and development of platforms and striking surfaces (Harding 1990a, 218-9). Preparation flakes are concerned with the early stages of the roughing and shaping of platforms and striking surfaces where as the various categories of trimming flakes relate to subsequent maintenance and extension of the flaking surface (Appendix 1). In an idealised situation, high proportions of preparation flakes should correlate with areas of extraction and roughing out of cores where as large quantities of trimming flakes should be associated with areas of the continued working and maintenance of cores.

The data for these categories of flakes are presented here as bar charts. These charts show the proportions of this material to all other flake type categories. However, as there are so many, the other categories have been removed from the charts in order to make them easier to read.

The data for the majority of sample areas closely resemble the data for the assemblage as a whole (Figs. 4.13 and 4.14). As with previous attributes this reflects the degree of homogeneity between different sample areas. In nearly every case preparation flakes represent the highest proportion of material by some degree. The one exception to this case is the material from Normanton Gorse (61), which lies to the southwest of Stonehenge a few hundred metres north of the Normanton Down barrow group. This area has the lowest proportion of preparation flakes accompanied by one of the highest proportions of side trimming flakes (Fig. 4.13). As was noted previously, this area also yielded a particularly small assemblage. This situation is also found at Pig Field (74) in the far south of the study area. A similar pattern is also found at The Diamond (59) where relatively low proportions of preparation flakes are found with high proportions of both side and distal trimming flakes (Fig. 4.13). Although less clearly defined, similar ratios of material occur at King Barrow Ridge (57), Fargo Road (63) and West Field (68). In terms relative to the rest of the assemblage, it can be said that these areas witnessed a higher degree of activities involving the maintenance rather than initial preparation of flaking surfaces than other parts of the Stonehenge landscape. However, it must be stressed that this pattern is marked in only one area, Normanton Gorse (61), an area with a relatively small assemblage.

Conversely, high proportions of preparation flakes are found at Coneybury Hill (51), South of Stonehenge (55), Woodhenge (60), Nile Clump (70), Aerodrome (79), Well House (83) Wood End (90) and Luxenborough (84) (Fig. 4.14). These areas are largely the same as those that witnessed high proportions of heavily cortical flakes (Section 4.3.4), which is unsurprising considering that large amounts of cortex is the most distinguishing feature of preparation flakes.

Particularly low proportions of trimming flakes are found at Horse Hospital (64), Bunnies Playground (75), Destructor (76), Rox Hill Unsown (86) and Normanton East (88) (Fig. 4.14).

#### 4.3.9.3 Retouched/utilised flakes

As suggested in Section 4.1.2.2, recognition of the differences between retouched, utilised and edge damaged flakes in ploughsoil assemblages is very difficult. This difficulty led analytically to the combination of the retouched and the utilised categories. Accordingly, a conservative approach was taken towards the recognition of these types of flakes (Appendix 1). Owing to these problems, the figures presented here should also be treated with some caution. This caution is due as much to the eradication of signs of retouch by random edge damage in the ploughsoil as the misidentification of edge damage as retouch. The potential for this problem is shown by the fact that the figures in the SEP archive for the proportions of utilised flakes[2] in sample area assemblages are slightly negatively correlated with those produced in the current analysis.

Retouched/utilised flakes are present in small quantities within the assemblage making up only 3.4% of its total. The area with the highest proportion of this category of flakes is Well House (83) where they form almost 11% of the assemblage. Normanton Bottom (67), The Ditches (77), Rox Hill Unsown (86) and New King (87) also all have relatively high proportions of these flakes.

In contrast, King Barrow Ridge (57), Sewage Works (66) and Destructor (76) have very low proportions of retouched/utilised flakes, whilst Normanton Down (56), South of Cursus (85) and Lake Bottom (89) have none at all. As before, it is important to note that except King Barrow Ridge (57) all of these areas yielded small assemblages. Indeed, these areas represent five of the bottom eight sample areas in terms of the quantity of flint collected. It is possible in this case that the combination of small assemblages and a category which only comprises a minor proportion of all material can easily lead to under-representation. In particular, this probably accounts for the total absence of this category of material in some areas.

However, a small sample size does not account for the low proportion of retouched/utilised flakes at King Barrow Ridge (57). Therefore, this feature of the assemblage seems to contradict the idea, presented by the SEP (Richards 1990, 22), that this area represents a focus for 'domestic' activities'.

[2] Note that the SEP used the category 'utilised flake' where as in the current analysis a wider definition of retouched/utilised flake was applied (Appendix 1).

#### 4.3.9.4 Blades and retouched blades

Even in comparison to retouched/utilised flakes there are small amounts of blades (2.3%) in the assemblage and there are even fewer retouched blades (0.3%). This is partially due to the strictness of the definition used in the analysis (Appendix 1). In a similar manner to retouched flakes, there are many areas which do not contain blades; all are areas with small assemblages. Normanton East (88), Normanton Bottom (67) and Railway (71) all have relatively high proportions of blades but the differences are small reflecting the relative paucity of blades in the assemblage. Owing to the small quantities of material present and the lack of marked patterning this category of material will not be discussed further here. However, the distribution of this material will be discussed in more detail in the Chapter 6.

The consistently low proportions of blades in the assemblage is in keeping with the data for flake length:breadth ratios, which also showed the predominance of broad flakes within the assemblage. These features indicate that there are no areas around Stonehenge in which large-scale blade production occurred. Although blade production is often associated with Early Neolithic assemblages, the relative lack of this type of product in the ploughsoil assemblages does not necessarily indicate a lack of Early Neolithic activity. Excavation in the area has shown that during this period production of broad flakes also occurred regularly (Section 8.3.2) and the choice of this type of reduction of blade production may have been a response to local raw material conditions rather than chronological traditions of working stone.

## 4.4 The statistical analysis of flake data

So far only basic techniques of statistical description have been used to present the basic character of the data for flake attributes. The overriding observation from this presentation of data has been the degree of similarity exhibited by the assemblages from different sample areas. Due to this level of homogeneity, it is difficult to differentiate between the data for different sample areas and where variation has been illustrated, it is hard to assess the extent of its statistical significance. In particular, it has been hard to identify variation in the histograms for the metrical data. Due to the character of the presentation thus far (i.e. separate charts for separate areas), it is also difficult to appreciate the spatial coherency of the variation that has been presented. In addition, due to the number of attributes that have been discussed, it is difficult to gain an overall appreciation of how sample area assemblages differ from one another.

In order to address the issues outlined above, more complex techniques of statistical description and inference are used in the following section to help indicate the patterning within this complex dataset. These techniques provide a more precise method of comparing data than the visual presentation that has been presented so far. In this manner, the degree of homogeneity in the dataset will be tested more thoroughly.

All of the analyses in the following section were run on SPSS v.10.0 for Windows.

### 4.4.1 One way analysis of variance

Analysis of variance (ANOVA) is a statistical technique that tests the hypothesis that a group of means are equal (Marzillier 1990, Ch. 11). Accordingly, it is a very useful technique in the current situation where there is a large group of apparently similar means (one for each sample area). As a technique that deals with means it can only be used on ratio data, from which means can be calculated. Due to this, its immediate application is only relevant to the metrical data that was measured (e.g. length, breadth, weight and cortex).

The similarity between the graphic representations of these data points towards their homogeneity. This pattern can be further underlined by tabulation of the means and standard deviations for these data (Table 4.1; Appendix 2). As suggested, ANOVA can be applied to the data in order to assess whether these means are statistically equal or not. Because the sizes of the samples (sample areas) are not equal, a one-way ANOVA test was used (*ibid.*, 365). The test was applied to the data for flake length, breadth, weight, length:breadth ratios and cortex coverage (Table 4.7).

| Flake Attribute | ANOVA $F$ ratio | Critical Value of $F$ Distribution at 0.01 significance | Result |
|---|---|---|---|
| Length | 16.23 | 1.6 | Means are not equal |
| Breadth | 12.90 | 1.6 | Means are not equal |
| Length:Breadth | 7.41 | 1.6 | Means are not equal |
| Weight | 15.16 | 1.6 | Means are not equal |
| Cortex | 4.93 | 1.6 | Means are not equal |

Table 4.7: The results of one-way ANOVA of different flake attributes.

In all cases, the results of the one-way ANOVA indicated that the variance *between* groups was significantly greater than the variance *within* groups. In other words, the tests for each attribute rejected the null hypotheses, indicating that the means for individual sample areas were *not equal*. It is also clear that for all tests the $F$ ratios are quite high whilst the critical values, the values that must be exceeded to reject the null hypothesis, are low (Table 4.7).

In light of the discussion in the preceding sections of this chapter, the conclusions drawn from the ANOVA are important. Despite the apparent similarity between the data for these attributes, which has already been discussed, the test has shown that the means for these data are not equal. However, several problems limit the significance of these results. Although, ANOVA indicates that the means of the samples are different, it does not:

1) Group the samples telling you which means differ from which.
2) Indicate the degree of significance of the variation between means.
3) Indicate the archaeological relevance of the variation between means.

In regard to the first two points, although the ANOVA test does not provide information on these points, SPSS allows the calculation of post hoc tests that can help. Post hoc tests, such as the strangely named 'Tukey's honestly significant difference' test, attempt to gather the means into homogenous subsets (basically groups). Such tests are potentially useful as they provide an independent means of grouping the data, which could be mapped accordingly. However, probably due to the similarity of means for individual sample areas, the post hoc tests are inconclusive in that the memberships of these groups overlap significantly. In addition, the differences in the mean values for the data are small making the archaeological relevance of the different groups difficult to assess. As a result, the post hoc tests have not been utilised in the present analysis.

As an example of point three mentioned above, it is possible to differentiate between means statistically and it is possible to find out the difference in the mean value for flake length between two sample areas. However, the important thing to realise is that it is still necessary to assess how significant a difference of 4cm in the mean length of flakes from two sample areas is, in *archaeological* terms. Therefore, the *significance* of any patterning, which may be proved *statistically*, is still ultimately a matter of *archaeological* interpretation.

In addition, ANOVA is a test that is sensitive to the use of large samples. As a result of the variation inherent in datasets of the size and character under current analysis, ANOVA has a tendency to indicate that variation exists (i.e. that means are not equal). (N. Fieller pers. com.). This effect is shown by the high $F$ ratios and the correspondingly low critical values in Table 4.7. Accordingly, despite the fact that the tests have shown there are differences between the data for sample areas that might be the basis for interpretation, the test is still of limited use in providing any more detailed information.

### 4.4.2 Z-scores

As suggested above, the application of ANOVA in the present situation is limited. In particular, it is desirable to find a method that can indicate the relative differences between the mean values for individual sample areas. It is also useful, for the sake of archaeological interpretation, if the results of this method can be presented on a map.

One such method that has been used in the presentation of results from several landscape surveys is the calculation and subsequent plotting of Z-scores (e.g. Shennan 1985; Bradley 1987; Schofield 1991b).

Z-scores do not represent a statistical test but a method of measuring the distance of a value in terms of "standard deviation units away from the mean of its distribution" (Shennan 1988, 105). The advantage of this measurement is that it provides a standard score, a standard means of assessing the extent to which values from a population differ from their mean. Hence rather than finding an arbitrary manner of dividing the value for flake lengths according to whether they are 5cm or 10cm longer than the mean, Z-scores suggests whether certain flake lengths are, for example, 1 or 2 standard deviations (s.d.) bigger than the mean. In this respect, Z-scores indicate the difference between values in relative terms by taking account of the dispersion of the population. Where as the significance of a 10cm difference in flake length cannot be assessed as it is not known whether this variation is big or small in relation to all other flake lengths; Z-scores standardise the difference in terms of the overall dispersion of the population.

As the shape of the normal distribution is known, it is also possible to assess where within the normal distribution of flake lengths a value lies (e.g. Plate 51). Hence, by reference to a statistical table (e.g. *ibid.*, Table C) it is possible to calculate that a flake whose length has a Z-score of 1 s.d. above the mean is longer than 86% of all flakes in the population (Plate 52). Equally, a flake which is 2 s.d. above the mean is longer than 98% of the flakes in the population. The importance of this is that, whilst it contains no information about their actual length, a flake from a completely separate population of flakes (such as another landscape survey) whose length is also 1 s.d. above the mean is also exactly longer than 86% of all the flakes in its own population. Therefore, the advantage of this approach is that it would be relatively easy to compare the spatial distribution of the variation in flake lengths across landscapes studied by different projects. To a certain extent, this can be achieved by the comparison of the distribution maps that have been produced from these values but unfortunately; the lack of tabulated data for these scores prevents more detailed comparisons[3].

[3] Accordingly, all of the tabulated data for the Z-scores produced in this and the following chapter can be found in Appendix 2.

The main drawback with the use of Z-scores is that, as they do not test variation statistically but indicate its extent in terms of s.d. units away from the mean, the data will always produce positive results.

One significant issue was encountered in the calculation of Z-scores for the current project, which is derived from uncertainties about what data should be used. The equation used in order to calculate Z-scores is:

$$Z = \frac{x - \mu}{s}$$

where $\mu$ is the mean, $s$ is the standard deviation and $x$ is the value whose relationship to the mean is being calculated (*ibid.*, 105). For the current analysis, the object was to calculate the Z-scores for the average values of metrical attributes from each sample area (these will represent $x$ in the equation). These values are therefore known. However, as the equation shows, values for the mean and the s.d. are also needed. The question is whether the mean and the s.d. that are required for the equation should be calculated from the population as a whole (i.e. calculated from all of the data) or worked out from the summarised data (i.e. the sample area means), which are ultimately the subject of the equation.

| Flake Attribute | s.d. for whole assemblage | s.d. for mean values from each sample area |
|---|---|---|
| Length | 14.70 | 3.19 |
| Breadth | 12.32 | 2.22 |
| Weight | 22.77 | 5.11 |
| Length:Breadth ratio | 0.51 | 0.08 |
| Cortex Coverage | 31.15 | 3.28 |

Table 4.8: The standard deviations for the whole assemblage compared to the standard deviations for mean values from sample areas.

The difference between a mean value for the assemblage as a whole and the mean of the mean values for each sample areas is, as one would expect, small. The problem lies in the fact that, as there is an obviously large difference between the dispersion of the total population and the dispersion of the mean values for each sample area, there is a large difference between their corresponding s.d. (Table 4.8).

According to the equation for the calculation of Z-scores, the value of interest and the mean are divided by the s.d. meaning that the larger the s.d. the smaller will be the corresponding Z-score. As can be seen, the differences in the possible s.d. values in the present case are large (Table 4.8) as is their effect on the resultant Z-scores. If the s.d. for the assemblage as a whole are used in the calculations then the variation and corresponding values of the Z-scores would be low and *vice versa.* As to which figures should be used, there does not seem to be any immediately 'correct' solution. However, as it was the scores for the mean values for sample areas that were to be calculated it was considered more appropriate to work out the mean and s.d. for these figures rather than the assemblage as a whole.

One factor that the issue raises is that in the published sources where Z-scores (e.g. Shennan 1985; Schofield 1991b) are presented for comparable data, it is not stated which figures have been used in the calculations. Accordingly, direct comparison of these data would be dependent on finding out whether the means and s.d. that have been used were calculated in the same fashion.

#### 4.4.2.1 Z-score distributions

As suggested Z-scores were worked out for the average values for each sample area for flake length, flake breadth, flake length:breadth ratios, flake weight and flake cortex. These values were then classed according to the distribution of the resulting Z-scores and plotted on a map indicating the location of the sample areas. The advantage of this method is that it provides a means for independently classing the relative character of assemblage attributes in a manner that allows comparison between sample areas. In addition, the distribution of the results can easily be plotted allowing an understanding of the spatial distribution of the data in a manner that is difficult with the presentation of charts.

