The interpretation of surface lithic collections: case studies from southern England.

A.J.Schofield

Submitted to the Department of Archaeology, University of Southampton for the qualification of Doctor of Philosophy, May 1988.

List of contents

i title page
ii list of contents
iii list of figures
vii list of tables
xi acknowledgements
xiv preface
xv abstract

1. Chapter 1: Introduction.

8. Chapter 2: Sampling and the logistics of surface collection: towards a project design.

36. Chapter 3: The environmental mosaic: towards a regional model.

95. Chapter 4: The structure and content of surface scatters: general problems of interpretation.

155. Chapter 5: Towards an off-site methodology.

191. Chapter 6: The middle Avon valley survey.

333. Chapter 7: The upper Meon valley survey.

482. Chapter 8: The Avon and Meon valleys compared: a question of scale.

498. Chapter 9: Coarse-and fine-grained adaptation between the Mesolithic and Bronze Age: towards a regional context.

529. Chapter 10: Conclusions.

536. References.

List of Figures

Page	Figure	Title
11	2.1	The distinction between valley and downland.
13	2.2	location of the two survey areas.
18	2.3	relative merits of various surface collection strategies.
19	2.4	levels of spatial accuracy of various surface collection strategies.
27	2.5	settlement and land-use at Breamore.
29	2.6	record sheet used in survey.
30	2.7	record sheet used in survey.
44	3.1	temporal change in an English beech wood.
48	3.2	patch occupancy patterns for fine- and coarse-grained populations.
58	3.3	braided palaeochannels in the Kennet valley, Berkshire.
65	3.4	list of sites used in text.
66	3.5	summary diagram for Hampshire/Dorset area.
75	3.6	summary diagram for Wiltshire/Sussex area.
81	3.7	summary diagram for south coast areas.
87	3.8	summary diagram for Poole Harbour.
93	3.9	suggested impact of prehistoric communities on the valley profile.
94	3.10	extent of clearance episodes in valley and non-valley contexts.
108	4.1	spatial and temporal variation in activity domains.
112	4.2	assemblage composition vs. distance from source.
123	4.3	distinction between 'site' and hectare

based interpretation.
134 4.4 plan of trench and result of one-years ploughing.
139 4.5 results of second season after ploughing.
140 4.6 results of second season after ploughing and cultivation.
141 4.7 effect of ploughing on different artefact types.
147 4.8 extent of disturbance caused by plough and cultivator.

164 5.1 artefact scatters and their surface representation.
169 5.2 Neolithic house plans.
176 5.3 archaeological correlates for the core reduction sequence.

193 6.1 fields walked in the Avon valley.
196 6.2 windspeed and direction for southern England.
197 6.3 annual precipitation for southern England.
198 6.4 soil map for the Avon valley.
207 6.5 results of test-pitting.
221 6.6 flake size graph for SU 136139.
222 6.7 flake size graph for SU 160183.
226 6.8 division of sub-zones within survey area.
230 6.9 density variation.
231 6.10 proportion of retouched artefacts.
232 6.11 proportion of primary waste.
233 6.12 proportion of tertiary waste.
234 6.13 proportion of cores.
235 6.14 proportion of scrapers.
245 6.15 distribution of finds prior to survey.
305-332 6.16-6.43 scatterplots relating to regression analyses; order of graphs corresponds

to that in Table 6.9.

334	7.1	fields walked in Meon valley survey.
338	7.2	soil map for Meon valley.
346	7.3	results of test-pitting.
361	7.4	flake size diagram for SU 630215.
362	7.5	flake size diagram for SU 622226.
364	7.6	division of sub-zones within survey area.
367	7.7	density variation.
368	7.8	proportion of retouched artefacts.
369	7.9	proportion of primary waste.
370	7.10	proportion of tertiary waste.
371	7.11	proportion of cores.
372	7.12	proportion of scrapers.
378	7.13	density variation in area 1.
379	7.14	proportions of primary waste in area 1.
380	7.15	proportions of tertiary waste in area 1.
382	7.16	finds prior to survey.
386	7.17	blade frequency diagrams.
387	7.18	blade frequency diagrams.
395	7.19	density variation in area 2.
396	7.20	variation in frequency of retouched artefacts in area 2.
399	7.21	jadeite axe.
402	7.22	distribution of round barrows.
404	7.23	distribution of hinge-fractured flakes.
405	7.24	distribution of core-trimming flakes.
407	7.25	distribution of burnt flint in area 2.
454-481	7.26-7.53	scatterplots relating to regression analyses; order corresponds to that in Table 7.6.
483	8.1	ubiquity indices for Avon and Meon valley surveys.

504 9.1 artefact patterns in the Kennet valley.

List of Tables

Page	Table	Title
32	2.1	lithic attributes recorded for analysis.
51	3.1	flow chart showing factors affecting the nature of the environment.
98	4.1	assemblage characteristics for southern England.
100	4.2	list of diagnostic artefacts in Wessex.
105	4.3	retouched and unretouched tools from Lubbock Lake.
110	4.4	sites used in the ASDA Factor.
122	4.5	various definitions of 'site'.
130	4.6	excavation and survey in the Ewerne valley.
136	4.7	ploughzone experiment: contents of trench.
143	4.8	results of first season.
144	4.9	results of second season.
149	4.10	application of results to domestic contexts.
150	4.11	application of results to industrial contexts
160	5.1	archaeological correlates for the home-range.
161	5.2	distinction between industrial and domestic locations.
172	5.3	locational aspects of Bronze Age settlements.
177	5.4	characteristics of industrial locations.
201	6.1	assemblage composition in relation to geology
202	6.2	assemblage composition in relation to

		soil types.
203	6.3	assemblage composition in relation to topography.
204	6.4	assemblage composition in relation to distance from the river.
218	6.5	flake size variation in Avon valley.
219	6.6	proportions of gravel-and chalk-derived flint.
225	6.7	ecological characteristics of the six zones.
227	6.8	assemblage composition for the six zones
228	6.9	regression values.
229	6.10	correlation matrix.
238	6.11	characteristics of proposed settlement locations.
239	6.12	characteristics of proposed special task locations.
262-	6.13-	assemblage variation vs geology
263	6.14	
264-	6.15-	assemblage variation vs soil type
265	6.16	
266-	6.17-	assemblage variation vs topography
267	6.18	
268-	6.19-	assemblage variation vs distance from
269	6.20	river.
270-	6.21-	assemblage variation vs six ecological
271	6.22	zones.
272-	6.23-	frequency distributions for the eight
279	6.30	variables discussed in the text.
280-	6.31-	analysis of variance relating assemblage
283	6.34	composition to geology.
284-	6.35-	analysis of variance relating assemblage
287	6.38	composition to soil type.
288-	6.39-	analysis of variance relating assemblage
291	6.42	composition to topography.
292-	6.43-	analysis of variance relating assemblage
295	6.46	composition to distance from the river.
296-	6.47-	analysis of variance relating assemblage

299	6.50	composition to the six ecological zones.
300-	6.51-	chi-square analysis relating assemblage
301	6.52	composition to geology.
302	6.53	chi-square analysis relating assemblage composition to soil type.
303-	6.54-	chi-square analysis relating assemblage
304	6.55	composition to topography.
340	7.1	assemblage composition in relation to soil type.
342	7.2	assemblage composition in relation to geology.
343	7.3	assemblage composition in relation to topography.
344	7.4	assemblage composition in relation to distance from the river.
358	7.5	correlation matrix.
359	7.6	regression analysis.
360	7.7	flake size variation.
365	7.8	ecological characteristics of the three zones.
366	7.9	assemblage composition for the three zones.
411-	7.10-	assemblage variation vs soil type.
412	7.11	
413-	7.12-	assemblage variation vs geology.
414	7.13	
415-	7.14-	assemblage variation vs topography.
416	7.15	
417-	7.16-	assemblage variation vs distance from
418	7.17	river.
419-	7.18-	assemblage variation vs three ecological
420	7.19	zones.
422-	7.21-	frequency distributions for the eight
428	7.27	variables discussed in the text.
429-	7.28-	analysis of variance relating assemblage
432	7.31	composition to soil type.
433-	7.32-	analysis of variance relating assemblage

436	7.35	composition to topography.
437-440	7.36-7.39	analysis of variance relating assemblage composition to distance from the river.
441-444	7.40-7.43	analysis of variance relating assemblage composition to the three ecological zones.
445-447	7.44-7.46	chi-square analysis relating assemblage composition to geology.
448-449	7.47-7.48	chi-square analysis relating assemblage composition to topography.
450-453	7.49-7.52	t-test relating assemblage composition to geology.
490	8.1	a comparison of assemblage composition between the Avon and Meon valleys.
502	9.1	comparable density figures from surveys in southern England.

Acknowledgements

This thesis owes much to discussions with and the commitment of my research supervisor Clive Gamble. I owe much to his encouragement both prior to and during the past three years and only hope that the contents of this thesis do that support justice. The work has also benefited enormously from discussions with my research advisor Arthur ApSimon, whose belief that I could not ignore chronology altogether finally paid off, and Stephen Shennan who put the Avon valley material at my disposal.

Bill Boismier's belief that "'sites' really do exist" was the bait which constantly spurred me on and which formed the basis for the methodology which I adopted. Whether or not we agree is irrelevant; what matters is that his considerable knowledge and experience of ploughzone archaeology have helped me considerably and for that I am most grateful. Mike Allen also provided invaluable assistance with the content and ideas presented in chapter 3, and it was perhaps his insistence that archaeological and palaeoenvironmental studies could profitably be integrated to produce valuable information, that persuaded me to promote that aspect from the sidelines to become a major aspect of the thesis.

Technical assistance came from Nick Bradford and Chris Webster -who drew Figure 7.21 -while Martin Oake provided the necessary information from the County SMR. Thanks also go to Malcolm Wagstaff for allowing me to quote a paper which he presented at TAG, 1986, Professor Small for discussing dry valleys with me, Alan Woolley of the British (Natural History) Museum for commenting on the jadeite axe, Frances Healy for commenting on the ASDA Factor and Bob Smith for discussing aspects of the Avon valley survey. The contents of chapter 8 have benefited from discussions with Julian Richards, Sue Lobb, Peter Bellamy, Peter Woodward, Robin Holgate, Steve Ford and Tim Earle while my thanks go

to Simon Keay and Martin Millet for giving me the opportunity to 'broaden my horizons' and work on the Ager Terraconensis survey. This was an experience from which I have benefited enormously.

Perhaps the most vital assistance as far as data collection was concerned was provided from within the Department. Rachel Seager-Smith, Mike Newbury, Paul Rodgers, James and Adrienne Steele, Royston Clark and Clive Gamble all helped with fieldwalking and to them I am most grateful. Thanks must also go to the landowners in the Meon valley who, although often puzzled, were nevertheless most co-operative. Special thanks go to Elaine M^{c}Phail of Peak Farm, Warnford and Stephen Horn of Bushey Down Farm, Soberton who each put up with my presence for over two weeks.

The ploughzone experiment described in chapter 4 was carried out in conjunction with Royston Clark and many of the ideas and results are a joint effort. Thanks must go to his father for giving us permission to conduct the experiment.

My interest and involvement in archaeology is due largely to my A'level archaeology teacher Veronica Falat (nee Dunbar), once of Southampton, who persuaded me both to take up the A'level at a relatively late stage and then to pursue it at University. It was she who, on hearing my research proposal, asked what I would do if I didn't find anything? It was this which prompted me to consider the value of negative evidence, although such a scenario thankfully never arose!

My parents too have been an enormous support, providing encouragement in whatever I choose to do. It was they who encouraged my initial interest in the past and for that I am most grateful.

Also I should like to acknowledge the support which my wife has provided over the past three years. Although not always a willing volunteer, Janet has assisted with fieldwalking, washing and packaging finds and the proof-reading of often unintelligible texts. When first married we occupied a bed-sit and for 7 months she had to sit quiet in the evenings while I wrote seminars and carried on with my research. Now in more spacious surroundings she has to suffer the inconvenience of flints drying on newspaper throughout the house. Above all that she has worked hard while I have continued with research and has provided financial support for which I can never thank her enough. Now that is all behind us, and I hope to repay some of that enormous debt which I feel I now owe. That this thesis was completed in four years is due largely to the support which my wife has given me.

Preface

The work presented in this thesis was carried out at Southampton University between October 1984 and October 1987, and was made possible by the award of the Lawrence Arthur Burgess research studentship. I am grateful to the selection committee for considering my work worthy of support, but most of all to Lawrence Arthur Burgess whose bequest it was which provided the financial assistance. It is for this reason that I dedicate this thesis to him and only hope that if he were alive today, he would read the final product and be pleased with the result. If I even came close to being considered a 'good investment' I would have achieved my main objective.

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF ARTS

ARCHAEOLOGY

Doctor of Philosophy

THE INTERPRETATION OF SURFACE LITHIC COLLECTIONS: CASE STUDIES FROM SOUTHERN ENGLAND.

by Arthur John Schofield

This thesis has two main aims: First to consider the potential for studying surface lithic collections as a means to understanding settlement and land-use strategies between the Mesolithic and Bronze Age periods in southern England. To achieve that, it was considered necessary to study surface material in an objective manner without resorting to the identification of 'sites' or dating material on the basis of some morphological characteristic. Surface collections do not produce information concerning 'precise moments in time' but rather overall aspects of land-use. It is such predominant patterns that are considered in this thesis.

The second aim was to examine the nature and extent of prehistoric settlement in southern England from two perspectives. First, the distinction between valley and non-valley contexts and the extent to which each zone maintains a distinct pattern of land-use through time. The second was to consider to what extent settlement density varied between the 'core areas' of Neolithic Wessex and areas outside of this monument zone. Two study areas were considered, one of which -the middle Avon valley -was peripheral to the core area of central Wessex, and one of which is separate from but equidistant between the areas of southern Wessex and the Sussex downlands. In both areas the evidence for settlement was intense but with an emphasis on different periods. The Meon valley for example seems to maintain a predominance of Mesolithic and early Neolithic activity, while the Avon valley sees a concentration in the late Neolithic/early Bronze Age. In a final chapter the Avon and Meon valleys are compared and considered in the context of southern England as a whole.