One problem with this data is that the calculation of Z-scores assumes a normal distribution. With the current datasets this is largely unproblematic as they represent means for sample areas, accordingly the level of variance is low as most averages within the assemblage are similar. However, as has been alluded to several times, the data for many attributes from Well House (83) vary greatly from the other sample areas. In some cases, this means that the data for this sample area represent an outlier in the distribution of the data which increases the s.d. of the population and accordingly produces comparatively lower Z-scores for the remaining sample areas. In most cases, the effect of this factor was not too serious. However, for some data, such as the average weight of flakes for Well House (83), the difference was so large that it did have a significant effect. Accordingly, the Z-scores were calculated twice, once with the Well House data and once without. The results of each method are presented here for comparison (Plate 6 and 7). In other cases, where similar problems occurred, judgements were made as to which calculations to use, in cases where an individual sample area Z-score is absent, it can be assumed that they were excluded as they represent the highest values above the mean.

#### 4.4.2.1.1 Flake length and breadth

The distribution of the flake length Z-scores at a broad level shows a tendency for longer flakes in the western half of the Stonehenge Environs (Plate 3; Appendix 2). There is a corresponding group of sample areas with shorter flakes along King Barrow Ridge and to the east, ground which slopes from the ridge down towards the River Avon. Within this group, there are several adjacent areas with noticeably shorter flakes. This group, consisting of Nile Clump (70), Home Fields (72) and New King (87), lies between King Barrow Ridge and the River Avon directly east from Stonehenge. The group is continued to the south at Whittles (73), just to the east of Coneybury Hill.

The western half of the Stonehenge Environs is dominated by areas with generally longer flakes although interspersed with areas with shorter flakes, such as at Aerodrome (79). The areas with the longest flakes are found at either end of the dry valley running between Rox Hill and Wilsford. This group is distinguished particularly by The Diamond (59) at one end and Well House (83) at the other.

The distribution for flake breadth Z-scores (Plate 4) are similar to flake length. Areas that have relatively short flakes also tend to have relatively narrow ones. This indicates a tendency for the variation in some areas not to relate to differences between elongate or squat flakes rather than larger or smaller flakes of the same basic morphology. In particular, the core of the group to the east of King Barrow Ridge also has relatively narrow flakes. Equally, the areas to the south of Stonehenge and north of the Cursus have flakes that are not only longer but broader as well. This can be examined in more detail using the distribution of length:breadth Z-scores discussed below.

Covariation between high scores for length and breadth on Plate 3 and 4 obviously indicate areas where generally larger flakes are found. This is particularly marked at Well house (83), Lake Bottom (89), Winterbourne Stoke Crossroads (50), The Diamond (59) and some of the areas north of the Stonehenge Cursus. These trends should be clearer when viewing the Z-scores for flake weight (Section 4.4.2.1.3)

#### 4.4.2.1.2 Flake length:breadth ratios

Although the previous two attributes give information about the sizes of flakes, it is necessary to see the two in tandem in order to understand differences in flake shape. To a certain extent, using the averages for length:breadth ratios allows this to be done on one map indicating differences in the gross morphologies of assemblages. It should be mentioned that, perhaps as they are ratios of other attributes, the differences between the sample area means for these data are particularly small (Appendix 2). In general, this indicates the similarity in the shape of flakes from different sample areas.

However, the data for the flake length:breadth ratios does break down some of the groups indicated by the previous attributes. Slightly different groups emerge consisting of relatively elongate or broad flakes. Examining the data for length:breadth ratios the group to the east of King Barrow Ridge (Plate 5) is broken up. Instead, it is shown that from this group New King (87) and Nile Clump (70) have comparatively narrow flakes, whilst Home Fields (72) and Whittles (73) have broad ones. The Z-scores for the previous attributes also indicates that the elongate flakes in the former two areas are also relatively small.

The other sample areas with on average the most elongate flakes in the Stonehenge Environs are Aerodrome (79) and particularly The Ditches (77) and Well House (83). The length and the breadth Z-scores indicate that of these last two areas The Ditches (77) has small flakes whereas, Well House (83) has the largest. It is notable, and in line with expectations, that the areas with the most elongate flakes are also have relatively high proportions of single platform cores (Section 5.6.2.2).

The areas with the more squat flakes tend to be mostly to the north and at either end of the Stonehenge Cursus. The flakes in the areas between Coneybury Hill and Normanton Down stretching across Stonehenge Bottom also tend to be slightly broader. This is particularly the case at Spring Bottom (78). The broadest of flakes were found at King Barrow Ridge Addit. (81), although the assemblage was very small.

4.4.2.1.3 Flake weight

As discussed in Section 4.4.2.1, the data for flake weight are presented twice, with and without Well House (83) (Appendix 2).

As all of the data discussed so far are related to the size or morphology of flakes, it is not surprising that the data are beginning to conform to each other. This is also the situation with the Z-scores for flake weight (Plate 6 and 7).

The group to the east of King Barrow Ridge is confirmed as having generally smaller flakes, which weigh less. Within this group, New King (87) has the lowest mean flake weights in the Stonehenge landscape. To the north of these areas, Woodhenge (60) is shown to have broad and heavy flakes.

Heavier flakes occur in a band across Normanton Down and Normanton Bottom although near this area The Ditches (77) is confirmed as having small elongate flakes. The heaviest group of flakes occurs around Rox Hill especially at Well House (83), as well as at the other end of the dry valley at The Diamond (59) and Winterbourne Stoke Crossroads (50). Relatively heavy flakes also occur north of the Stonehenge Cursus.

As will be shown later (Section 5.2.1), the general differences between sample areas in terms of flake weight are mirrored by (larger) differences in core weight. This perhaps gives a clue as to the significance of this pattern. It is at least clear that larger cores were used to produce larger flakes. It is also likely that the differences in the sizes of artefacts between areas do not just relate to the relative extent to which cores have been exhausted but also to the original size of the flint nodules that were worked down.

4.4.2.1.4 Extent of cortex on flakes

Z-scores were also calculated for the average amount of cortex remaining on the dorsal surfaces of flakes (Appendix 2). The distribution of Z-scores for the extent of cortex coverage differs slightly from those for flake weight, length and breadth. There is a coherent block of areas immediately south of Stonehenge consisting of Aerodrome (79), South of Stonehenge (55) and Luxenborough (84), which have above average amounts of cortex on flakes (Plate 8). The other areas, which have more heavily cortical flakes, are widely spread across the landscape. The areas along King Barrow Ridge stretching to the east has many areas with flakes with above average amounts of cortex, but as with those areas north of the Stonehenge Cursus, they are interspersed with areas with relatively little cortex.

The most coherent block of areas with below average amounts of cortex is around Winterbourne Stoke and Wilsford. At the other end of the dry valley from these areas, both Well House (83) and Rox Hill Unsown (86) have on average flakes with small amounts of cortex but these areas are separated by Rox Hill (82) and Lake Bottom (89) where higher amounts are found. The distribution of these data tends to disprove

Richards' (1990, 22) suggestion that the area between Wilsford and Rox Hill is an extensive 'industrial' zone connected with the initial extraction and roughing out of cores. If this were the case, these areas would be expected to be characterised by relatively high, rather than low, amounts of cortex on flakes.

### 4.4.3 Principal Components Analysis

So far, the analysis of attributes has mostly sought to explain only one variable at a time. Although such analysis is invaluable, it is limited in that it does not recognise patterns of association between different variables. For example, it might be expected that there is a correlation between the length and breadth of flakes, but it is much more useful to know if there is an additional correlation between these attributes and the extent of cortex or the termination types of flakes. Effectively, the different attributes recorded for the analysis are all different methods of characterising particular flakes. It is therefore reasonable to assume that the more of these variables that can be used in a single analysis the more completely the material will be characterised. In addition, the inclusion of different variables will lead to an understanding of the extent to which flake attributes are related to each other. Given this situation what is required is a multivariate analysis of the data using a technique such as Principal Components Analysis (PCA).

PCA is a technique of ordination, which accordingly seeks:

> "... to compress the information contained in a large number of variables into a much smaller number of new variables." (Shennan 1997, 267).

Using concepts of Euclidean distance PCA reduces the variation within a set of data into a set of components. From these it selects the (normally 2 or 3) principal components that account for the majority of variation in the dataset. The mathematical procedures of these techniques are extremely complex and there is little need to explain them here (for a clear explanation see Shennan 1997, Ch. 12). Shennan (*ibid.*, 297-8) suggests that the useful attributes of this technique are that,

1) It gives a helpful indication of the relationships between variables.
2) It provides information about the relationships between units.
3) It suggests whether there are any major summary trends within the data, and which variables are mainly involved in the trends.
4) It provides a transformation of the data in which, in general, a very large percentage of the variation in a large number of variables is compressed into a smaller number of variables.
5) The transformation is carried out in such a way that the new variables are uncorrelated with one another.

One of the major benefits of being able to reduce a large number of variables into just two or three is that this makes identification of groupings of cases (i.e. sample areas) much easier to identify. This is particularly so as the reduction of the number of variables means that the data can be plotted on to a 2-dimensional graph.

In order for PCA to be applied to the current dataset, it needs to be summarised first. Due to the size of the dataset (20,697 flakes were measured), it is not practical to use individual flake measurements as cases. Accordingly, the data need to be summarised per sample area. The data for PCA also need to be numerical and must be continuous or ratio data (*ibid.*, 298). This is a particular problem as many flake attributes represent nominal or categorical data which cannot be averaged or summarised into a single value. Due to this, a decision was made that for nominal attributes the proportions of a single category of the attribute in a sample area would be used to represent all of the data for that attribute for that area. For example, the data for flake termination types for each area are only single values recording the proportion of feathered terminations in the sample area assemblages. The data used in the analysis were:

1) The proportion of Bulb Type category 2 (Pronounced Bulbs).
2) The proportion of Butt Type category 1 (Plain Butts).
3) The proportion of Termination Type category 1 (Feathered Terminations).
4) The proportion of Flake Scar Orientation category 1 (Same Axis as Striking Platform).
5) The proportion of Flake Class category 1 (Point of Percussion Behind a Ridge).
6) The proportion of Flake Shape category 2 (Divergent Edges).
7) The coefficient of variation for Flake Length.
8) The coefficient of variation for Flake Breadth.
9) The coefficient of variation for Flake Weight.

As can be seen, much of the data used were the proportions of only one category of an attribute. To use such data is not ideal as there is obviously information that is lost in the process. However, it was considered acceptable in the current analysis because in all cases apart from flake class, the category of the attribute that was chosen was by far the most common. In addition, as these data represent the proportions of a single nominal category to the rest of the material, there is a correlation between the values that have been used and the proportions of the other categories that have not. Accordingly, the data contains indirect information about the relative proportions of the other categories of attributes not used in the analysis.

The above list also shows that for the metrical attributes it was not the mean values per areas but their coefficients of variation that were used. Rather than being a measure of central tendency (like the mean), a coefficient of variation is a measure of dispersion. As it is calculated from the s.d. divided by the mean it can be a better measure of dispersion than s.d. which have a tendency to become larger when dealing with higher means (Shennan 1997, 42). As the mean of a population does not describe the shape of population, it was decided that the coefficient of variations were better suited to the current analysis.

The PCA was conducted using SPSS and was used to reduce the variation within the data for all attributes to just three components. The Eigenvalues indicate that these three components accounted for just under 60% of the variation within the data (Table 4.9). In general, a figure closer to 80% or 90% would be a more satisfactory degree of variance to be explained by three components. Accordingly, the figure of 60% indicates that there is a significant aspect of variation in the data that has not been described by the current analysis. This probably indicates both the sacrifice that had to be made in order to summarise the data for PCA as well as the lack of clear correlations occurring between the range of attributes recorded on each flake. It should also be noted that only two dimensions (axes) have been used in most of the plots used in this section to make them more readable. As the product of only the first two principal components, these plots account for just under 50% of the variation in the data (see Table 4.9). However, the relatively low level of variance explained does not mean that the analysis has not produced significant results as the reduction of the data to two or three components, explaining 50%-60% of variance, is still capable of indicating relationships in the data which would not normally be noticed.

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.474 | 24.744 | 24.744 | 2.474 | 24.744 | 24.744 |
| 2 | 2.090 | 20.901 | 45.645 | 2.090 | 20.901 | 45.645 |
| 3 | 1.231 | 12.314 | 57.959 | 1.231 | 12.314 | 57.959 |
| 4 | .916 | 9.160 | 67.118 | | | |
| 5 | .815 | 8.148 | 75.266 | | | |
| 6 | .781 | 7.808 | 83.074 | | | |
| 7 | .565 | 5.653 | 88.727 | | | |
| 8 | .490 | 4.898 | 93.624 | | | |
| 9 | .359 | 3.587 | 97.211 | | | |
| 10 | .279 | 2.789 | 100.000 | | | |

Table 4.9: The Eigenvalues indicating the extent of variance explained per component.

PCA also produces component loadings which indicate the extent to which each of the first two dimensions are related to the individual attributes (Table 4.10). Positive values indicate a positive correlation between the component and the attribute and negative values a negative one: the higher the number the stronger the relationship.

| Attribute | Dimension | |
|---|---|---|
| | 1 | 2 |
| Bulb Type (% of 2) | -.717 | -.445 |
| Butt Type (% of 1) | .828 | -.082 |
| Termination Type (% of 1) | .782 | -.049 |
| Flake Scar Orientation (% of 1) | -.216 | .212 |
| Flake Class (% of 1) | .519 | .420 |
| Cortex (% of 0%) | .395 | .336 |
| Flake Shape (% of 2) | .763 | .448 |
| Length C.V. | -.191 | .865 |
| Breadth C.V. | -.507 | .675 |
| Weight C.V. | -.476 | .740 |

Table 4.10: The component loadings from the Principal Components Analysis.

The values for the component loadings can also be plotted in two dimensions indicating graphically the character of the relationships between attributes and components. This plot indicates something of the nature of the correlation between attributes. In Fig. 4.15 those attributes which appear close together tend to co-vary, groups which are at right angles with another group are totally uncorrelated and those groups opposite each other at 180° are perfectly negatively correlated

The groupings that are indicated by the component loadings plot mostly indicate information which can be understood intuitively. For example, it is expected that there will be a strong relationship between the length, breadth and weight of flakes. As discussed in Section 4.3.7, there is also a close relationship between flake shape, flake class and the amount of cortex covering flakes.

Understanding the component loadings is also important, as they are needed to interpret any plots based on these scores. In particular, component scores are produced for each sample area according to their relationship to each principal component, these themselves can be plotted to assess any patterning between areas (Fig. 4.16). In order to understand the significance of the locations of sample areas on these plots a further summary based on Table 4.10 can be presented showing the relationships between the axes in Fig. 4.16 and the original flake attributes.

It is the plotting of sample area scores which is potentially the most useful output of the PCA analysis. This is particularly the case due to the number of attributes that the technique accounts for and the general problems in detecting variation within the data that have been discussed in this chapter. In part, the success of PCA in characterising the data is shown by the extent to which it confirms observations already made from individual attributes. However, as can be seen in Fig. 4.16 this is not to suggest that the PCA resolves the sample areas into clear groups. Indeed, like the data for individual attributes the majority of areas cannot easily be distinguished from each other. This corroborates the main suggestions of homogeneity that has previously been made from the analysis of individual attributes. The distribution of the main amorphous group of sample areas is spread largely along Dimension 2 (Fig. 4.16). As Table 3.10 shows, this group varies mostly in terms of attributes relating to the degree of dispersion in the size and shape of flakes rather than any other technological features.

| | Corresponding Attribute Values | |
|---|---|---|
| | High | Low |
| Dimension 1 | Butt Type category 1 (Plain Butts)<br>Termination Type category 1 (Feathered Terminations)<br>Flake Shape category 2 (Divergent Edges)<br>Flake Class category 1 (Point of Percussion Behind a Ridge) | Bulb Type category 2 (Pronounced Bulbs)<br>C.V. for Flake Breadth<br>C.V. for Flake Weight |
| Dimension 2 | C.V. for Flake Length<br>C.V. for Flake Breadth<br>C.V. for Flake Weight | Bulb Type category 2 (Pronounced Bulbs) |

Table 4.11: The relationship between plot Dimensions and flake attribute values.