The off-site approach adopted for this thesis is considered a valid model for understanding regional land-use strategies while the distinction between valley and non-valley contexts -based upon the use of environmental evidence -is best seen in terms of human adaptation and is considered a useful starting point in any further regional survey such as those described in this thesis.

Chapter 1

Introduction

> 'Surface remains are just that -the junk you find on the surface -and nothing more' (Flannery 1976,51).

The aim of this thesis is two-fold: First, to reject the notion of 'site' -where 'site' is considered a correlate for the settlement unit -as a means of analysing surface artefact collections, and to present a valid alternative based upon the principles of habitat selection and human behavioural response. Second, to examine the nature of valley adaptation between the Mesolithic and Bronze Age periods in southern England and to contrast this with evidence from downland contexts. To examine both questions, area-intensive surface collection was carried out in two Hampshire river valleys. The aims, method and background to the thesis may now be described in more detail.

1.1 The trouble with 'sites'...

Ever since Foley (1981) laid down the principles of what he termed 'off-site archaeology' and Shennan declared extensive rural surveys 'a waste of time' (1980,125), landscape archaeology in southern England has gone from strength to strength. Work in a variety of environmental settings (for example Shennan 1985, Richards 1984) - concerned with both specific questions in time and space (Gaffney and Tingle 1985) and with more general land-use histories (Richards 1978) -has provided a picture of settlement and land-use vital to our understanding of human adaptation within the region as a whole. If excavations produce evidence for 'specific moments in time', it is intensive regional survey which provides the spatial and

temporal context within which they may be more fully understood.

Unfortunately with such an emphasis on results and methodology, other, perhaps more critical questions have tended to be ignored. The literature now abounds with both the results of survey projects and with various artefact collection strategies (for example Macready and Thompson 1985, Haslegrove, Millett and Smith 1986, Archaeological Review from Cambridge 1985). There has been little discussion however as to what the results actually represent (but see Ferdiere and Zadora Rio 1986, and Schofield forthcoming). Are we to go on believing for example that we can distinguish between a 'site' -however that may be defined -and areas of off-site activity, and even more important, between 'sites' belonging to the Mesolithic, Neolithic and Bronze Age periods? I suggest that such assumptions are largely unrealistic and that, '...the recognition and delimitation of a site is an act of interpretation, not observation' (Cherry 1984,119).

It is the aim of this thesis both to reject the 'site' as a unit of analysis and to produce a viable alternative. This is based upon the size of collection units, the nature and density of flint collections and on the distinction between types of activity and the locations within which they were predominant (Foley 1981). In other words it is a means by which to distinguish between types of activity on a local scale.

The approach breaks new ground in two ways:

1. It involves the calibration of evidence obtained through both surface collection and palaeoenvironmental studies. By examining the environmental evidence and producing a broad picture of landscape evolution, it should be possible to predict within which areas and at what time, human society was present. Such predictions could then be tested through

problem-orientated surface collection.

2. The interpretation of results will not be based on type-fossils as is generally the case. These represent at most 1-2% of an artefact collection obtained through intensive survey, and this where comparative collections are available from excavation. It is argued that a methodology should be developed whereby the majority of artefacts are used to create a general picture, and any type fossils used later to reject or confirm that hypothesis. Surface remains are not just 'the junk you find on the surface' (Flannery 1976,51); every piece of chipped stone is a signature -a distinct pattern created at a specific moment in time and for a particular reason. Considered as a whole and in relation to every other artefact, a pattern may emerge suggesting either continued or short-term occupation (measured by assemblage density) or a predominance of domestic or industrial activity (measured by assemblage composition). Such patterns may represent either continuity in time or continuity in space. Whichever the case, it is patterns of accumulation which surface artefact collections will produce. 'Sites' do not exist in the ploughsoil and it is time a less subjective alternative was sought.

1.2 A tale from the riverbank

It was recently suggested that, 'future research in chalkland valleys is a most exciting prospect' (Smith 1985,323). Indeed, it is only since the emergence of a landscape archaeology in the 1970's that the distinction between valley and downland, crucial to our understanding of prehistoric settlement patterns, has been the subject of any detailed investigation. But why, with the work of for example Froom (1972), Bradley and Holgate (1984) and Smith (1985) do we need to focus once more on this specific part of the landscape? Are we not in danger of reversing the process and producing a bias towards the river valley? This is unlikely, certainly for the research presented in this

thesis which sees a focus of attention slightly different to that of other landscape surveys carried out in recent years. My chief concern is with the nature and density of occupation outside of the 'monument zone', that is in areas devoid of the major classes of field monument belonging to the Neolithic and Bronze Age periods. Much work has been carried out in the Avebury, Stonehenge and Cranborne Chase areas of Wessex; we know they contain a density and diversity of monuments unparalleled in southern England and hence further work is likely to be both attractive and profitable. The unfortunate result is that as more knowledge is obtained in the areas where fieldwork is most intense, those areas take on renewed significance as central places, with other parts of the landscape becoming increasingly sparse by comparison. The fieldwork in this thesis aims to redress that balance and to demonstrate that the density of occupation was as great, if not greater than in the more established core-areas. River valleys are therefore considered vital archaeological resources and the decision to focus on the Avon and Meon should provide a detailed indication of their role throughout prehistory. The question of whether rivers were occupied simply in preference to areas of downland will be supplemented in this case by that of whether individual valleys were ranked according to more specific criteria.

1.3 'Thinking Mesolithic'

Until recently it has been sufficient to interpret the surface remains of hunter-gatherer and farming communities as distinct, both in time and space. They do, after all display considerable diversity both in subsistence strategies and in the nature and size of settlement units. It is however the case that materials deposited on the surface are subjected to common post-depositional processes. There must therefore be some argument for treating all items of the surface collection in a similar way. It was on this basis that Foley's (1981) off-site

model was extended beyond the analysis of mobile forager communities to include evidence from the Neolithic and Bronze Age periods. If we are not looking for 'sites' then there is no reason why that same method based on the idea of regional discard patterns and artefact density should not apply to all periods. Bogucki (1987,6) for example has noted the potential for the wider application of models designed for hunter-gatherer societies in his investigation of agrarian communities on the north European plain. Examples of 'low-bulk' procurement sites, described by Binford (1980) as locations in a system of residential mobility, may for example include 'grazing stops'. Such locations would never appear as 'sites' through surface collection but would instead form part of a more general 'off-site' scatter, often resulting in considerable 'palimpsest accumulations' where repeated visits have occurred. Therefore unless every type of 'site' can be identified, both by density and assemblage composition, any attempt to investigate the settlement system will be incomplete. By 'thinking Mesolithic' and viewing settlement not as an individual place or 'site', but as part of a long-term use of the landscape, our results -although less precise than 'dots-on-maps' and perhaps less attractive - will nevertheless be a totally accurate representation of how prehistoric communities exploited the landscape.