Despite the large group mentioned above there are still several outlying groups. For the most part the membership of these groups is unsurprising as the sample areas have been highlighted several times in the preceding discussion of individual attributes. Well House (83) and The Ditches (77) appear together far up on Dimension 2 at the end of the amorphous group just mentioned. The two areas which lie furthest from the main group, Normanton Gorse (61) and New King (87) have also been mentioned several times previously. Their position at a high negative value for Dimension 1 indicates that these areas have particularly low values for the occurrences of attributes such as plain butt types and feathered terminations (Figs. 4.15; 4.16 and Table 4.11). A tight group of areas also occurs whose position is not heavily pronounced on either axis. This group comprises of Rox Hill (82), The Diamond (59), Aerodrome (79) and South of Stonehenge (55). The latter two of these areas also lie adjacent in the Stonehenge landscape. In this respect, the other two main outliers, Nile Clump (70) and King Barrow Ridge (57), also appear adjacent on the scatterplot and in the landscape. It is possible that the appearance of these areas in proximity on the scatterplot and in the landscape indicates relative similarity in the way the flint was worked in these locations. In the case of the group mentioned last, which have the highest negative score on Dimension 2, this similarity appears to relate to low C.V. for attributes relating to flake size and weight. In other words, there is less variation in the size and dimensions of flakes in these areas.

## 4.5 Conclusion

As can be seen, the results of the PCA are in agreement with the other aspects of the analysis of flakes. This gives an additional weight to the suggestions that have been made concerning the data. The description of the data has revolved around the similarity or homogeneity between sample area assemblages in terms of a number of attributes. Within this overriding pattern, there are inevitable aspects of variation relating at least in part to the size of flakes in different parts of the landscape.

It is not yet clear whether these differences relate to alternate approaches to working raw material, which varies in character in localised areas. However, the limited evidence of technological differences between assemblages hints towards this. In order to understand the nature of production more fully it is necessary to understand all aspects of debitage. In this respect, the subject of the next chapter is the analysis of the cores from the assemblage. Once the current findings are integrated with those from the analysis of cores, then the reconstruction of the Neolithic and Bronze Age taskscape can begin.

# Chapter 5: The Analysis of Cores: Searching for Patterns Through Statistical Analysis

## 5.1 Introduction

The following chapter provides details of the statistical analysis of the cores from the SEP assemblage. Moving on from the analysis of flakes, the analysis of cores provides complimentary data with which the technology from the ploughsoil assemblages surrounding Stonehenge can be fully understood. In the second part of this chapter, the two aspects of the assemblage of debitage will be brought together in order to discuss the significance of the results. Before proceeding, it is first necessary to outline some of the issues, which were encountered during this part of the analysis.

### 5.1.1 Problems of non-mutually exclusive attributes

As described in Section 3.3.2, the cores were measured by a mixture of numerical and written description. Although, aspects such as the weight of cores and the length of flake scars on them were recorded numerically, the majority of the information was recorded through written description of raw material, platform type, production type, and the reasons for core rejection. The main reason behind this was to keep the recording of cores in line with that carried out by the SEP on the, mainly excavated material, which it recorded in detail.

In retrospect, it was felt that although this approach allowed flexibility in recording detailed information about the character of working of individual cores, it created many problems with the subsequent analysis of the data. The major problem was that the information needed to be accessed onto a computer database in order to quantify the results. This was important because statistical description was necessary to highlight any significant patterns due to the large quantity of cores measured (1,672) and the level of detail with which they were recorded. Hence, it was necessary to transform verbal description into quantifiable values. The main problems encountered in this process relate to the need to reduce varied verbal descriptions into a restricted set of categorical variables. One of the reasons for this difficulty was that many of the cores were worked unsystematically and therefore resisted standardised classification. Therefore, it was inevitable that some information would be lost in the transformation of the data from written description to numerical categories.

However, the process of transforming descriptions was aided by the fact that the initial written description was orientated around the use of keywords (Appendix 1). As the analysis proceeded, there was also an inevitable standardisation in the way in which cores were recognised and described. As a corollary, it was possible to recode the keywords that were used in the description of cores into attribute categories (Appendix 1). However, one significant problem that was encountered in this process lay in the fact that some of the resultant categories were not mutually exclusive, which makes quantification difficult.

An example of the above is the description of the causes of core rejection. Six main causes of core rejection were identified and used as keywords (Appendix 1). However, the extent to which they affected the productivity of a core varied in each case, which also needed to be assessed. A core might for example be non-productive due to heavy edge recession, slight hinge fractures and heavy natural flaws. As a core may have multiple reasons for rejection, which may vary in seriousness, there are a huge number of possible variations. This makes the reduction of all of this information into the separate categories of a single attribute impractical. Accordingly, it was necessary to provide a separate field in the database for each possible reason for rejection with the categories of these individual attributes representing the degree of the problem (e.g. None, Slight, Medium or Heavy). This situation means that it is not possible to reduce the causes for core rejection to a single variable potentially making quantification overly complicated.

As a solution to these problems two techniques have been used. The first is to concentrate on the individual attributes, such as edge recession, displaying the data as for any other attribute. In this way, any consistent patterns in the character of core rejection can be assessed. The problem is that the different aspects of core rejection are related meaning that information is inevitably lost. For example, a sample area might have a high incidence of cores with edge recession and high incidences of cores rejected due to a loss of flake angle, but it cannot be assessed whether these two features occur on the *same* cores. To a certain extent, this can be checked through cross tabulation or statistical correlation but in the current situation, the techniques are cumbersome and the results are inconclusive.

The second approach to resolving this issue is to use a comparison of the individual 'rejection' attribute category values (e.g. None, Slight, Medium or Heavy) to assess the *main* cause for rejection for each core. In other words, the attribute that has the highest value is identified as the main reason for rejection of a core and a new category is created that records this. The benefit of this approach is that it reduces all of the different reasons for core rejection to a single variable. The drawback is that again information is lost (i.e. other causes for rejection). It is also far from ideal to retrospectively assign reasons for core rejection during a post-analysis phase. However, the logic behind the approach is sound and the analysis utilises aspects of both approaches just mentioned giving a greater depth to the analysis.

In addition to the attributes relating to core rejection, similar problems were encountered with the characterisation of the raw material, the number and type of platforms and the production type (e.g. elongate, squat or broad flakes). Parallel approaches to those outlined above were used to deal with the characterisation of these attributes.

It is easy to identify in hindsight problems such as those that have just been discussed and in future, it would be preferential to use a simpler recording system. However, that these issues were mainly caused by the level of detail of the recording system indicates that as analytical issues are overcome the approach is still fruitful due to the amount of information that has been recorded. The only issue is the extra work that is needed in order to extract the data.

### 5.1.2 Problems of sample size

Before proceeding to the description of the analysis of the cores, it is also necessary to outline another issue that could not be avoided. As discussed in Section 3.2, the cores were selected for analysis with the same sampling strategy used for flakes.

However, as there are many less cores in the assemblage than there are flakes the numbers of them that were measured in some sample areas were very small (Table 5.1). The most extreme case was at Luxenborough (84) where only one core fell within the sampling frame. As some sample areas produced such small samples of cores, summaries of these data, such as means or proportions, can be skewed and misleading. Due to this problem, judgement has to be exercised to assess which data for which sample areas need to be excluded from the current analysis. In general, these are data for areas from which less than ten cores were recorded although this varies according to circumstance.

## 5.2 The analysis of cores

### 5.2.1 Core weight

As suggested, the small number of cores measured from some areas causes a problem of statistical representation. This is clear when viewing the histograms for the weight of cores. The distributions are reminiscent to those for flake weight but are often much more fragmentary (Fig. 5.1). This effect is exaggerated by the combination of small sample numbers and the high degree of dispersion in the data. In many cases there are significant proportions of cores of much heavier weights than the majority of the material. Cross-tabulation of core weights and the potential remaining in them at discard confirms expectations in that the larger cores have mostly been abandoned rather than exhausted. The suggestion is that these outlying groups of much heavier cores are cores rejected early on in the reduction sequence. However, they cannot simply be regarded as tested and failed nodules as many of these cores have more than one platform and are worked unsystematically. This perhaps suggests that they are cores that have been worked expediently to produce a few workable flakes and then quickly abandoned.

Because of the fragmentary nature of the distribution patterns, an easier way to assess the relative differences between core weights for individual sample areas is through the comparisons of means (Table 5.1). The C.V. are indicated in the column next to the mean values in order to provide a measurement of the differing degrees of dispersion that occur between the sample areas.

| Area Name | Area No. | No. of Recorded Cores | No. of Complete Cores | Mean Weight (g) | Mean Weight C.V. | Mean Maximum Flake Scar Length (mm) | Mean Maximum Flake Scar Length C.V. |
|---|---|---|---|---|---|---|---|
| Winterbourne Stoke Crossroads | 50 | 83 | 81 | 144.3 | 1.61 | 41.4 | 4.50 |
| Coneybury Hill | 51 | 130 | 116 | 90.0 | 1.64 | 37.4 | 3.94 |
| North of Cursus | 52 | 260 | 245 | 127.1 | 1.53 | 41.9 | 3.88 |
| Stonehenge Triangle | 54 | 95 | 88 | 102.0 | 1.30 | 41.6 | 4.00 |
| South of Stonehenge | 55 | 30 | 24 | 127.8 | 1.50 | 42.9 | 3.33 |
| Normanton Down | 56 | 14 | 14 | 116.2 | 2.17 | 39.1 | 3.26 |
| King Barrow Ridge | 57 | 67 | 63 | 94.4 | 1.98 | 36.2 | 4.07 |
| The Diamond | 59 | 92 | 88 | 145.5 | 1.40 | 43.6 | 3.96 |
| Woodhenge | 60 | 51 | 43 | 86.2 | 2.40 | 37.0 | 4.11 |
| Normanton Gorse | 61 | 4 | 4 | 134.3 | 3.75 | 46.5 | 3.88 |
| Cursus West End | 62 | 63 | 59 | 111.9 | 1.43 | 37.7 | 3.93 |
| Fargo Road | 63 | 52 | 49 | 119.5 | 1.38 | 40.9 | 3.44 |
| Horse Hospital | 64 | 42 | 40 | 104.9 | 1.80 | 40.0 | 4.65 |
| Durrington Down | 65 | 41 | 39 | 123.1 | 1.77 | 43.0 | 4.30 |
| Sewage Works | 66 | 8 | 8 | 226.9 | 1.28 | 46.1 | 2.76 |
| Normanton Bottom | 67 | 52 | 50 | 155.8 | 1.79 | 46.9 | 4.01 |
| West Field | 68 | 45 | 40 | 134.1 | 1.91 | 39.7 | 3.78 |
| Kg Barrow Ridge Addit | 69 | 15 | 15 | 94.7 | 1.62 | 39.5 | 3.02 |
| Nile Clump | 70 | 35 | 33 | 101.4 | 1.50 | 39.5 | 4.07 |
| Railway | 71 | 41 | 41 | 104.4 | 1.64 | 42.1 | 4.17 |
| Home Fields | 72 | 29 | 25 | 100.7 | 2.17 | 41.8 | 4.92 |
| Whittles | 73 | 6 | 5 | 111.6 | 4.43 | 40.0 | 3.48 |
| Pig Field | 74 | 9 | 8 | 162.3 | 2.13 | 47.1 | 5.54 |
| Bunnies Playground | 75 | 11 | 11 | 133.4 | 2.06 | 45.5 | 4.14 |
| Destructor | 76 | 8 | 8 | 122.2 | 1.65 | 37.6 | 4.53 |
| The Ditches | 77 | 44 | 39 | 153.3 | 1.44 | 40.7 | 3.39 |
| Spring Bottom | 78 | 42 | 38 | 131.8 | 1.64 | 42.0 | 3.44 |
| Aerodrome | 79 | 31 | 27 | 121.3 | 1.56 | 39.6 | 3.88 |
| Ammo Dump | 80 | 21 | 21 | 170.7 | 0.95 | 43.6 | 3.21 |
| Kg Barrow Ridge East | 81 | 8 | 8 | 94.6 | 3.14 | 35.6 | 5.09 |
| Rox Hill | 82 | 79 | 72 | 133.4 | 1.20 | 43.6 | 4.36 |
| Well House | 83 | 31 | 26 | 441.1 | 1.09 | 64.0 | 2.83 |
| Luxenborough | 84 | 32 | 32 | 134.7 | 1.24 | 43.6 | 3.25 |
| South of Cursus | 85 | 15 | 15 | 93.2 | 1.62 | 38.0 | 4.47 |
| Rox Hill (unsown) | 86 | 32 | 32 | 145.6 | 1.09 | 40.0 | 3.33 |
| New King | 87 | 24 | 21 | 108.3 | 1.59 | 36.1 | 3.09 |
| Normanton East | 88 | 22 | 22 | 140.2 | 1.51 | 41.2 | 4.38 |
| Lake Bottom | 89 | 1 | 1 | 143.1 | - | 39.0 | - |
| Wood End | 90 | 8 | 8 | 86.9 | 1.71 | 34.1 | 4.37 |
| Total | - | 1673 | 1559 | - | - | - | - |
| Mean | - | 42.90 | 39.97 | 132.6 | 1.78 | 41.4 | 3.91 |

Table 5.1: Mean and Coefficient of Variation data for core weight and average maximum length of flake scars (complete cores only).

The most obvious feature when comparing the sample area means for core weights is the high degree of variation that was not witnessed in any of the continuous or ratio data for flakes. The extent of this can be assessed by comparison of the variation between the mean flake lengths and weights from sample areas with the mean core weights (Tables 4.1 and 5.1). Unlike any of the flake data, the variation in average core weight is to the extent that the cores from the areas with the smallest mean weights are over two thirds of the average weights from the majority of sample areas.

As was the case with many of the flake attributes one area, Well House (83), stands out from all of the others. As will be seen in the following discussion it was the cores which most distinguished this area. Table 5.1 shows that the average weight of cores at Well House (83) is over four times that from most other areas. The difference in size of the cores from this area was obvious during the analysis with several examples weighing well over 1kg (Plate 78). Due to the massive difference between the weight of cores at Well House (83) compared to all other areas these data have been left out of the calculation of Z-scores shown in Plate 9 for the reasons discussed in Section 4.4.2.1.

The distribution of Z-scores for the mean core weights per sample area shows a clear pattern of lighter cores to the east of Stonehenge and King Barrow Ridge and heavier cores to the southwest (Plate 9). The group of lighter cores extends from King Barrow Ridge onto Coneybury Hill (51). The areas north of the Stonehenge Cursus also tend to have lighter cores. The group of areas with heavier cores appears to be concentrated around the dry valley system running from Rox Hill to the Wilsford/Winterbourne Stoke area. It was this valley, which was identified by the SEP as the focus for industrial activity in the Stonehenge Environs, and all of the sample areas within it have above average mean weights of cores. However, there are also several areas, notably on Normanton Down, at Sewage Works (66) and Ammo Dump (80), which have relatively heavy cores and are more spread throughout the landscape. It is noticeable that the assemblage from Sewage Works (66) is represented by only eight cores.