1.4 Time as a constant?

Although diagnostic artefacts are retrieved by surface collection, they are rarely represented in any quantity. Indeed where a collection of 10,000 flints contains only 20 diagnostic items, the tendency has always been to start with the latter and only use the remainder of the collection as a secondary process, building a general picture based on technological and size attributes displayed by the waste material. Two observations persuaded me to reverse that process: First, that for the majority of intensive surveys, comparative collections are available

which provide analogies relating for example to specific aspects of core reduction (Bradley and Holgate 1984,109). Such observations cannot however be extended outside such regions because it is that unique combination of the location and availability of raw material which ultimately controls the nature of a lithic assemblage (this is discussed in detail in Chapter 4). The second belief was that a majority of artefacts should produce far more information than a minority, especially when the proportions are as extreme as 99:1. Why put diagnostic artefacts on the map first when the larger collections of waste could provide equally valuable information. A simple analogy may be described as the task of erecting a ridge-tent. Two alternative strategies are available: One is to insert the pegs in the places where the holes in the canvas are likely to be situated. Once the canvas is positioned however, they may require either realignment or removal. A more established technique is to position the canvas first and then to insert the pegs. This will not involve making any decisions about peg-location but simply fitting them into predetermined positions, governed by the location of the canvas. Needless to say it is the latter which I have adopted for this thesis. Chronology is not ignored or treated as a constant, but is only introduced once the more general pattern -the canvas -has been prepared. Obviously chronology is abbreviated to broad cultural divisions, but this is unavoidable where absolute dates are not available.

1.5 Structure and content of the thesis

The remainder of the thesis is divided into the following sections: 1. (Chapter 2): Looking at the type of research strategy best suited to answering the questions of settlement and land-use described above. Emphasis will be towards the sampling strategy, the nature of surface collection and the recording system adopted. Brief mention will also be made of the various statistical techniques used in the analyses. 2. (Chapter 3): An environmental

model is presented, based on the principles of the 'patchy environment' and to what extent that applies to the palaeoenvironmental record of central-southern England. The distinction is made between two types of response which communities may display. These may be identified through the evidence presented: The coarse-grained response, where disproportionate amounts of time are spent in different environmental patches, and the fine-grained response, where resources are exploited in the same proportions in which they occur. This same distinction is identified between valley and non-valley contexts and forms the basis of later investigations. 3. (Chapters 4 and 5): The problems with interpreting evidence from surface collections are discussed and an alternative model presented. Problems include the definition of discrete units which may be regarded as 'sites', the dating of artefact scatters and to what extent material on the surface is representative of what underlies it. The alternative is an off-site approach based entirely on the density and composition of artefact scatters. It is suggested that by adopting the hectare as the unit of analysis, it should be possible to distinguish activity areas displaying continuity or discontinuity in time and/or space without resorting to the setting of precise boundaries. 4. (Chapters 6, 7 and 8): Case studies are presented from the middle Avon and upper Meon valleys in west and east Hampshire respectively. In the final chapter (Chapter 9) the two study areas are compared and seen in the context of southern England as a whole.

Chapter 2.

Sampling and the Logistics of Surface Collection: towards a project design

> 'The archaeological process of discovery necessarily involves inspection of spatial units to recover and discover prehistoric data. Archaeologists are constantly sampling space during survey and excavation. This is a methodological fact of life that is inescapable and irrefutable' (Mueller 1975,39).

> 'In carrying out survey work, the onus is on us to achieve a satisfactory balance between quantity of information, quality of information and cost' (Shennan 1985,7).

In the introductory chapter I presented the main aims of the thesis as well as the general thematic approach which I believe is most appropriate to the data base concerned. However the question of regional settlement patterns and the continuity which they may or may not display makes it necessary to consider two other aspects of the research strategy upon which the outcome ultimately depends. These may be described as follows:

(1) What form must the study area(s) take if the questions of regional settlement and land-use continuity are to be effectively answered?

(2) What form of data collection strategy would be most appropriate?

2.1 The Study Area

2.1.1 The value of regional analysis

Before considering the nature of the study area itself, it is important to address the question of what constitutes a region and why it needs to be precisely defined. This is a question which has long been the concern of both geographers and archaeologists, but is rarely considered in terms of comparison of results from adjacent regional surveys. In fact Regionalization is not so dissimilar from classification. The latter implies the grouping of objects into classes on the basis of some common properties or relationships. It is therefore possible with regional classification to group them for comparison on the basis of similarity or dissimilarity. But how precise should our definition of the region be? Simpson (1961) suggested that, 'if each of the many things in the world were taken as distinct, unique, a thing in itself unrelated to any other thing, perception of the world would disintegrate into complete meaninglessness.' In other words we need to relate things to each other and we cannot do that unless things are classified on the basis of some relationship.

The value of regions as analytical units does depend on the level of question being asked. For the purpose of this thesis the context is one of human behaviour, and hence variation in time and space is of interest. In chapters 6 and 7, regional variation is considered on a local scale in relation to soil type, geology, topography and distance from the river, while a fifth category - a combination of variables - was also established. In chapters 8 and 9 variation is considered between the two survey areas and across central southern England as a whole.

If a comparison is to be made between two analytical units at whatever scale, then the boundary between those units must be distinct. For example to compare the nature and density of prehistoric settlement in a river valley with that on the chalk downs would involve drawing a line between those two zones. If a high density scatter was identified on the chalk but situated on the river terrace,

within which zone would that scatter be located (Figure 2.1)? The decision would depend not so much on the definition of region but the judgement of the researcher.

A further point concerns the size of the survey area. Obviously an area such as central-southern England cannot be the subject of an intensive survey; the input of finance and manpower would be enormous. Small areas on the other hand can be surveyed intensively and with greater precision, a parish survey for example representing an extreme case. In such a context however the tendency is generally towards specific questions of primarily local significance, regarding for example the history of settlement in a particular area.

Regionalization is therefore a means to an end and not an end in itself. A system of regions is only established as a first step and points to the study of how and why spatial variation exists. It is also the case however that we need the region as a means of quantifying variation within it. If we do not have the boundary, we do not know which values to exclude. It is therefore critical that we define clearly the region under investigation but also that the distinction between micro-regions within that region are fully appreciated. It will not always be the case that variations in soil, geology and topography will coincide.

2.1.2 The Survey Area Defined

'The fundamental division into the chalklands and the tertiary lowlands which forms such a striking feature of the structure and geomorphology of the Hampshire region, is obviously of major significance when considering land-use' (Tavener 1964,131).