Comparisons can be made between the distribution for Z-scores for flake weight and those for core weight (Plates 6, 7 and 9). As can be seen, a correlation between areas with heavier cores and those with heavier flakes does exist. In particular, the two main groups, to the east of King Barrow Ridge and between Winterbourne Stoke and Rox Hill, maintain coherency between the two distributions. In general, this goes to show that larger cores tended to be used to produce larger flakes. This pattern may also be linked to how heavily cores were worked before being rejected. In this respect, several of the areas in the southwest of the survey area, which produced both heavier cores and flakes, such as The Ditches (77), the Diamond (59) and Well House (83), also had cores that were rejected earlier on in the reduction sequence (Section 5.2.9).

One of the major factors, which probably influenced the relationship between flake and core weights, was the varied abundance and quality of flint raw material across the Stonehenge landscape. Although it is hard to assess, it is possible that the heavier cores in the southwest of the survey area indicate the use of larger nodular type flint in that area. In contrast, it is possible the presence of lighter cores in areas such as those to the north of the Stonehenge Cursus and to the east of King Barrow Ridge, represent the use of smaller nodules that were perhaps present as weathered surface nodules or within clay-with-flint drift deposits.

Despite the correlation between flake and core weight there are some areas that are noticeably different. Woodhenge (60), King Barrow East (69), King Barrow Ridge Addit. (81), Coneybury Hill (51) and Horse Hospital (64) are all areas which produced flakes of above average weight and conversely, cores of below average weight (Plates 6, 7, and 9). The opposite situation occurs at The Ditches (77), Ammo Dump (80) and to a lesser extent Bunnies Playground (75) where lighter flakes were produced from heavier cores. This degree of variation indicates that the relationship between core weight, flake weight and the extent to which cores are exhausted is not always clear-cut. Therefore, it should be remembered that beyond the constraints of raw material availability and quality, technological choices were informed by a wide range of other concerns.

### 5.2.2 Core flake scars

#### 5.2.2.1 Average number of flake scars

The number of flake scars recorded on a core provides an indication of the extent to which a core has been worked. However, the number of flake scars remaining on a core after discard is not directly related to the extent to which it has been worked because:

1) Many more flakes may have been removed than there are scars remaining on a core depending on the extent of working.
2) A large core abandoned whilst potential still remains, due to the large surface area, might record more flake scars than a small core that has been heavily worked until exhaustion.
3) Only complete flake scars are counted so the number remaining on a core after discard will vary according to the character of reduction.
4) The count of flake scars can be confused by the sometimes numerous small scars on a core that might relate to unsuccessful removals, shatter or platform preparation/maintenance.

Therefore, the number of flake scars should be understood to be only a broad indication of how heavily a core has been worked. Despite this, it is a useful measurement as it can certainly distinguish between cores with only one or two removals and those that have been more extensively knapped. In this respect, the number of flake scars recorded on cores from the assemblage as a whole varied from one to twenty five (Table 5.2).

As can be seen, the majority of cores had between three and nine complete flake scars remaining on them (Table 5.2). Furthermore, on average cores from nearly all sample areas have about six or seven scars remaining. Accordingly, there is little difference between the mean values for this attribute between areas. The similarities between the C.V. for sample areas also indicate that the dispersion of values within the sample areas is also limited. This degree of homogeneity should be borne in mind when comparing the Z-scores distributions for these data (Plate 10; Appendix 2).

By comparing Plates 9 and 10 it can be seen that whilst many areas, which have heavier and therefore larger cores, also have higher than average numbers of flake scars, this relationship is not exclusive. Although, Coneybury Hill (51) and Woodhenge (60) had amongst the lowest mean weight of cores, their cores also have an above average number of flake scars. This would tend to suggest that the cores in

the areas have been more heavily worked. This pattern is replicated to a lesser extent at Nile Clump (70) and Home Fields (72); all four areas are in the eastern half of the study area.

| No. of Flake Scars | No. of Cores | % of Assemblage |
|---|---|---|
| 1 | 28 | 1.7 |
| 2 | 54 | 3.2 |
| 3 | 110 | 6.6 |
| 4 | 178 | 10.6 |
| 5 | 201 | 12.0 |
| 6 | 229 | 13.7 |
| 7 | 208 | 12.4 |
| 8 | 168 | 10.0 |
| 9 | 140 | 8.4 |
| 10 | 96 | 5.7 |
| 11 | 80 | 4.8 |
| 12 | 56 | 3.3 |
| 13 | 33 | 2.0 |
| 14 | 24 | 1.4 |
| 15 | 14 | .8 |
| 16 | 13 | .8 |
| 17 | 7 | .4 |
| 18 | 4 | .2 |
| 19 | 2 | .1 |
| 24 | 1 | .1 |
| 25 | 1 | .1 |
| Total | 1647 | 98.3 |
| Missing | 28 | 1.7 |
| Total | 1675 | 100.0 |

Table 5.2: The number of flake scars recorded on cores from the assemblage as a whole.

By comparing Plate 9 and 10 it can be seen that whilst many areas, which have heavier and therefore larger cores, also have higher than average numbers of flake scars, this relationship is not exclusive. Although, Coneybury Hill (51) and Woodhenge (60) had amongst the lowest mean weight of cores, their cores also have an above average number of flake scars. This would tend to suggest that the cores in the areas have been more heavily worked. This pattern is replicated to a lesser extent at Nile Clump (70) and Home Fields (72); all four areas are in the eastern half of the study area.

The opposite of this pattern (high mean weights of cores with low numbers of flake scars) is found in the southwestern part of the Stonehenge Environs, particularly in the complex of sample areas around Rox Hill. The areas where this pattern is most clear are Well House (83) and The Ditches (77). For Well House (83), this is unusual considering the massive size of the cores there, however it is explained by the equally large size of the resultant flakes. At The Ditches (77), the situation is a little more unusual because the combination of comparatively heavy cores and light flakes with high length:breath ratios should be expected to produce cores with a high number of flake scars. The fact that this is not the case presumably suggests that the cores at The Ditches (77) were not as heavily worked as those elsewhere and to a lesser extent this also seems to be the case for Well House (83).

5.2.2.2 Flake scar dimensions

The issues regarding the measurements of complete flake scars remaining on cores are similar to those concerning their number (Section 5.2.2.1). The largest discrepancies between the length of actual flakes and the length of flake scars on cores is likely to be due to variations in how heavily cores are worked before being discarded. Obviously, over the course of the reduction sequence cores become smaller and so do the flakes that are produced. This means that the sizes of flake scars remaining on cores are likely to be somewhat shorter than a reasonable proportion of the flakes removed. Due to this it may be suggested that large differences between the two values would tend to suggest heavily worked cores.

In general, the data for both the average and the maximum length of flake scars on cores tends to be similar in terms of their distribution. In other words, areas that have the longest maximum flake scars also have the longest average length of flake scars (Plates 11 and 12; Appendix 2). This is unsurprising considering the relationship between the two variables. It might also be expected that there would be a correlation between the weight of cores and the average and maximum length of flake scars remaining on them. Comparison of the Z-score distributions for these data shows that a broad correlation does exist with most sample areas producing heavier cores also producing cores with longer flake scars (Plates 9, 11 and 12). Hence, the broad division between smaller cores to the east of King Barrow Ridge and larger ones to south and west of Stonehenge is mirrored in the distribution of areas with shorter versus longer flake scars.

The most notable exception to this is The Ditches (77). In the last section it was noted that despite the cores in this area weighing more than average they also had a relatively fewer flake scars. In terms of the length of flake scars on these cores it can also be seen that although their maximum length is below the mean, the average length of scars is above average (Plate 11 and 12; Appendix 2). This combination of heavy cores and relatively small differences between average and maximum length of flake scars suggests that the cores in this area have not been heavily worked. This is especially the case when it is considered that despite having cores with flake scars of above average length, the flakes in the area are short in comparison to other areas (Section 4.3.2).

### 5.2.3 Raw material

All of the cores measured in the analysis were made from typical chalk-derived flint nodules with a few examples of river gravel types. No cores were found made from any other type of raw material. Furthermore, there is no evidence of any flint or chert debitage derived from sources outside of the Stonehenge Environs (c.f. Richards 1990, 229). It should be noted that this does not necessarily mean that no material was brought in from other areas, as flint from most of the chalklands of southern Britain would be indistinguishable to that from the Stonehenge Environs.

Within the cores in the assemblage it was considered difficult to differentiate between material that may have been procured as surface flint, either eroded out of the chalk or as clay-with-flint deposits, and 'fresher' material that was taken directly from seams within the chalk. Accordingly, no attempt was made to record such features. However, it is clear that both types of flint were used.

The majority of cores were heavily patinated but there was also variation with some cores appearing in mint condition. Although it was noted that there were some localised patterns, with some sample areas having much less patinated material than others, no attempt was made to quantify this. In future, the degree of patination might be a fruitful attribute to record as its degree can provide a gross assessment of the relative age of exposed surfaces. However, weathering processes on flint are complex and poorly understood. Patination can vary widely according to localised differences in depositional environments (Saville 1981, 2; Luedtke 1992, 107-12). Therefore, it is difficult to assess the significance of differences in patination in unstratified material spread across large areas. One context where differences in patination have been recorded is in situations where there are different levels of patination on the *same* artefacts (Section 6.2.5).

Within the flint nodules used as raw material, the major differences were in size, cortex and shape. Cortex on cores varied from hard, thin and skin like to thick and chalky. It was also clear from cores still heavily covered in cortex that nodule sizes vary widely across the landscape. The extreme size of cores in areas such as Well House (83) suggests that nodule size may have varied significantly and within quite localised areas. However, for the most part, there does not appear to have been any consistent selection of certain sizes of nodules with some very small nodules being used as cores after minimal preparation (Plate 79). Although only partially reflected in the distribution of material, Harding (1990a, 215) notes that there is a greater density of flint (raw material) in the southern half of the Stonehenge Environs.

The shape of nodules varied mainly in terms of tabular versus nodular flint. Cores made in tabular flint were relatively uncommon. Although the ease of recognition of the original shape of a nodule varies according to the extent of reduction, only about 3% of cores were made on recognisably tabular-like flint. Harding (*ibid.*) observed seams of tabular flint outcropping on the north side of Rox Hill and Coneybury Hill. In the former area, there are higher average proportions of tabular like cores at Rox Hill (82) and especially at Well House (83). There are also higher than average types of these nodules at Coneybury Hill (51). The wider distribution of cores made on tabular nodules is spread evenly throughout the landscape but with relatively high proportions at The Ditches (77), Pig Field (74) and New King (87).

Cores made on nodules with obvious thermal fractures were also relatively uncommon (about 2%) although particularly high proportions of thermally flawed cores were recorded at New King (87).

In general, there does not seem to have been a concern with the selection of nodules of either good quality or large size. Accordingly, it seems likely that the material that was used was that which was the easiest to procure. Where available, surface nodules were probably often used. The main exception to this is probably the areas in the southwest of the survey area concentrated around the dry valley running from Wilsford to Rox Hill. Especially at Well House (83), flintworking may have taken advantage of nodules that erode out of the sides of the dry valley. Such material should have been less weathered than surface material and therefore would present better qualities for working.

### 5.2.4 Character of working

For each core a judgement was made concerning their overall character of working. It was decided whether the care and control with which cores had been worked was best characterised as unsystematic, semi-systematic or systematic. As such, this attribute was similar to that for the potential remaining in cores. To a certain degree, judgement of one is also judgement of the other and recording both requires judgement on the techniques of working and the intentions of the knapper (Section 5.2.9).

When considering the data for the character of working of cores the clearest pattern is the overriding dominance of unsystematically worked cores in all parts of the assemblage (Figs. 5.2 and 5.3). This aspect of the assemblage has been alluded to throughout this chapter and was most clearly shown in the cores. Overall, 72.7% of the cores in the assemblage were classified as unsystematic, 19.6% as semi-systematic, only 4.8% as systematic and 2.9% as unclassifiable. Cores that were classified as unsystematic were examples that showed almost no desire to control reduction. In many cases, platforms have been prepared but normally with minimum effort, perhaps just through the removal of one or two flakes. Equally, there is no effort expended in the shaping of the core preceding production or latterly in preparation or maintenance of striking surfaces or platforms. Due to the character of the reduction sequence and the lack of control over flake shape the majority of flakes produced were broad. Many cores worked in this fashion were abandoned after only a few removals (Plates 65, 79 and 80,) but many others were worked until platforms became untenable. The most common method of rectifying this situation was the simple rotation of the core. Most commonly, this was done through turning the core roughly 90° (Plates 66 and 81). This rotation was often succeeded by use of the previous flaking surface as the new platform. Concurrently, the predominance of cores with platforms at 90° rather than parallel or at an oblique angle (Section 5.2.5) probably reflects consistent use of the most convenient means of continuing reduction rather than any other technological choice. However, on many cores, working did not stop after exhaustion of a second platform. Often the option remained to rotate the core again using another part of the flaking surface as a third platform (Plates 67 and 82). After reduction from a third platform, many of these cores began to become roughly spherical with working on all major surfaces of the core. Examples of this type of core normally reached exhaustion through a combination of loss of flaking angle, edge recession and size. In the most extreme cases, cores were worked until almost completely spherical.

Due to the predominance of unsystematic cores in nearly all sample areas, examples where there are significant proportions of other types of cores standout clearly. The areas where more systematically worked cores are more prevalent are King Barrow Ridge (52), The Diamond (59), Nile Clump (70), The Ditches (77), Aerodrome (79), Rox Hill (82), Well House (83) and New King (87) (Fig. 5.3). Of these areas, most have higher proportions of semi-systematic cores and only slight increases in the occurrence of systematic cores. However, within this group New King (87), Nile Clump (70) and The Ditches (77) do have particularly large quantities of systematic cores, although these still only represent a maximum of 16% of the cores in these areas. A clear indication of the unusual character of lithic reduction at Well House (83) is that this is the only area with more systematic than semi-systematic cores. The systematic cores in the area make up 29% of all cores, a much higher proportion than from any other area.

The distribution of the areas with higher proportions of systematically worked cores is slightly different to those for many of the other core and flake attributes. For example, the Z-score distributions for the metrical dimensions of cores and flakes have tended to be split between two broad groups. There were generally heavier flakes and cores in the southwest of the Environs stretching between Winterbourne Stoke/Wilsford and Rox Hill, whilst lighter debitage occurred to the east of King Barrow Ridge. However, for the character of working of cores, areas from *both* groups have larger proportions of more systematic cores (Fig. 5.3). Hence, higher proportions of systematically worked cores are found in a block of areas around King Barrow Ridge and in the areas at either end of the Winterbourne Stoke to Rox Hill dry valley.

### 5.2.5 Core type

During the analysis, the cores were classified mainly according to Clark's (Clark *et al* 1960) typology from the Hurst Fen excavation report. Clark's typology classifies cores according to the number and orientation of their platforms (Table 5.3). Some of the problems related to this approach are discussed below. In addition to Clark's eight core types, four were added to accommodate different types that were encountered during the analysis. Although the two are similar, unlike Clark's typology these new categories apply to distinct types of core reduction techniques rather than to the number and orientation of platforms.