As will be described at some length in chapter 3, the ecology of southern England varies according to a number of factors, the most important of which is the physical

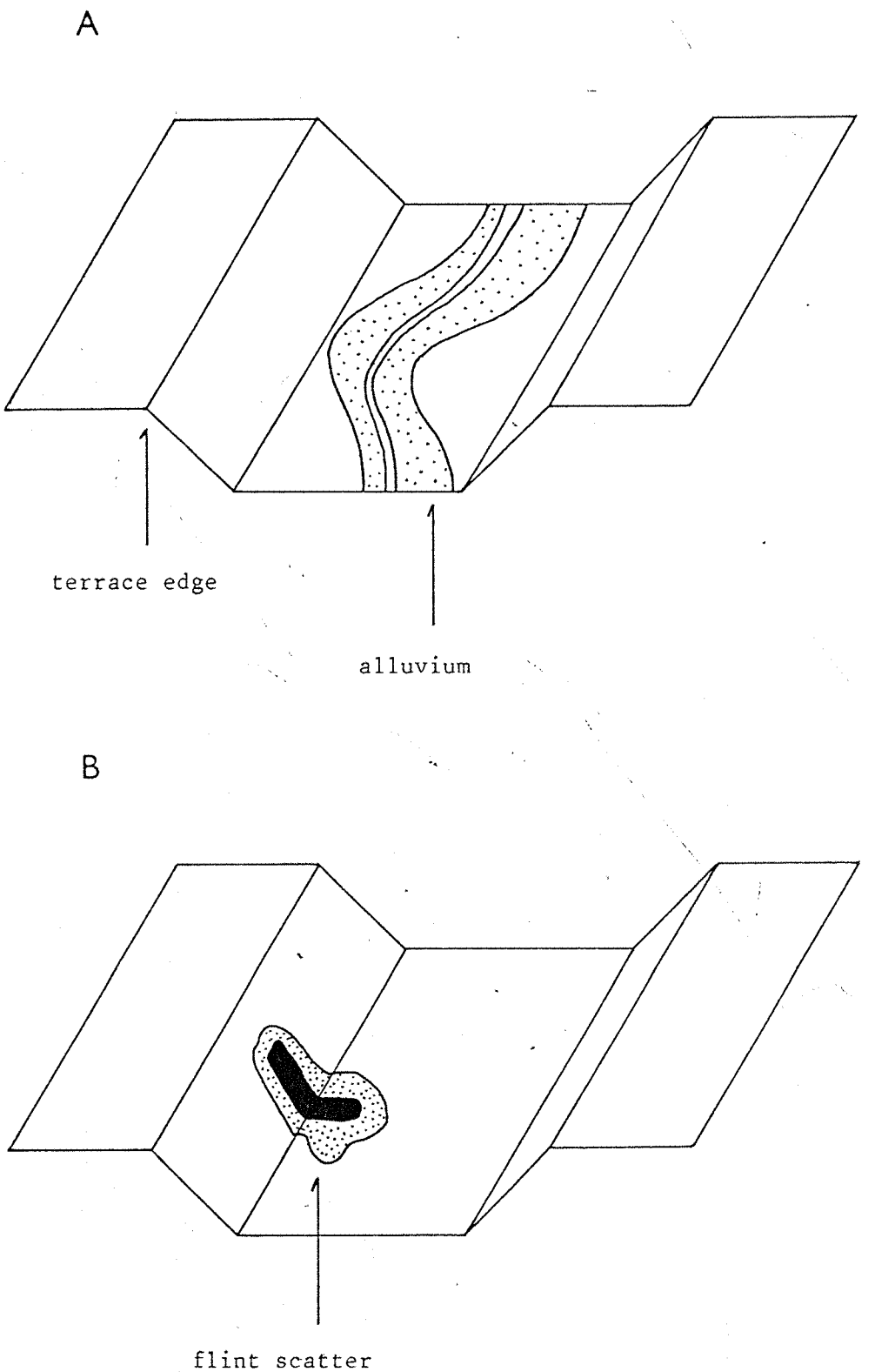


Figure 2.1: the distinction between valley and downland and how a flint scatter on that boundary may be perceived.

structure of the area in question. Hence the upland/valley dichotomy, the distinction between soil types or between types of hydrological regime are all significant and quantifiable variables when considering the nature of human adaptation, whether at a macro- (regional) or micro- (local) scale.

The emphasis of this thesis is on regional patterns of land-use. In such cases survey must be at a scale small enough to make intensive collection possible with the workforce available, yet to cover large enough an area to make any patterns of past human behaviour clearly discernible and the contrasts between varying density and aspects of assemblage composition clearly apparent. Examples of such surveys are numerous in the area of the Hampshire Basin and the surrounding chalklands (for example Richards 1978, 1984; Bradley et.al. 1984). Shennan for example took an area of 150 square km in north-east Hampshire and attempted to survey 30 square km with a team of fieldwalkers. In general this size of study area is fairly standard and for the results of these survey projects to be useful in terms of inter-regional comparisons it seemed reasonable to adopt a similar sized area. It also seemed logical to adopt the river valley as a study area because of the ecological framework I favour (see chapter 3) and in terms of research emphasis in the recent past. Field survey in the region has tended to concentrate away from valley contexts (for example Richards 1978,1984, Bradley et.al. 1984 and Shennan 1985). It seemed that if a viable comparison were to be drawn between the two types of environment then this balance had to be redressed. The two study areas may be defined as follows (Figure 2.2):

1. The upper Meon valley.

2. The middle Avon valley.

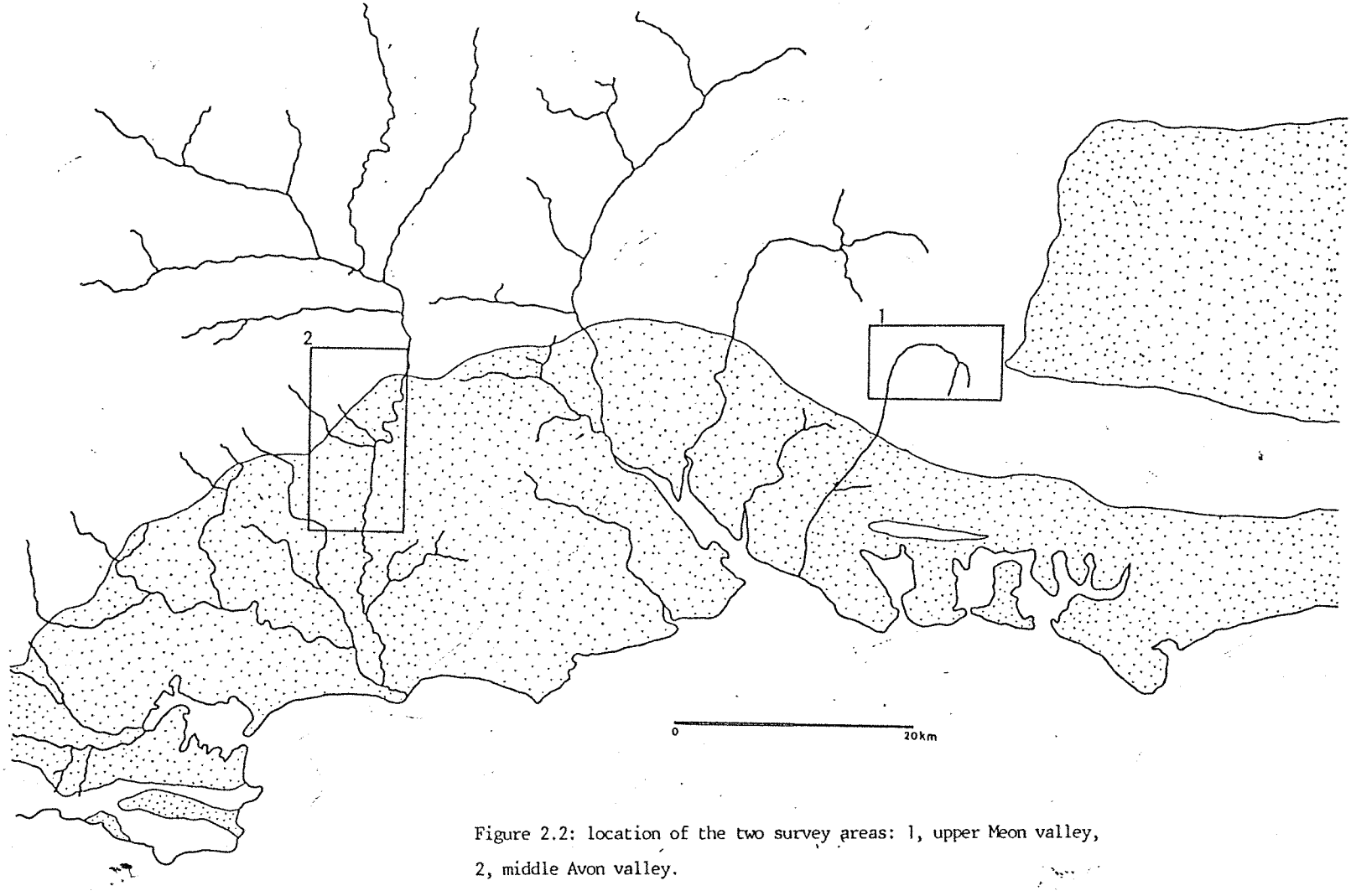


Figure 2.2: location of the two survey areas: 1, upper Meon valley, 2, middle Avon valley.

The specific physical attributes of the study areas will be described in detail in the appropriate chapters.

Having therefore established the type of study area best suited to answering questions of regional land-use and settlement and the problems of definition associated with regions, it is necessary to discuss the nature of the research design which will best suit the study areas which I have adopted. The discussion may be divided into two problem areas:

(1) the sampling design: size and type.

(2) the data collection strategy.

2.2 The Sample Design

The size of the sample area is a question uppermost in any regional research strategy. In a way it is separate from the size of survey area but often specific questions warrant some form of 'proportional representation'. In the discussion which follows, emphasis is based largely upon the Meon valley survey, on the one hand because it is my own project and I was solely responsible for the overall project design, and on the other because the aim of the Avon valley survey was total coverage of available land and hence the question of sampling *per se* did not arise.

In the case of the Meon valley the project design was geared to two main factors: First that only two winter seasons were available for fieldwalking and second, that much of the work would have to be done on my own. There are advantages to this as will be discussed below, but there are obvious limitations such as the rate of surface coverage. It was decided therefore not to choose a specific proportion of the area in this case but rather to take individual zones and concentrate my efforts on them.

The problem therefore was not sample size - as that was determined by the time available and my own capabilities - but rather a case of whether to adopt a quadrat- or transect-based collection strategy and where to locate the sample units. This is a question which ultimately faces most project designs at some stage and it may be suggested that the choice depends largely upon the aims of the project and the context as a whole. Bintliff for example in the Boeotia project suggested that while narrow transects may provide a reasonable sample of a settlement pattern composed of numerous widely dispersed 'sites', it is a very poor tool for picking out the small number of nucleated 'sites' with which his project was primarily concerned (1985,198). In general we may suggest that the quadrat tends to permit the investigation of a wider range and larger number of collection units while the transect allows a larger area to be examined and variations in density and assemblage composition to be discerned. It was suggested that where one of the main questions concerned activity in relation to the physical environment, then the use of transects would be of greater value, while it has also been implied that they are more straightforward to use in the field - for example taking less time to set-up - and often perform well in providing estimates of material density (Judge et.al. 1975).

The orientation of sampling units has long been the concern of ecologists and archaeologists alike; Clapham (1932) for example noted that the variance between samples was least if transects were located at right angles to the observable strata; Hasel (1938) found that the accuracy of sampling was enhanced when sample units cut across ecological zones, while Bintliff has suggested that settlement patterns are closely controlled by local variations in geology and soils and hence that sample units should include a representative cross-section of local physical geography (1985,200). It was thus decided to locate sample units on the basis of these criteria.

2.3 The Surface Collection Strategy

The next issue to discuss concerns the collection process and those factors which may be seen to introduce potential bias into the sample population. It should be borne in mind however when considering the nature of the collection strategy, that my primary intention was to make comparisons between this and other landscape projects in the area as a whole, and for that to be viable the actual size and nature of the collection unit had to be comparable. It was therefore decided to adopt the same methodology as was used in the East Hampshire survey (Shennan 1985) and the middle Avon valley survey which has been in progress since 1978. The collection process may therefore be described in terms of three factors:

(1) the extent of coverage.
(2) the nature of coverage.
(3) bias factors.

2.3.1. The Extent of Coverage

This may be described more accurately as a question of surface area or 'how many fields to walk'. As we have already seen in the Meon valley, the collection of data is limited to a number of systematic transects located in order to get the maximum information from the data set. The question of how many fields to walk is therefore determined in this case by two factors: one is the size of the transect and second the amount of land within that transect which has been ploughed and to which the landowner has given access. In the light of these factors and the idea that rotation of arable and pasture is commonplace, it was decided that every available field within or partly within the transect should be covered. The Avon valley differs in that it represents a long-term project aimed at total coverage; in this case therefore fields have been walked as

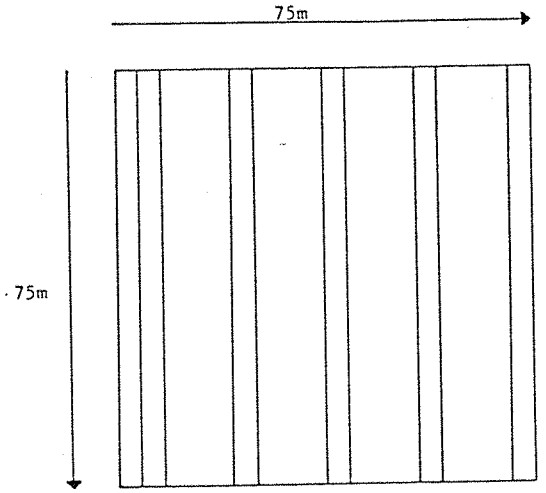
and when they became available.