In all thirteen core types were recorded during the analysis, several of which were represented by only a few examples. The most common core types are core categories 0, 2, 5 and 6, which between them make up 75% of all of the cores in the assemblage (Table 5.3). The types of cores that these categories refer to are detailed in Table 5.3 and Appendix 1.

| Core Type | Clark Type | Description | No. of Cores | Percent |
|---|---|---|---|---|
| 0 | | Miscellaneous/indeterminate | 208 | 12.5 |
| 1 | A1 | One platform, flakes removed all the way around | 67 | 4.1 |
| 2 | A2 | One platform, flakes removed part of the way around | 508 | 30.3 |
| 3 | B1 | Two platforms, parallel | 76 | 4.5 |
| 4 | B2 | Two platforms, one at an oblique angle | 60 | 3.6 |
| 5 | B3 | Two platforms at right angles | 225 | 13.4 |
| 6 | C | Three or more platforms | 310 | 18.5 |
| 7 | D | 'Keeled', flakes struck from two directions | 119 | 7.1 |
| 8 | E | 'Keeled' with more than one platform | 40 | 2.4 |
| 9 | | Tortoise core | 7 | 0.4 |
| 10 | | Tabular core | 27 | 1.6 |
| 11 | | Bifacially worked tabular core | 23 | 1.4 |
| 12 | | Kombewa type core | 5 | 0.3 |
| Total | | | 1675 | 100 |

Table 5.3: Description, frequency and proportions of different core types from the assemblage.

5.2.5.1 Issues with Clark's core typology

Some consideration of Clark's (*ibid.*) core typology is warranted here, not only because the typology was used during the analysis, but also because the typology is in wide use throughout later prehistoric lithic analysis (e.g. Woodward 1991; Durden 1995; Whittle *et al* 2000). Considering that the typology is now over 40 years old, it is time that it is critically evaluated.

As suggested 0, 2, 5 and 6 type cores make up the majority of the assemblage; closer consideration of their classification indicates the problems with Clark's (Clark *et al* 1960) typology. For example, Clark's core type A2 (my core type 2) refers to cores with a single platform that has been worked part of the way around. The problem is that this definition is so broad that it applies as equally to carefully prepared, partially exhausted blade cores (Plate 93) as to crudely worked cores that have produced only a few squat flakes (Plate 79). A more refined understanding of the original definition is hampered because Clark's (*ibid.*) original description of these core typologies was not accompanied by any detailed illustrations of examples. Therefore, all that is needed for a core to be assigned to Clark's A2 category is one partially used platform.

| | | | Character of Working | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | 0 Unsystematic | 1 Semi-systematic | 2 Systematic | 3 Indeterminate | |
| Core Type | 1 | Count | 18 | 26 | 23 | 0 | 67 |
| | | Row % | 27 | 39 | 34 | 0 | 100 |
| | | Column % | 2 | 11 | 37 | 0 | 6 |
| | 2 | Count | 345 | 125 | 27 | 11 | 508 |
| | | Row % | 68 | 25 | 5 | 2 | 100 |
| | | Column % | 43 | 53 | 44 | 61 | 46 |
| | 5 | Count | 170 | 41 | 10 | 4 | 225 |
| | | Row % | 76 | 18 | 4 | 2 | 100 |
| | | Column % | 21 | 18 | 16 | 22 | 20 |
| | 6 | Count | 263 | 42 | 2 | 3 | 310 |
| | | Row % | 85 | 14 | 1 | 1 | 100 |
| | | Column % | 33 | 18 | 3 | 17 | 28 |
| Total | | Count | 796 | 234 | 62 | 18 | 1110 |
| | | Row % | 72 | 21 | 6 | 2 | 100 |
| | | Column % | 100 | 100 | 100 | 100 | 100 |

Table 5.4: Cross-tabulation of the most common core types and their character of working.

It is partly the broad scope of this definition that explains the frequency of this type of core. It is also explained by the tendency for unsystematic *ad hoc* cores that have been roughly worked and quickly discarded. These suggestions can be backed up by cross-tabulation of the most common core types against their character of working (Table 5.4). This indicates the tendency for core type 2 cores to be more systematically worked in comparison to cores with more platforms. As suggested, the reason for this is most probably the conflation of *ad hoc* single platform cores with more controlled examples of more systematic partially worked single platform cores.

The comparison of the three most common types of cores (core types 2,5 and 6) also reveals another issue with Clark's (1960) typology. These three core types are distinguished mainly by the number of their platforms. However, although they may be morphologically distinct at the point of *discard*, this does not mean that they are necessarily different *types* of cores. The point that Clark's method of classification misses is that all three of the above categories may represent essentially the same type of cores with the same reduction strategies with the only difference being the *stage* at which they have been *rejected*. In this case, it could be argued that the three core types that dominate the SEP assemblage are not three distinct types. Instead, they may describe a reduction strategy in which, according to how heavily a core was to be worked, a single simple platform was prepared; when this platform failed the core was rotated 90° (most often using the previous flaking surface as the next platform). After this platform also failed, the core was rotated again and so on until exhaustion. Such a strategy is typical of the irregular multi-platform cores that characterise many Late Neolithic and later assemblages (Edmonds 1987; Durden 1995, 409). It should also be clear that during the reduction strategy just hypothesised, the core would shift in terms of Clark's typology from A2, to B3 to C. As suggested the difference in core classification would only record the different stages at which a core had been rejected.

The above suggestion can be assessed to some extent by reference to cross-tabulation between the three core types and the potential remaining in the cores at rejection (Table 5.5).

| | | | Potential Remaining | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | Exhausted | → | Abandoned | | | |
| | | | 0 | 1 | 2 | 3 | 4 | |
| Core Type | 2 | Count | 88 | 97 | 166 | 84 | 68 | 503 |
| | | Row % | 17 | 19 | 33 | 17 | 14 | 100 |
| | | Column % | 41 | 43 | 53 | 50 | 60 | 49 |
| | 5 | Count | 44 | 58 | 58 | 40 | 25 | 225 |
| | | Row % | 20 | 26 | 26 | 18 | 11 | 100 |
| | | Column % | 21 | 26 | 18 | 24 | 22 | 22 |
| | 6 | Count | 82 | 69 | 92 | 45 | 21 | 309 |
| | | Row % | 27 | 22 | 30 | 15 | 7 | 100 |
| | | Column % | 38 | 31 | 29 | 27 | 18 | 30 |
| Total | | Count | 214 | 224 | 316 | 169 | 114 | 1037 |
| | | Row % | 21 | 22 | 30 | 16 | 11 | 100 |
| | | Column % | 100 | 100 | 100 | 100 | 100 | 100 |

Table 5.5: Cross-tabulation of the most common core types and their remaining potential.

Table 5.5 shows that of the three most common core types the less platforms there are on the core the higher the tendency for it to be discarded when there is still definite potential remaining. This is in line with the suggestions made in the last paragraph that these three core types effectively represent different stages of the same reduction strategy. Those cores that are discarded after the use of only one platform have been rejected earlier on in the reduction sequence and so are more likely to be recognised as abandoned. It might seem logical that regardless of similarities in the style of reduction, cores with more platforms are more likely to be exhausted due to more of the surface of a core being utilised but this is not necessarily the case. Indeed, if care had been taken over the reduction of single platform cores they could just as easily have been worked until exhaustion.

If it is accepted that the classifications of the most common cores might represent different stages of the same reduction sequences it must also be realised that the same applies for several other categories. This is particularly the case for Clark's core types B1 (my core type 3) and B2 (my core type 4) (see Table 5.3 and Appendix 1 for descriptions). In this case, including the three most common core types discussed above, these five types of cores may represent the same strategies towards reduction. If so, differences in the number and orientations of platforms may only reflect slightly different approaches towards the rotation of the core. The relative frequencies of the different core types would then indicate preferences for the extent and manner in which a core is rotated. It is notable that a feature of this *ad hoc* technology is the use of the affordances of the existing shapes of nodules to minimise the need for core preparation and maintenance (Plates 65 and 80). Therefore, the degree of rotation of cores may have simply represented the easiest choice given the shape of the nodule.

Accordingly, the value of Clark's (Clark *et al* 1960) core typology should be questioned in terms of the way in which it categorises different types of cores. It would be preferable if the categories represented distinct technological *approaches* to core reduction. However, given the unsystematic character of Late Neolithic and Bronze Age lithic technologies, it can be argued that many of Clark's categories represent the same *attitude* to core reduction. Therefore, differences in the relative proportions of these categories only provide meaningful information about the point of rejection of and type of rotation of cores and not necessarily the technique of their reduction or the technological character of the core.

#### 5.2.5.2 The distribution of core types

Due to the issues outlined above, the data for the proportions of core types must be treated with caution. Although, it may be questioned to what extent different categories refer to distinct types of cores, the information is still of some value as it details the number and orientation of platforms. Accordingly, the data are considered here.

The relative proportions of the different core types within the assemblage as a whole have already been considered. From these data, it has been shown that the most common types are cores with single platforms, ones with two platforms at right angles and those with three or more platforms (Table 5.3; Figs. 5.4 and 5.5). The data for individual sample areas indicates a general agreement with this pattern but there is a higher degree of variation than was witnessed with many of the flake attributes. To a certain extent, this variation relates to the combination of small numbers of cores from some areas and the infrequency of certain core types.

Due to its extent, it is not possible to describe all of the variation between sample areas but the data are presented as bar charts (Figs. 5.4 and 5.5). Despite the criticisms of Clark's typology, within the data certain patterns can be understood in relation to the patterning of previous attributes. In particular, Aerodrome (79), Ammo Dump (80), King Barrow Ridge (57), Nile Clump (70), Winterbourne Stoke Crossroads (50) and Well House (83) all have relatively high proportions of core type 1 cores (Clark type A1) (Fig. 5.4). Of these areas, Well House (83) has 23 % of this type of core, twice the amount from any other area. Within Clark's typology this type of core is different because although it describes cores in the same manner, the type of core it describes tends to be quite specific (Plate 33; c.f. Sections 6.4.2 and 6.4.3). Essentially, this category refers to single platform cores that have removals all of the way around the platform. Due to the difficulty of this type of working, the cores that fall into this category tend to be quite carefully worked cores, which produce elongate flakes (often blades). This is also indicated by the much more systematic character to the working of these cores (Table 5.4). In this respect, the fact that Well House (83) has such a large proportion of these cores is unsurprising taking into account the other data that have been considered so far. It can now be shown that the much larger and elongate flakes and more systematic cores from this area relate to the working of single platform cores, some of which are very large examples (Plate 21).

Although, the data for Well House (83) are unsurprising, it is noticeable that, apart from Winterbourne Stoke Crossroads (50), none of the other areas from the dry valley that runs from Wilsford to Rox Hill, have high proportions of core type 1 cores. This is particularly so for The Ditches (77), The Diamond (59) and Rox Hill (82); areas that have stood out in respect to many of the same attributes as Well House (83). However, despite not having particularly high proportions of core type 1 cores, all three areas do have the highest proportions of single platform cores that have been worked part of the way around (core type 2 cores) (Fig. 5.4). As discussed (Section 5.2.5.1), the problem with this category is that it conflates two very different types of cores. This issue is highlighted again here. As can be seen from Table 5.6 the core type 2 cores in the three areas just mentioned were worked much more systematically than those from the rest of the assemblage.

| Area Name | Character of Working | | | | No. of Core Type 2 Cores |
|---|---|---|---|---|---|
| | 0 Unsystematic | 1 Semi-systematic | 2 Systematic | 3 Indeterminate | |
| Rox Hill (82) | 40% | 57% | 3% | 0% | 35 |
| The Diamond (59) | 46% | 43% | 8% | 3% | 37 |
| The Ditches (77) | 39% | 22% | 22% | 3% | 18 |
| All Cores | 68% | 25% | 5% | 2% | 508 |

Table 5.6: The proportions of different categories of character of working for core type 2 cores.

What Table 5.6 suggests is that the more systematically worked cores from the three sample areas are not the same style of cores as the majority of core type 2 cores in the assemblage as a whole. Therefore, the difference between these cores and those from areas such as Well House (83) is that production has not occurred all of the way around the platform. As with previous examples, cores from two of Clark's categories probably represent the same type of reduction technique worked to different extents.

Another related pattern linking the areas from the Winterbourne Stoke to Rox Hill dry valley is the relatively low proportion of the most common multi-platform core types. Rox Hill (82), Well House (83), The Diamond (59) and the Ditches (77) all have below average proportions of either core type 5 (two platforms at right angles) or core type 6 (three or more platforms) cores or normally both (Fig. 5.4).

The above patterns indicate that the emphasis in these areas is on controlled single platform reduction and that in less cases core rotation is used as an easy option for rejuvenation. It is possible that this pattern is connected to the tendency for cores in this area to be abandoned with potential remaining, hence leaving more single than multi-platform cores. However, the more systematic character of the technology does not suggest that the type of core reduction in this area is the same as in the rest of the Stonehenge Environs.

The reverse of the above situation is found in several areas where there is a preference towards multi-platform reduction and low proportions of single platform cores. This pattern occurs at Stonehenge Triangle (54), Woodhenge (60), West Field (68), Horse Hospital (64), Durrington Down (65), Home Fields (72), Luxenborough

(84) and Ammo Dump (80) (Fig. 5.5). The distribution of these areas tends to be a little spread with two areas lying close to Stonehenge and the rest around the margins of the study area to the north of the Stonehenge Cursus and to the far East of King Barrow Ridge near Woodhenge. It is surprising that the areas with more multi-platform cores are not the same as those with more flakes with multi-directional flake scars (Section 4.3.5). This might possibly suggest the movement of cores but this seems highly unlikely considering the wasteful and expedient character of the reduction sequence under consideration.

Within the assemblage 'keeled' cores (Plate 80) are relatively uncommon and there seems to be little patterning in their distribution. Despite this there does seem to be a slight affiliation with areas with low proportions of single platforms and those that have large quantities of multi-platform cores such as at Cursus West End (62) and Luxenborough (84) (Fig. 5.5).

It is difficult to discuss the relative proportions of those core types that have not already been dealt with because they are represented by such small numbers (e.g. levallois cores and Kombewa type cores; c.f. Table 5.3). Accordingly, the distribution of these cores is discussed more fully in the Chapter 6 (Sections 6.2.3 and 6.2.4).

### 5.2.6 Platform type

As discussed in Section 5.1.1, problems were encountered with how to quantify the number and types of platforms. The first method of dealing with this situation is to assess which types of platforms are the most dominant. For example, if a core is recorded as having one prepared platform and two using negative flake scars, and then the latter is recorded as the most common or dominant type. One problem with this approach is that where there are equal numbers of different types of platforms information is lost as none can be regarded as dominant. This is particularly the case for cores with two platforms as often one is prepared and one uses negative flake scars. In such cases, it would have been more preferable to assess which of the platforms was more productive with the core in hand, but unfortunately, this problem was not realised until the analysis had been completed.

| | | | Dominant Platform Type | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 0 Indeterminate | 1 Prepared | 2 Use of Negative Flake Scar | 3 Use of Existing Flake Surface | 4 Unmodified | Total |
| Total No. of Platforms | 0 | Count | 49 | 0 | 0 | 0 | 0 | 49 |
| | | Row % | 100.0 | 0 | 0 | 0 | 0 | 100.0 |
| | | Column % | 21.0 | 0 | 0 | 0 | 0 | 2.9 |
| | 1 | Count | 0 | 506 | 195 | 32 | 38 | 771 |
| | | Row % | 0 | 65.6 | 25.3 | 4.2 | 4.9 | 100.0 |
| | | Column % | 0 | 68.6 | 32.0 | 80.0 | 70.4 | 46.1 |
| | 2 | Count | 153 | 183 | 159 | 2 | 10 | 507 |
| | | Row % | 30.2 | 36.1 | 31.4 | .4 | 2.0 | 100.0 |
| | | Column % | 65.7 | 24.8 | 26.1 | 5.0 | 18.5 | 30.3 |
| | 3 | Count | 3 | 45 | 156 | 4 | 4 | 212 |
| | | Row % | 1.4 | 21.2 | 73.6 | 1.9 | 1.9 | 100.0 |
| | | Column % | 1.3 | 6.1 | 25.6 | 10.0 | 7.4 | 12.7 |
| | 4 | Count | 28 | 4 | 98 | 2 | 2 | 134 |
| | | Row % | 20.9 | 3.0 | 73.1 | 1.5 | 1.5 | 100.0 |
| | | Column % | 12.0 | 0.5 | 16.1 | 5.0 | 3.7 | 8.0 |
| | 5 | Count | 0 | 0 | 1 | 0 | 0 | 1 |
| | | Row % | 0 | 0 | 100.0 | 0 | 0 | 100.0 |
| | | Column % | 0 | 0 | 0.2 | 0 | 0 | 0.1 |
| Total | | Count | 233 | 738 | 609 | 40 | 54 | 1674 |
| | | Row % | 13.9 | 44.1 | 36.4 | 2.4 | 3.2 | 100.0 |
| | | Column % | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 5.7: Cross-tabulation of the number and dominant types of platforms on cores.

Because the core typology was predicated upon the number and orientation of platforms, the data for the dominant platform types reflect that for core types (compare Figs. 5.4 and 5.5 with Figs. 5.6 and 5.7). The main dominant platform types are 'prepared' and 'use of negative flake scar'. The proportions of these two categories reflect the proportions of cores with single platforms and those with multiple platforms. The reason for this is that the majority of single platforms are prepared where as the more platforms on a core the greater the tendency to use the negative flake scars (or facets) of previous flaking surfaces as platforms (i.e. through core rotation) (Table 5.7).

Due to the nature of the relationship just outlined, many of the areas that have high proportions of mainly prepared platforms were also identified as having greater quantities of single platform cores and more systematically worked cores. This is the case at King Barrow Ridge (57), The Diamond (59), The Ditches (77), Aerodrome (79), Rox Hill (81) and Well House (83) (Fig. 5.6; c.f. Sections 5.2.4 and 5.2.5).

The opposite pattern to the above is also replicated as many of the areas indicated as having more multi-platform cores; also have higher proportions of cores that use negative flake scars as the dominant type of platform. This is the case at Horse Hospital (64), Durrington Down (65), Home Fields (72), and Luxenborough (84) (Fig. 5.7; c.f. Section 5.2.5). In addition, Stonehenge Triangle (54), King Barrow Ridge East (69), Spring Bottom (78), South of Cursus (85) and Rox Hill Unsown (86) also have higher proportions of cores using negative flake scars as the dominant type of platform (Fig. 5.7). The extent of these locations indicates areas where rotation of cores was a more common approach to core rejuvenation.

Two other types of platform have not yet been discussed. The first type is cores that use existing surfaces as platforms. These are predominantly cores made on flakes where the ventral surface of the flake is used as a platform. The second is cores that have unmodified platforms; these include naturally patinated, thermal or cortical surfaces that have been used as platforms without modification. Both of these groups are relatively uncommon and although ubiquitous in small numbers there are no areas with particularly high proportions of cores with *dominant* platforms of this type. One exception to this rule is at New King (87) where there are unusually similar proportions of several different platform types including cores with mainly unmodified platforms (Fig. 5.6). This is surprising considering that this area also has relatively high proportions of more systematically worked cores (Section 5.2.4). However, the area also had high proportions of hinged, stepped and plunging terminations as well as flakes with high length:breadth ratios (Sections 4.3.3 and 4.3.6). Perhaps these contrasting proportions of different attributes suggest the existence of two parallel forms of technology at New King (87) (c.f. Section 6.1.1).

It is possible that due to the method used here the occurrences of the two types of less common platforms are under-represented. It must be remembered that the data for dominant platform types only record the most common type of platform on a core. This is not so problematic for cores using existing flake surfaces as platforms because these are mainly cores made on flakes, which usually have only one platform. However, the situation is more problematic for cores with unmodified platforms as they have a tendency to be only one (often the first) amongst several platforms, the majority of which use negative flake scars. Hence, there is a tendency for this type of platform to be slightly under-represented in favour of cores with a majority of platforms using negative flake scars. Of the 121 cores with unmodified platforms, only 54 are recorded as having unmodified platforms as the dominant type on the core.

5.2.7 Platform maintenance

Four types of platform maintenance were recognised during the analysis. These were platforms showing signs of trimming, faceting, trimming and faceting or rejuvenation. In general, signs of platform maintenance were rare occurring on just 6% of recorded cores. Within the separate categories, trimming was by far the most common form of platform maintenance followed by faceting (Table 5.8). There were equal amounts of cores that showed signs of either both trimming and faceting or core rejuvenation but these represented under 1% of measured cores.

| | | | Platform Maintenance | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 0 None | 1 Trimming | 2 Faceting | 3 Trimming & Faceting | 4 Rejuvenation | Total |
| Dominant Production Mode | 0 Indeterminate | Count | 692 | 21 | 10 | 6 | 4 | 733 |
| | | Row % | 94.4 | 2.9 | 1.4 | 0.8 | 0.5 | 100.0 |
| | | Column % | 44.0 | 44.7 | 38.5 | 46.2 | 30.8 | 43.8 |
| | 1 Elongate | Count | 138 | 15 | 10 | 6 | 3 | 172 |
| | | Row % | 80.2 | 8.7 | 5.8 | 3.5 | 1.7 | 100.0 |
| | | Column % | 8.8 | 31.9 | 38.5 | 46.2 | 23.1 | 10.3 |
| | 2 Broad | Count | 683 | 11 | 6 | 1 | 5 | 706 |
| | | Row % | 96.7 | 1.6 | 0.8 | 0.1 | 0.7 | 100.0 |
| | | Column % | 43.4 | 23.4 | 23.1 | 7.7 | 38.5 | 42.2 |
| | 3 Squat | Count | 60 | 0 | 0 | 0 | 1 | 61 |
| | | Row % | 98.4 | 0 | 0 | 0 | 1.6 | 100.0 |
| | | Column % | 3.8 | 0 | 0 | 0 | 7.7 | 3.6 |
| Total | | Count | 1573 | 47 | 26 | 13 | 13 | 1672 |
| | | Row % | 94.1 | 2.8 | 1.6 | 0.8 | 0.8 | 100.0 |
| | | Column % | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 5.8: Cross-tabulation of the dominant mode of production with evidence for platform maintenance on cores.

Cross-tabulation of the proportions of different types of platform maintenance with the dominant production mode of cores clearly indicates that although platform maintenance is rare, in relative terms it is much more common amongst cores which produced mainly elongate flakes (Table 5.8). Similar cross-tabulation also shows that it is more common amongst cores with predominantly prepared platforms and also those with only one or two platforms. Unsurprisingly, these findings indicate that platform maintenance is mostly associated with single platform cores (or sometimes cores with two platforms) with prepared platforms producing elongate flakes. This does not necessarily mean that these examples are all blade cores but they have been worked with the same basic approach towards a more controlled reduction.

Only five cores predominantly using negative flake scars as platforms also showed signs of platform maintenance. This clearly indicates that the use of negative flake scars as platforms was used as an *easy* method of core *rejuvenation*. As such, no attempt was made to subsequently maintain these new platforms in any way. Most likely, problems encountered on these new platforms were simply treated with either further rotation or rejection of the core. In either case, it is indicative of the lack of concern for either the productivity of the core or the shape of the resultant flakes.

Due to the small proportion of cores showing signs of platform maintenance, it is difficult to compare different sample areas either in terms of proportions, Z-scores or even bar charts. This is because the combination of small sample sizes and a category of material representing small percentages of the assemblage provides a tendency for under-representation. It is noticeable that nearly all of the sample areas that have no recorded incidences of platform maintenance also have particularly small assemblages. However, it is clear that in general platform maintenance is uncommon in all sample areas. Table 5.9 presents the sample areas with the highest proportions of platform maintenance and the proportions of different types.

It is clear that all of the areas in Table 5.9 apart from Ammo Dump (80) have repeatedly mentioned as having more systematic cores with a tendency towards production of elongate flakes and cores with fewer platforms. Accordingly, it is of little surprise that these cores also have higher occurrences of platform maintenance. Within the overall tendency for platform maintenance in these areas there seems to be little concordance as to its character. In some sample areas trimming or faceting of platforms seems to be preferred, whilst others rejuvenation is. It is hard to correlate these patterns as the two are not mutually exclusive techniques of platform control. Trimming or faceting of platforms is largely directed towards rectifying or improving minor problems such as slight overhang, whilst core rejuvenation is most often used to resolve more serious problems that cannot be overcome in any other way.

| Area Name | Proportion of core with platform maintenance (%) | | | | | No. of Cores |
|---|---|---|---|---|---|---|
| | Trimmed | Faceted | Trimmed and Faceted | Rejuvenated | Total | |
| Aerodrome (79) | 6.5 | 3.2 | 0 | 0 | 9.7 | 31 |
| Ammo Dump (80) | 14.3 | 0 | 0 | 0 | 0 | 21 |
| Nile Clump (70) | 0 | 0 | 8.6 | 2.9 | 11.5 | 35 |
| Rox Hill (82) | 6.3 | 2.5 | 2.5 | 0 | 11.3 | 79 |
| The Diamond (59) | 10.9 | 1.1 | 0 | 0 | 12 | 92 |
| The Ditches (77) | 0 | 2.3 | 0 | 11.4 | 13.7 | 43 |
| Well House (83) | 0 | 3.2 | 3.2 | 9.7 | 16.1 | 30 |

Table 5.9: The sample areas with the highest incidences of platform maintenance and the proportions of different types.

The presence of Ammo Dump (79) within the list of areas in Table 5.9 is a little surprising as the material there has not appeared to be of the same quality as the other areas. However, the proportion of cores with platform maintenance maybe over-represented as only 21 cores were sampled in this area. Of these cores only three actually showed signs of platform maintenance two of which were single platform cores (Clark Type A1) producing elongate flakes.

### 5.2.8 Core production type

Assessing the rough morphology of the flake scars left on cores provides an indication of the character of the flakes that they produced. The data for this attribute were recorded in a similar fashion to those for platform type (Section 5.2.6). The production of three types of flakes was assessed (elongate, broad or squat) and the degree of production of that type of flake recorded. Accordingly, similar problems were faced in reducing this information to a single attribute as those discussed for platform type (Section 5.2.6). Again, when providing an assessment of the dominant type of production, there was a problem in the over-representation of the 'Indeterminate' category. This category represents cores where equal levels of production of two or more types of flakes had occurred. The large quantity of cores in this category is indicative of the fact that many cores did not exclusively produce flakes of one type (or shape). This lack of standardised production reflects the general lack of core control, which leads to a lack of control over the shape of the resultant flakes.

When considering the proportions of different types of flake production it is clear that by far the majority of cores produced broad flakes (Table 5.10). This pattern is also indicated in the data for the *dominant* type of *production* for cores (Fig.5.8). In these data, it is possible that squat and especially elongate flakes are under-represented because they are produced on cores alongside other types of flakes. Cross-tabulation shows that high proportions of cores producing elongate and squat flakes also produce equal amounts of broad flakes. This indicates that broad flake production is dominant whilst specific production of either elongate or squat flakes is relatively uncommon.

| | | Extent of Production | | | |
|---|---|---|---|---|---|
| | | 1<br>Productive/<br>Limited | | 2<br>Productive | |
| Production Type | Elongate | 302 | 18.0% | 430 | 25.7% |
| | Broad | 404 | 24.1% | 1058 | 63.2% |
| | Squat | 366 | 21.9% | 327 | 19.5% |

Table 5.10: The number and proportion of cores producing different types of flakes.

Despite the predominance of cores producing mainly broad flakes, the data shows that this is not the case for all sample areas. Several areas, which have been shown in previous sections to have higher proportions of more systematic single platform cores, also have higher proportions of cores producing predominantly elongate flakes. This pattern occurs at Nile Clump (70), The Ditches (77) and especially at Well House (83) (Fig. 5.8). One surprising factor is that several areas that were similar to the aforementioned areas in terms of core type and their character of working do not produce above average proportions of cores producing predominantly elongate flakes. This is the case at The Diamond (59), Aerodrome (79) and Rox Hill (82). It is unclear what this pattern refers to especially as these same areas had flakes with above average mean length:breadth ratios (Sections 4.3.3 and 4.4.2.1.2.).

Several areas have unusually high proportions of cores producing mostly broad flakes. These areas are Horse Hospital (64), Durrington Down (65), Normanton Bottom (67), King Barrow Ridge East (69), South of Cursus (85), Rox Hill Unsown (86) and Normanton East (88). Many of these areas were noted to have relatively high quantities of multi-platform cores (Section 5.2.5), which confirms that such cores produce predominantly broad flakes.

### 5.2.9 Core potential remaining

The potential remaining on cores was recorded on a five-point scale varying between exhausted and abandoned (Appendix 1). Where a core fitted within this spectrum was decided through assessing a series of factors such as the size of a core or the occurrence of hinge fractures. Assigning a core to a spectrum between exhausted and abandoned requires a high degree of judgement and is often dependent upon an understanding of the properties of flint knapping and possible methods of core rejuvenation. In this respect, judgement also involves an assumption of the character of the technology that is being applied. For example, size alone is often not a good indication of how much potential remains in a core. A small, finely worked, blade core may have much more potential for further removal of flakes than a much larger poorly worked core where careless reduction has led to total loss of the flaking angle (compare Plates 64 and 68 with Plate 67). In addition, between the two examples the likely techniques and therefore potentials for core rejuvenation are quite different and a judgement of these is necessary in order to assess whether a core is exhausted or not.

Under such conditions the decisions that have been made could be described as 'subjective', however it is important to realise that they are also informed. Most importantly, they are also *consistent* throughout the course of the analysis. A sign of this consistency was the need to add two further categories to what had originally been a three-point scale (i.e. exhausted, potential limited, abandoned) because too many cores fell between the originally broad definitions. As the data produced in this manner are ranked and not ratio data, it is more difficult to quantify or summarise them into single values (e.g. means) that can be directly compared with one another. Accordingly, the method used here to distinguish any patterning is visual comparison of the data represented as bar charts.

The data for the potential remaining in cores at discard indicate a relatively high degree of variation between sample areas (Fig. 5.9). The most common category is cores that have limited potential remaining (Fig. 5.9). This category refers to two main types of cores:

1) Cores whose immediate productivity is either limited or prevented by a feature that could be corrected but where correction of the problem would leave the core too small for significant further production.
2) Cores whose productivity is limited (not exhausted) mainly by size or the presence of natural flaws, meaning that further flakes could be removed but only in limited numbers.

In the assemblage as a whole, the distribution is spread quite evenly between categories but favours cores that have limited potential or are exhausted (Fig.5.9). Considering the character of the majority of the technology in the area, rather than this pattern being a feature of the careful curation of flint resources, it reflects the poor quality with which cores have been worked; the lack of platform control and core rejuvenation strategies.

The sample areas can be split into two broad groups one with relatively high proportions of cores rejected with little potential remaining and one with more cores abandoned whilst still workable. The first group is the most common and is typified by areas such as Stonehenge Triangle (54), Woodhenge (60), Horse Hospital (64), Durrington Down (65), Nile Clump (70), Railway (71) and Luxenborough (84) (Fig. 5.9). The second group of areas, with more cores rejected whilst significant potential remained, consists of The Diamond (59), Home Fields (72), The Ditches (77), Well House (83), Normanton East (88), Pig Field (74) and Bunnies Playground (75). Of this group, the last two areas were represented by only nine and eleven cores respectively.