2.3.2 The Nature of Coverage

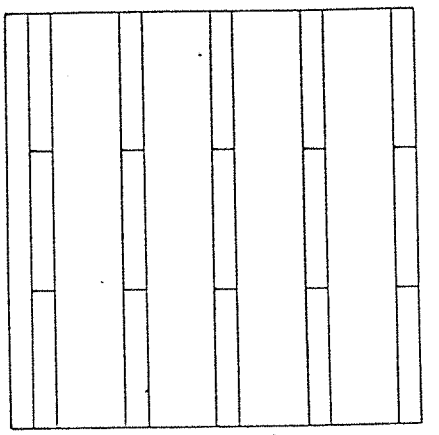
The question of time availability is of relevance when the type of collection strategy is concerned. With a large workforce and sufficient time it may be possible to achieve 100% recovery, but where manpower and time are limited then a sample is the only realistic alternative. This is a complex problem and one for which every case is different. In Figure 2.3 four methods are presented by which a hypothetical field could be covered. The coverage rate assumes that each line is walked straight and without divergence, and that material will be visible for up to 2.5m on either side of the line. In other words at any one point the visual span is 5m in circumference.

The figure shows the various techniques (described in more detail by Fasham et.al. 1980) while the numbers represent estimates based on my own observations and assume a workforce of one; if two persons are present then times may be halved, if four persons are present divide by four etc. As the box suggests it is subdivided transects which are most cost-effective while producing effective spatial control. It is this technique which I adopted for the Meon valley. In terms of the time involved the process is only slightly slower than conventional whole-uninterrupted line-walking, the extra minutes being largely accounted for by setting up the extra collection points and writing extra labels.

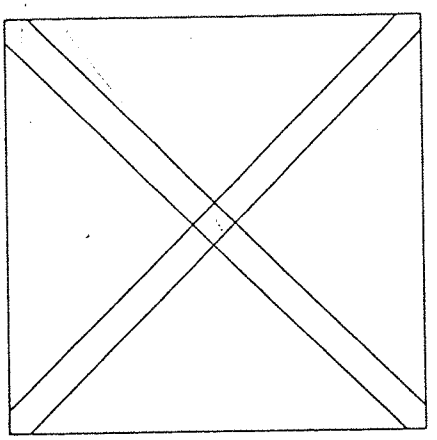
It is in terms of spatial accuracy however that I believe the sub-transect technique has its greatest advantage. The top diagram in Figure 2.4 shows a hypothetical flint scatter while the other four diagrams show how after walking the field, results would be presented. It is clearly apparent that the two 'quickest' techniques (ie transects and cross-transects) only exhibit low levels of



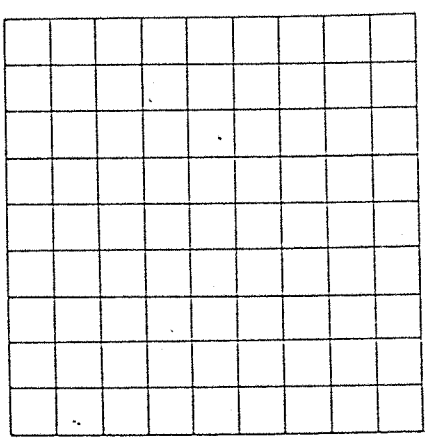
1. transects



2. sub-transects



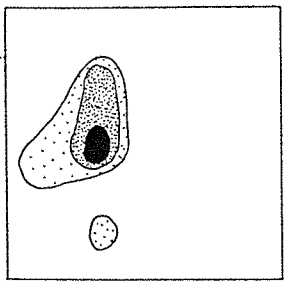
3. cross-transects



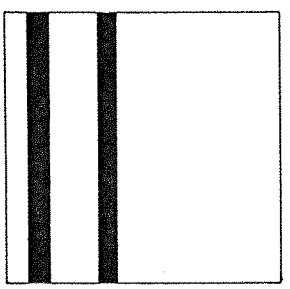
4. grid

technique	1	2	3	4
total coverage (%)	c.30	c.30	c.25	100
set-up time (mins)	20	30	20	60
walk-time (line, in mins)	15	20	15	45-60
TOTAL time per field (mins)	110	150	110	280-350

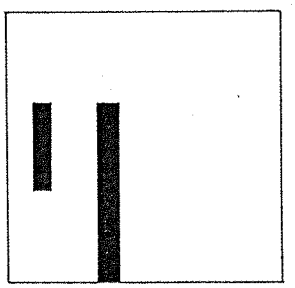
Fig 2.3: Relative merits of various surface collection strategies.



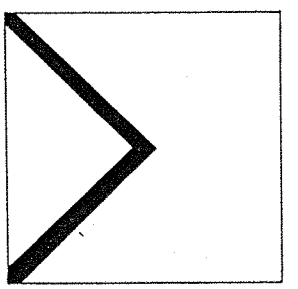
Plan of a hypothetical flint scatter.



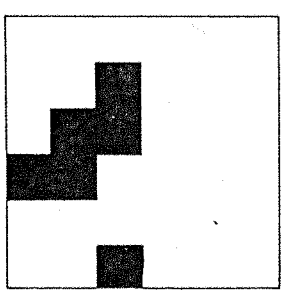
1. transects



2. sub-transects



3. cross-transexts



4. grid

technique	1	2	3	4
extent of scatter	mod.	high	low	high
structure of scatter	low	mod.	low	high

Fig 2.4: Levels of spatial accuracy as exhibited by various surface collection strategies.

pattern replication while the sub-transect and grid techniques appear particularly accurate. When we consider that the time of carrying out a sub-transect survey is half that of a grid survey, it was fairly clear that this was the best strategy to adopt.

For the Meon valley survey therefore, a policy of sub-transect collection was adopted with transects spaced at 15m intervals. This was to provide a comparison with other data collection strategies in the region as well as ensuring a standard rate of 15% recovery for each field. For the Avon valley survey uninterrupted transects have been adopted, thereby maintaining the same density of coverage but without the same degree of spatial accuracy. Total or 'saturation' coverage was not only considered impractical but also unnecessary. As Shennan has demonstrated, the proportions of worked flint recovered will not vary significantly between total and partial collection strategies (1985,10). Furthermore gridded collection is generally regarded as a technique for defining in very precise terms the limits and content of artefact scatters. This was not one of the aims of the project.

Another technique which often forms part of regional survey projects is that of subsurface testing or 'test-pitting'. This is both a valid and widely used technique by which areas not under arable - for example pasture or woodland - may be investigated. The idea is to set up grids of small pits either along transects or in quadrats and attempt to draw conclusions regarding the density and distribution of findspots. There are however serious limitations: First, there is the size of sample which the technique allows. A grid of 1 sq.m. squares every 30m means that only 1 sq.m. in 900 is being sampled (Shennan 1985,45). A second problem is time. Unless a well rehearsed team is on hand or mechanical aids available, the process can be extremely time-consuming. A combination of these factors led Shennan

(1985) to the conclusion that as a technique it was probably not to be recommended at a regional scale.

In a detailed synthesis, Wobst (1983) analysed 220 subsurface survey projects undertaken in Massachusetts between 1970 and 1979. Most test-pits were squares of between 25cm and 1m across, with an average distance of 24m separating the sample units. Wobst calculated a sample fraction of the survey area as ranging between .001 and .00001 (1983,60). With such widely dispersed sample units there is bound to be a discovery bias towards sites characterised by large, dense artefact scatters while overall density estimates are bound to be overexaggerated.