The distribution of these two groups in the Stonehenge landscape indicates two broad areas. It is noticeable that the group of areas with cores rejected earlier on in the reduction sequence lies mainly along the dry valley running from Wilsford and Winterbourne Stoke to Rox Hill. The association of this area with cores rejected earlier on in the reduction sequence has also been suggested from the analysis of other attributes. In particular, it was shown that the average core weight in this area was high (Section 5.2.1). In addition, the same area was suggested to have higher proportions of more systematically worked cores. As suggested above, the fact that there is a higher proportion of cores of this type here is linked to the judgement of the potential remaining in them as generally the degree of control over flaking surfaces and platforms in systematically worked cores means that they will be productive for longer than expedient types. Therefore, the significance of this pattern is not immediately clear.

### 5.2.10 Core rejection

Several different problems affecting further core reduction were recorded during the analysis, such as the loss of flake angle or the occurrence of edge recession, hinge fractures or natural flaws. As such, these issues largely determined the overall assessment that was made of the potential remaining in cores, which has been discussed above.

The most common reason behind core rejection is the loss of the flaking angle between the platform and the flaking surface (Table 5.11). The high incidence of this problem is symptomatic of the poor core control that typifies much of the assemblage. In particular, multi-platform cores tended to have only minimal preparation of platforms and little maintenance. In addition, attempts to regulate flake shapes or size through the development of the flaking surface or shaping of the core are uncommon. The lack of control over the flaking surface means that in many cases platforms have to be abandoned when the flaking angle reaches 90°. The normal reaction to this is rotation of the core. If the loss of flaking angles continues to be a problem on subsequent platforms, cores eventually become almost spherical or cuboid, until no further flakes can be removed.

| Core Rejection Factor | Extent of Problem | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | 0 Slight | | 1 Medium | | 2 Heavy | | | |
| Flake Angle | 47 | 2.8% | 130 | 7.8% | 5 | 0.3% | 182 | 10.9% |
| Edge Recession | 59 | 3.5% | 63 | 3.8% | 3 | 0.2% | 125 | 7.5% |
| Hinge Fractures | 45 | 2.7% | 87 | 5.2% | 4 | 0.2% | 136 | 8.1% |
| Natural Flaws | 15 | 0.9% | 23 | 1.4% | 16 | 1.0% | 54 | 3.2% |

Table 5.11: Factors behind core rejection showing the number and proportion of cores affected.

In cases where attempts are made to continue to remove flakes after losing the flaking angle, edge recession sometimes leading to crushing of the lip of the platform can occur. This also encourages the creation of hinge and step fractures. There are roughly equal amounts of both in the assemblage (Table 5.11). According to Harding (1990a, 218), a reasonably low occurrence of edge recession suggests an appreciation of the point at which a core becomes unworkable. The proportion of cases in the assemblage here are comparable to those recorded on assemblages from the intensive collection and excavation of ploughsoil and subsoil contexts by the SEP at Robin Hood's Ball (W83), King Barrow Ridge (W59) and Wilsford Down (W31) (*ibid.*).

Despite the above, cross-tabulation indicates that the different factors behind core rejection most often do not appear on the same cores. The reason for this is perhaps that the occurrence of one, such as edge recession, might remove signs of the occurrence of others. In either case, despite the relatively low proportions of cores with any single cause for core rejection, over 21% of all cores have some signs of one of the three main causes. This figure is probably more representative of the overall lack of controlled reduction techniques within the assemblage as a whole.

### 5.2.11 Cores reused as hammerstones

Roughly 6% of cores also show signs of being reused as hammerstones. It was noticed during the analysis that cores that were used as hammerstones were often of a good size and shape to fit the hand. Many such cores had been worked until becoming spherical before use as hammerstones further crushed and rounded edges. This selection is unsurprising as unwanted fractures or flakes are much less likely to occur on hammerstones made from rounder cores due to the lack of flaking angles on any surfaces.

The cores that have been reused as hammerstones have a mean weight of 156g compared to the average core weight of 124g, they also have a higher C.V.. This indicates that there is a wider variation in the weights of cores used as hammerstones than in the population as a whole. This probably relates to the selection of a wide range of sizes of hammerstones according to different tasks such as early preparation of cores or later trimming of platforms. Their higher mean weight gives a further indication that selection was made of appropriately weighted cores. No cores under 53g showed signs of reuse as hammerstones even though almost 20% of cores were under this weight. Due to the small numbers involved, the distribution of hammerstones is dealt with in Chapter 6 (Section 6.2.6.2).

## 5.3 Discussion

In the preceding sections, the character of the data for individual flake and core attributes has been described. The most consistent feature of these data, especially concerning flakes, has been the level of homogeneity between different sample areas. However, within this similarity, patterns of variation have begun to emerge. The detection of this level of variation is mostly due to the detail of the analysis and can be only understood through assessing combinations of attributes. In this respect, certain sample areas have been mentioned in regard to several different attributes, indicating that a level of technological variation exists in the material from the Stonehenge Environs that was hitherto unrecognised. It must be said that some elements of this variation were tentatively suggested by the SEP (Richards 1990; Section 2.3.1), but due to the basic level of analysis carried out by the project the extent of these differences could not be properly understood.

It is now necessary to summarise the findings of the analysis and discuss both the overriding homogeneity and the elements of variation that have been identified in the landscape around Stonehenge.

### 5.3.1 Comparisons between flake data and core data

As suggested, there is a considerable degree of homogeneity in the material from the Stonehenge Environs. In retrospect, this is most typical of the data from the analysis of flakes. It has been the analysis of cores that has most clearly highlighted differences between sample areas and given meaning to the more subtle patterns of variation within the assemblages of flakes. The reasons for this relate to difficulties of the palimpsest nature of ploughsoil assemblages. The conflation of many different reduction sequences can make distinctions of differences based purely on waste flakes very difficult. In contrast, cores are more individually indicative of particular technological processes. Although the portability of cores remains a problem, it is for example, much easier to identify the presence of blade production in a lithic scatter by finding a blade core rather than identifying the element of blades within the mass of other forms of debitage. In future, it would be profitable to emphasise the importance of the analysis of cores when studying ploughsoil assemblages. However, it must also be stressed that it is only through the relationship of cores and flakes that the full character of technology can be understood. In this respect, it is necessary to provide a comparison between the data measured for flakes and cores.

In general, there is concordance between the data for flakes and cores. For example, with a few notable exceptions (Section 5.2.1) the distributions of Z-scores indicate that areas with heavier cores also have heavier flakes (Plates 6 and 9). This pattern reveals the tendency for smaller flakes and cores in the group of areas east of King Barrow Ridge compared to heavier ones in the areas south and west of Stonehenge stretching along the dry valley from Winterbourne Stoke to Rox Hill. Similar agreement also occurs when comparing the distributions of Z-scores for the average lengths of flakes with the lengths of flake scars from cores. Those areas with heavier cores also generally have longer flake scars on those cores and these same areas have heavier and longer flakes. In this respect, there seems to be a situation where larger cores also produce larger flakes.

Further detail is added to the picture when it is considered that the associated pattern of the size of cores and flakes is also replicated in the potential remaining in cores at the point of discard. This pattern is not so clear amongst the areas to the east of King Barrow Ridge, but many of the areas to the south and west of Stonehenge have cores which compared to other areas, have been discarded with more potential remaining in them. In this case, the suggestion is that the larger flakes and cores are also a product of the cores not having been worked as extensively as in other parts of the landscape.

Given the frequency of larger cores abandoned earlier on in the reduction sequence in the areas around Winterbourne Stoke and Rox Hill, it would be tempting to suggest that these areas were concerned primarily with the extraction of raw material and the early stages of reduction such as the trimming of nodules. Indeed, this was suggested by the SEP who described the broader area as the 'Normanton Bottom industrial zone' (Richards 1990, 22). However, the situation is not clear-cut. The SEP also suggested that such areas should be characterised by high proportions of more cortical flakes (primary flakes under the definition used by the SEP). Although a different type of cortex classification was used in the current analysis, a more detailed assessment of the amount of cortex remaining clearly shows that contrary to expectation, the SEP's 'Normanton Bottom industrial zone' is actually distinguished by areas with below average amounts of cortex on flakes (Plate 8; Section 4.3.4). Indeed, the only areas with above average amounts of cortex in this part of the landscape are Rox Hill (82) and Lake Bottom (89).

In light of the above, the size of some of the cores from Well House (83) indicates that some of the differences between sample areas in terms of the potential remaining in cores when rejected relate to variation in the size of nodules across the landscape. In addition, it is also possible that raw material is generally more abundant in this part of the Stonehenge landscape (Section 4.3.4), which may have lead to its more profligate use in this location.

Another area of general agreement between the data for flakes and cores is between multi-platform cores and high occurrences of flakes with scars running at 90° to the axis of the flake. Such flakes are the result of removals after the rotation of the core and high proportions of these are found alongside high proportions of multi-platform cores at Stonehenge Triangle (54), Durrington Down (65), Home Fields (72), Luxenborough (84), Winterbourne Stoke Crossroads (50), Horse Hospital (64) and Bunnies Playground (75). In the last three areas these types of flakes are found alongside high proportions of cores with two platforms at right angles to each other. This type of core is the most likely to produce flakes with scars running at 90° to the axis of the flake. In these areas, there is a clear technological correlation between certain types of cores and products distinctive of their working. As such, the consistent occurrence of both types of artefacts in the same sample areas lends much to the suggestion that these types of cores and their products were not being transported to different locations around the Stonehenge landscape. This is also in keeping with the expedient quality of this type of technology. In this respect, at a landscape scale, the ploughsoil assemblages around Stonehenge do not show any signs of spatial organisation or differentiation of the different phases of the reduction sequence.

5.3.2 The character of lithic technology in the Stonehenge Environs

As has been suggested, the vast majority of material from the SEP can be characterised as an unsystematic technique of core reduction producing mainly broad flakes. Within this, both single platform and multi-platform cores are common and the suggestion is that the majority of both types represent the same *character* of reduction sequence (Section 5.2.5). This technique of reduction is typified by a disregard for control over flake shape indicated by a lack of shaping of the core and flaking surface, lack of intentional placement of blows in relation to crests on the flaking surface and a lack of maintenance and preparation of the platform to facilitate removals. On flakes, this is indicated by the mass of broad flakes and the paucity of flakes with prepared butts.

This type of uncontrolled multi-platform technology is typical from the Late Neolithic onwards (Edmonds 1995, 80-2). Although something of a caricature, this shift in technology from the blade cores of the Early Neolithic is responsible for the oft-quoted shift from elongate to broad flakes over this period (e.g. Pitts 1978a; Pitts and Jacobi 1979). Another feature of Late Neolithic lithic technology is the profligate use of material (Edmonds 1998, 255) and this attitude seems to be exaggerated in areas with abundant flint resources (Schofield 1986). In Chapter 7 it will be shown that it is not only the presence of raw material that explains the abundance of debitage, but in the Stonehenge Environs the character of the majority of the material clearly points to a post-Early Neolithic technology (Section 8.3). The profligate character of this material also means that the remains of earlier activities are likely to be swamped by later patterns of activity.

However, despite the domination of material of the character that has just been described, there are elements of a more systematic type of technology within some of the individual sample area assemblages. The location of both types of technology will be discussed below.

5.3.2.1 Discussion of the homogeneity of data

A consistent theme in the discussion of the data, particularly for the analysis of flakes, has been the degree of homogeneity between assemblages from different sample areas. As this is such a central feature of the data, discussion of the significance of this pattern is warranted.

The first question to ask is why this level of similarity occurs. There are two obvious possibilities:

1) The overriding character of production is the same in all areas; all stages of the reduction sequence and all technological practices took place in all parts of the landscape.
2) Lithic scatters are palimpsests of material; over long periods, many different types of activities occur in the same locations ultimately resulting in amorphous and mixed assemblages.

It is not possible to provide a definitive statement as to which of these possibilities is correct. Undoubtedly, aspects of both arguments are implicated in the character of the ploughsoil assemblages in the Stonehenge Environs.

Consideration of the second suggestion must be taken seriously. The assemblages under study were accumulated over a period of at least two millennia and probably more. Over such a period of time, it is inevitable that there were changes in attitudes to all stages of lithic reduction. Equally, the life histories of individual locales must have changed significantly. Areas and landscapes that were perceived and inhabited in one way in the Early Neolithic were understood quite differently by the Early Bronze Age. The question is to what extent this has effected the composition of ploughsoil assemblages. Essential in answering this question is an understanding of the longevity of material traditions. In this respect, it is of benefit that some stoneworking traditions persist over the kinds of periods of time sympathetic to the chronological coarseness of lithic scatters. At least this is certainly the case in terms of the rate of change in the formal production of most tool types, which tend to persist for hundreds of years. If changes in technological practice took place at a very slow rate then it is more likely that ploughsoil assemblages are still representative of the character of particular processes, rather than combinations of diachronically different practices averaged over time. It is also necessary to understand that although there is great time depth to lithic scatters it is most likely that the vast majority of the material is derived from the Late Neolithic and Early Bronze Age (Section 8.3). In addition, both of these periods are dominated by similar attitudes towards the bulk of flint knapping. Furthermore, despite the character of the majority of material that blankets the landscape, elements of different technological processes survive. The presence of a more systematic method of reduction was identified within a restricted set of sample areas (Section 5.3.2.2). This indicates the persistence of these activities and shows that if similar practices were present in other areas it would be possible to detect them. Therefore, although the palimpsest character of lithic scatters is a problem, which can lead to homogenous assemblages, it is unlikely that this is the only factor that created the patterns under study here.

Given the above, it is still important to be realistic when considering the interpretations of ploughsoil assemblages. In particular, any associated chronologies will necessarily be broad and tentative. This can make it difficult to compare ploughsoil material with the other components of the archaeological landscape as often details of, for example, environmental or monumental sequences are understood through reference to a different chronological schema with a tighter resolution (c.f. Allen 1997). Accordingly, it should be realised that in areas with dense lithic scatters the only patterns that will be detected or interpreted will most often be long-term, broad-scale or intensive in character. Therefore, when we discuss the nature of inhabitation using this material any suggestions come with the corollary that this was probably the case *over time*. However, within these limits, the results of different landscape surveys have shown that there are differences in the nature of lithic practice between different landscapes and that these can be detected. Accordingly, it has been shown that these data are worth collecting and interpreting as they do tell us of local and regional variations in inhabitation.

In this light, it is the suggestion that similar technological practices took place in all parts of the landscape that probably provides the best explanation for the overall character of the SEP material. This suggestion only refers to the majority of material that creates the homogeneity between assemblages. It is not only a proposition that *similar* technological *practices* took place in all locations, but that these represented *all stages* of the reduction sequence. This is indicated by the similarities in the proportions of cortex on flakes, the occurrence of hinge fractures, the sizes and weights of flakes, the types of core and many other attributes. This possibility also seems likely due to the relatively widespread availability of flint in the area, which would make it unnecessary to transport raw material or prepared cores over significant distances.

This last factor may have serious bearing on the nature of our understandings of the level of homogeneity between ploughsoil assemblages in this landscape. It is apparent from work conducted in other landscapes that the degree of similarity in the Stonehenge Environs may be untypical. Examples are limited by the type of analysis presented in publications, but a good example is the work of Schofield in the Upper Meon Valley, southeast Hampshire (1988; 1991b; 1991c). Although, only using a restricted range of attributes, Schofield was able to show significant covariation between density and assemblage composition (mainly the proportion of cores) according to different parts of the survey area. This degree of covariation is not witnessed in the material from the Stonehenge Environs. The point is that the differences, which Schofield detected, were between areas located on different geologies with the major variation being that only one had naturally occurring flint deposits. Accordingly, in this project as with several others (e.g. Ford 1987a; 1987b; Chapter 7), major variation in assemblage characteristics occurred according to differences in surface geology and especially the presence of workable flint. As flint raw material is present across most of the Stonehenge landscape, it is perhaps unsurprising that the types of variation that have been witnessed in some projects are not apparent here. This realisation has serious consequences for the level of expectations of this particular dataset. It also indicates some of the possible differences in the manner in which different types of landscapes were inhabited.

The possibility that all stages of the reduction sequence took place in all areas is also suggested by the expedient quality of most cores. Such cores are characteristic of the quick reduction of nodules to produce usable flakes for tasks at hand, rather than the preparation of artefacts ahead of scheduled tasks (e.g. Myers 1989, Torrence 1989). The expedient attitude towards flint use is also hinted at by a small proportion of material that shows evidence of reworking some time after being originally discarded (Section 6.2.5; Plates 35 and 47). These pieces show that in some instances, there was no effort to even work a core in order to gain a flake, instead an old and already partly patinated flake or core was picked up and used after a little retouch to re-sharpen an edge. Accordingly, it is likely that much reduction of cores occurred for tasks that were carried out close by. Variations in the densities of material indicate that such activities did not take place to the same extent in all parts of the landscape, nonetheless they did occur across a significant proportion of it.

If the arguments above are accepted, then they have serious implications for our understandings of the nature of inhabitation of the Stonehenge landscape. In particular, it suggests that in technological terms the landscape cannot be divided into broad landscape zones. Instead, practices were piecemeal and showed no signs of organisation at the level of the landscape. This simple proposition is in direct disagreement with most previous interpretations of the Stonehenge landscape, which have orientated around the interpretation of monuments (Section 2.2). A detailed discussion of these approaches indicated the extent to which they describe the landscape as zoned and ordered, mainly through the observance of ritual. This degree of influence clearly could not have involved all areas of life, as indicated by the lack of organisation and structure in the material from the lithic scatters. This not only opens the possibility that certain spheres of life may have been lived differently, but also that perhaps all aspects of the inhabitation of this landscape need to be re-evaluated. These possibilities are pursued in more depth in Chapter 8.

5.3.2.2 Areas displaying systematic forms of technology

As has been suggested in previous sections, the vast majority of the material from the ploughsoil in the Stonehenge Environs represents the unsystematic, often multi-platform, reduction of cores producing broad flakes. However, several areas have also been mentioned repeatedly for having relatively high proportions of material displaying a more controlled approach to core reduction. For the most part this element is represented by higher proportions of more systematically worked, often single platform, cores. The different factors that suggest this pattern will now be summarised. However, before doing so it is essential to stress that although different forms of technology appear in these areas, they still only represent *elements* within assemblages of similar character to the rest of the material. In all areas (except Well

House (83)), where there are high proportions of systematic cores, there are still as many and often more examples of typically unsystematically worked multi-platform cores. Equally, in these areas broad flakes with no butt preparation dominate assemblages. This factor emphasises the ubiquitous and profligate character of the dominant form of reduction present in the assemblage. Given this, the fact that elements of a different type of technology can still be identified within some sample area assemblages indicates the duration and persistence of these types of practices in a few restricted locations.

The different character of working in certain locations was most obvious through the analysis of cores. For example, assessment of the character of working of cores revealed eight areas with comparatively high proportions of more systematically worked examples; these were King Barrow Ridge (57), The Diamond (59), Nile Clump (70), The Ditches (77), Aerodrome (79), Rox Hill (82), Well House (83) and New King (87). Table 5.12 provides a broad assessment of the relative proportions of certain categories of attributes for these sample areas. Although it indicates that no uniform pattern can be expected given the character of ploughsoil material, it does show that there is a consistent emphasis in these areas on relatively high proportions of more systematic, often single platform, reduction.

As many of the proportions in Table5.12 probably relate to the measurement of different attributes on the same artefacts (cores), it is perhaps unsurprising that there is an element of covariation with, for example, single platform cores also having prepared platforms and producing elongate flakes. However, credence is added to the suggestions of a different character of technology in these areas as they also have differences in their assemblages of flakes. In this respect, PCA was conducted on summarised data for all flake attributes for all areas (Section 4.4.3). In line with other means of description, PCA indicated the level of similarity between flake assemblages between different areas. However, it also successfully identified several areas that had flakes of a different character to the majority of areas. All of the areas that have been suggested here as having assemblages with cores of a different character, were also identified as having flakes which differed significantly from the rest. The fact that an independent analysis of flakes is in agreement with the assessment of cores, gives great weight to the suggestions made here.

| Area Name | Relative Proportions of Systematically Worked Cores | Relative Proportions of A1 type Cores | Relative Proportions of Prepared Platforms on Cores | Relative Proportions of Cores Producing Mainly Elongate Flakes | Relative Proportions of Platform Maintenance on Cores | Relative Proportions of Retouched Flakes | Relative Proportions of Prepared Butt Types |
|---|---|---|---|---|---|---|---|
| New King (87) | High | | | | | High | |
| King Barrow Ridge (57) | High | | High | | | Low | |
| Nile Clump (70) | High | High | | High | High | | |
| The Diamond (59) | High | | High | | High | | High |
| The Ditches (77) | High | | High | High | High | High | High |
| Rox Hill (82) | High | | High | | | | |
| Well House (83) | High | High | High | High | High | High | |
| Aerodrome (79) | High | High | High | | | | |

Table 5.12: The relative proportions of selected core and flake attributes of areas suggested to have elements of a more systematic technology.

In addition to the PCA, the analysis of individual flake attributes indicate that several of the areas in Table 5.12 also have relatively high proportions of flakes with prepared types of butts and of retouched flakes. Furthermore, all of these areas have above average length:breadth ratios indicating a tendency towards more elongate flakes (Plate 5), presumably the result of controlled single platform core reduction.

The spatial distribution of the areas with elements of a more systematic technology reveals that the majority come from either end of the dry valley running from Winterbourne Stoke to Rox Hill. In part, this pattern is in line with the SEP's suggestion that this area was a focus of 'industrial' activity, although they did not also identify this activity as having any specialised character (Section 2.3.1). However, the pattern suggested by the SEP is broken apart by the conclusion that in addition to these areas similar assemblage characteristics are noted in three areas near King Barrow Ridge (i.e. King Barrow Ridge (57), Nile Clump (70) and New King (87)) and one area just south of Stonehenge (Aerodrome (79)). It is also noticeable that all of these areas except Aerodrome (79) represent adjacent pairs (Plate 13).

Aspects in which these areas do differ from each other are the overall densities of flint and the proportions of cores compared to flakes. In terms of density, there is wide variation with Aerodrome (79) yielding 46 flints per ha. compared to the massive 449 flints per ha. at The Ditches (77). The latter area has by far the densest assemblage in the survey area. The same two areas also represent the extremes of the proportions of cores in the assemblages; at Aerodrome (79), the cores represent 11.7% of all material where as at The Ditches (77) the figure is 4.7%. In general, the level of variation between areas for both of these aspects is typical of the variation between sample areas as a whole. This means that there does not seem to be any consistent relationship between the areas highlighted here in this respect. It is possible that this is due to variations in the proportions of material that represent the more typical unsystematic technology in the area, processes that are seemingly unconnected with those under discussion here.

### 5.3.3 The findings of the Stonehenge Environs Project in light of current analysis

Following the detailed analysis of the material from the Stonehenge Environs, it is now possible to assess the conclusions that the SEP drew from the same set of material.

The main conclusions presented by the SEP have been detailed in Section 2.3.1. It has been shown that due to the severely limited character of their analysis very few interpretations of the material were put forward. This approach, partly influenced by the huge size of the assemblage, was typical of many landscape survey projects in that it sought mainly to identify areas of activity through a 'dots on map' approach that involved little understanding of assemblage composition or technological character.

The interpretations that the SEP presented mainly leant towards the identification of broad zones of activity identified principally through spatial variation in the density of material. The detailed descriptions of these zones are presented in Section 2.3.1.2 and summarised in Plate 43. Although there are few concrete conclusions drawn about the differences in the activities that the various areas represent, some suggestions were made. Overall, these are directed towards an assumed division between industrial and domestic activities. This hypothesis is clear in statements that outline the approach of the SEP towards functional analysis:

> "The first stages of reduction may often be associated with the procurement site, together constituting the 'industrial' side of the process... Subsequent stages, involving more portable elements of the reduction sequence, such as prepared cores or selected flake blanks, may take place on or near, habitation areas". (Richards 1990, 16).

Considering this statement it is unsurprising that ultimately the SEP divided the broad landscape zones accordingly. The area to the north of the Stonehenge Cursus (Area 3 on Plate 43) and the area stretching along the dry valley from Winterbourne Stoke to Rox Hill (Area 4 on Plate 43) were suggested to represent two 'lithic resource zones' (*ibid.*, 22). These are basically areas of 'industrial' activity; the first was more of an extensive and dense spread compared to the more nucleated activity in the second area.

In contrast to these two zones, functional interpretation of lithic scatters was only presented for one other area. Initially described as the 'Durrington Zone', this area around King Barrow Ridge and to the east was suggested to have a domestic emphasis. This was mainly due to interpretation of the ratios of tools to cores and waste flakes. In addition, it was suggested that:

> "In comparison [to the lithic resource zones]... the core weights... from King Barrow Ridge are consistently lower. This may suggest the curation of raw material... [or] may involve the utilisation of small, locally derived nodules." (*ibid.*, 22).

and:

> "... the concentrations of tools from the King Barrow Ridge... were not associated with high densities of lithic debris. This suggests activities involving the use and careful curation of flint presumably arriving as either prepared cores or flake blanks." (*ibid.*, 23)

These general statements about the lithic scatters from the Stonehenge Environs have the following implications:

1. The landscape can be divided on functional grounds into broad zones.
2. Lithic producing and using activities in the past can be separated into industrial and domestic components.
3. As there is possible curation of material and broad zones (industrial vs. domestic), prepared cores or flake blanks were transported within the landscape.

In light of the detailed technological and typological analysis that has now been carried out on the material collected by the SEP, their conclusions can be reconsidered.

Although many of the areas from the dry valley from Winterbourne Stoke to Rox Hill (Area 4 on Plate 43) have been shown to have material of a different character (Section 5.3.2.2) and unusually dense scatters, they cannot be described as one zone. Actually, the locations of these areas are at either end of the proposed zone and the areas in between, such as Bunnies Playground (75), West Field (68) and Whittles (73) do not fit within this pattern. Accordingly, activity is more localised than has been suggested.

The area to the north of the Stonehenge Cursus is not of the same character as the other 'lithic resource zone' to the south. There are no elements of a more systematic technology within the broad and densely scattered material in this area. In terms of assemblage composition and the proportions of different types of cores there is nothing to differentiate this broad zone from any of the other areas in the in the Stonehenge Environs.

In addition, the definition of these areas as 'lithic resource zones' is not confirmed by the present detailed analysis. The proportions of cores in sample area assemblages varies widely between the different areas within the zones, some below some above average. In addition, it would be expected that such areas would have high proportions of more cortical flakes and yet very few do. The highest proportions of cortical flakes actually appear almost exclusively outside of these zones (Plate 8). Furthermore, several of the areas in the southern 'lithic resource zone' also have some of the highest frequencies of retouched flakes (Section 4.3.9.3) which again is not an element expected within an 'industrial', type assemblage.

The area around King Barrow Ridge was also identified as a zone, this time of domestic character. Again, there is little to suggest this in terms of the compositions and technology present within this area. The areas within this supposed zone vary greatly in character and it has been suggest that of these, New King (87), King Barrow Ridge (57) and Nile Clump (70) actually share much in common with the areas that were included in the southern 'lithic resource zone' by the SEP (Section 5.3.2.2).

In order to test the hypothesis that the landscape could be split into broad zones the data for the different sample areas was grouped together according to their corresponding zones. This perhaps shows the clearest indication that this level of division is inapplicable. It would necessarily be expected that the data for these different zones would differ from each other according to their different suggested functions. However, Figs. 5.10 and 5.11, which represent the typical character of the data, clearly shows that this is not the case. In fact, the degree of homogeneity that previously characterised much of the data for individual sample areas is taken to the extreme once the data is grouped at a broader level. At this level there is almost no difference whatsoever between any separate areas of the landscape. If the assignation of different landscape zones is supposed to represent areas of functionally different and enduring processes, then the level of homogeneity of the data between areas irrevocably denies this possibility. This plainly indicates that the levels at which sample areas have been grouped together is far to broad meaning that differences between them have been lost in the process. The significance of this is that this means that differences in technological practice within the Stonehenge Environs were much more restricted and localised than the SEP suggested.

It has already been suggested that the Stonehenge landscape cannot be divided into 'industrial' or 'domestic' zones, as the character of the assemblages does not support this. However, it must also be questioned to what extent such terms are applicable in the first place. Such terminology creates a false dichotomy between practices that should all be understood to be embedded in social life. In addition, these particular labels carry unavoidable modern connotations about the character of different types of activities, connotations which may not be relevant to understanding prehistoric life (Section 2.3.1.4.2). Suffice to say that in this case, the theoretical disagreement with the application of these terms is backed up by the character of the lithic material.

One further implication of the division of the landscape into 'industrial' and 'domestic' zones is that this necessarily implies the movement of material from one to the other. Considering the results of the analysis, this possibility would seem highly unlikely. First, it is unclear for which periods the SEP suggests such activity. It is of course possible that this was the case, for example during the Early Neolithic, or for restricted sets of material such as core tools. However, the limited evidence that the SEP put forward to support this hypothesis seems to rely on discussion of the material making up the majority of assemblages. In this case, the argument seems much less likely. The main reason for this is that the vast majority of material represents an *ad hoc* and expedient approach to core reduction. When this is combined with the fact that flint is present across most of the landscape (albeit in slightly different qualities), it is highly unlikely that there can be any significant movement (or need for it) of prepared cores across any significant distances. If such practices were consistent over long periods of time it would also be expected that this would leave clear traces in assemblage composition, and these cannot be found. In addition, it has also been shown that areas with high proportions of flakes distinctive of core rotation are found in areas with high proportions of rotated cores. This suggests that cores and their products ended up in the same places and therefore were not transported. Finally, it would seem likely that the transportation and curation of flint would actually involve the careful, unwasteful working of the material at its end point and this is certainly not the character of the vast majority of material within the assemblage.

Accordingly, it has been shown that subsequent to a more detailed phase of analysis, many of the findings of the SEP can be brought into question. Rather than zoned and distinct practices, it is apparent that the organisation of practice was much more localised with probably many different elements of life being acted out side by side. In this sense, the industrial and the domestic were one and the same, each being implicated in the other.

## 5.4 Conclusions

In this and the last chapter, a full description of the data from the analysis of the sample of material from the SEP assemblage has been presented. The level of detail of this presentation is justified by the size and complexity of the assemblage under study. The main character of the material within the assemblage has been discussed and two main themes of *homogeneity* and *variation* have been identified. The significance of these findings has been suggested and will be picked up in more detail in Chapter 8.

In addition, the analysis of material has allowed a reappraisal of the interpretation presented by the SEP. This suggests that the current analysis is of importance in allowing a more complete understanding of the *character* of the lithic scatters surrounding Stonehenge.

Comprehensive though it has been, the current analysis is limited to a certain extent by its lack of sensitivity towards the spatial element of the data. This theme is elaborated in the succeeding chapter through a GIS based analysis of the same dataset. This does not replace the analysis presented in this chapter, as it is only through the combination of techniques that our understandings of the Stonehenge landscape can proceed.