This is a technique well-established in the United States and one which is becoming increasingly popular in this country. However in view of both the time and manpower constraints under which the Meon and Avon valley surveys were carried out and the observation that large areas of land are under arable in both cases, the test-pit technique was not considered a worthwhile investment in terms of data collection. It was however used as a means of measuring the extent of colluvium on the sides of valleys. This application will be described in the relevant chapters.

2.3.3 Bias Factors

The bias factors inherent in survey data have been the subject of some debate recently (Shennan 1985, Hodder and Malone 1984, Richards 1978) and may be divided into three sub-categories:

a. collection bias.
b. surface and weather conditions.
c. agricultural disturbance.

2.3.3.1 Collection Bias

This is a factor discussed by a number of authors, observations tending to vary both in relation to finds classes as well as the physical regime of the area and motivation of the individual concerned. Hodder and Malone (1984,128) for example have suggested that individuals vary in their ability and motivation to identify sherds and obsidian, and since these factors will also be affected by soil and land-use types, weather and time of day, then individual collection performance is likely to be complex and variable. Shennan on the other hand suggests that although variation will be present and will vary according to the individual finds class, it will be a minor source of variation; indeed for chipped stone in the East Hampshire survey, variation is described as 'not substantially significant' (1985,41).

These points are clearly of relevance in the context of the middle Avon valley project where a group have been responsible for data collection over the past eight years. On the basis of all the individuals now having gained experience in artefact recognition, and that experience having increased from 1978, it was decided to only analyse data from the winter of 1980 onwards. This would prevent inter-walker variability prior to 1980 having any marked affect on the distribution and density of material as well as maintaining a substantial data base for analysis.

In the context of the Meon valley the problem was very different. In this case much of the work was to be carried out on my own thereby reducing the possibility of collection bias. It was clearly apparent to me however that factors of fatigue and concentration still have a major effect, especially when alone, and hence it was decided from the outset not to establish a rigid timetable but rather to work in the field only when the 'mood was right'. This degree of flexibility I found worked extremely well

but would not be feasible when working as part of a team. On occasion volunteers were available but all had some experience in fieldwalking and the identification of lithics.

2.3.3.2 Surface and Weather Conditions

Weather conditions can have a major effect on the ability of any individual to recognise material in the ploughsoil. Hodder and Malone (1984,130) for example suggest that individuals are likely to pick up larger size classes when walking towards the sun than when walking away from it. This tends to be the result of surface relief and patterning being bleached out by the glare. With the sun behind the back however, the eyes are less dazzled and even though shadows may mask certain areas, visibility tends to be higher. Ideal conditions are provided by even light. Where this is the case, shadows do not exist and hence all material on the surface is clearly visible. For the Meon valley survey it was therefore decided to make a conscious effort to work only under such conditions and keep an accurate record of lighting conditions. With the limited time available however and the extension of British summertime well into November 1985, this proved near impossible to maintain!

Another bias factor and one which is often underestimated is the surface condition of the field; it is a point often discussed but rarely presented in terms of data interpretation. In the context of an unweathered ploughsoil for example, large clods of earth and ridges tend to create an uneven surface. At one level this makes fieldwalking extremely difficult and indeed hazardous under certain conditions, while at another it tends to obscure material, withholding it within the clods of earth. In a weathered ploughsoil this is not the case with the earth having been broken up into a crumbly flat surface. Under these conditions faster surface coverage is possible, the visual

range tends to be wider and the range of size classes visible on the surface tends to be greater.

A further problem is generated by crop growth; often farmers do not object to surface collection under such conditions and as a general rule, the thicker the crop growth the narrower the visual range of the individual and hence a lower coverage fraction results. For example where the crop growth is 30cm high, the individual, depending on height will have a visual range of, at most 1m to either side of the line while if the crop is 10cm high, the visual range may extend up to 2m.

2.3.3.3 Agricultural Disturbance Processes

This may be described as the extent to which present land-use has affected the distribution and patterning of material in the ploughsoil. Tingle (1987) for example has demonstrated how direct drilling and ploughing of the same field may affect the nature and composition of flint distributions. The results presented suggest that normal ploughing exposed nearly five times the amount of lithic material than did a cultivator. While the amount of lithic material varied however, the character of the assemblage tended to remain constant. There was a marked consistency both in flake size and in the proportion of tools and cores. As Tingle suggests, the results clearly afford comparison with those achieved by Trubowitz (1978,64) who concluded that there was, 'no significant variation in the prehistoric surface debris patterns on the site over three years of observed cultivation'. This is a point which will be discussed more fully in chapter 4.

A distinction should also be made however between types of ploughing: On the one hand there is the mouldboard plough, perhaps the most widely used of all ploughing techniques (Lambrick 1977). It is designed to loosen and turn over the soil, burying surface vegetation and exposing fresh soil

from beneath. The soil is moved forwards slightly and sideways by the width of the furrow. The depth of ploughing depends largely on the nature of the soil, but ploughing to more than 22.5cm tends to loosen and aerate the soil, improving its structure and drainage. One of the variations of the mouldboard technique known as one-way ploughing is described in chapter 4.

In contrast to this is the chisel plough, again described by Lambrick (1977). This is a more recent innovation becoming established in the late 1960's. The aim in this case is to break up and loosen the soil, often lifting it and shattering clods, but disturbing it rather than turning it over. This variation between techniques is obviously relevant to the composition of surface assemblages; the suggestion could be made for example that larger quantities of material are likely to be brought to the surface by a mouldboard plough while material is less likely to be displaced by a chisel plough. The type of information which is obviously required can be obtained through discussions with the landowner.

It is also useful to consider the surface assemblage in relation to the land-use history of the particular area in question. This can be achieved either by discussion with farmers or, for the mid 19th. century, through the Tithe returns. It was an aim of the project from an early stage that where land-use could be 'mapped' accurately both for the 1840's and for the present day, then a general model could be established regarding the measure of agricultural disturbance. Upper Street, Breamore in the Avon valley was taken as a case study and a number of questions put forward.

(1) Are there any definite trends in the land-use pattern of the 1840's which may be regarded as universal across the study area as a whole?

(2) Can any aspects of this pattern be seen to continue into the present day?

(3) What are the points of reference by which this continuity may be assessed?

As a first stage three classes of land-use were defined: A) houses, gardens, horticulture, B) pasture, meadow, C) arable, and corresponding with this a scale referring directly to the measure of agricultural disturbance. This was established on the basis of disturbance being considerable where arable has persisted from 1840 to the present day and where arable has been intensive since the late 1930's (mainly on the chalklands), present where arable occurred in 1840 but did not continue into the later 20th. century, limited where pasture or meadow has persisted, possibly with intermittent arable episodes and minimal where housing or gardens have persisted throughout the period.

On this basis it was decided to examine in detail the Tithe map and returns for the village of Upper Street and from this analysis two clear patterns emerged: First that in the 1840's, as today meadow and pasture tend to concentrate in the river valley up to a distance of about 800m from the river, a pattern also reflected along the tributaries. Secondly is the fact that a similar spatial 'zoning' occurs around the village and both patterns display a degree of continuity. In Figure 2.5 two maps are presented which demonstrate this; on the one hand housing has expanded while on the other pasture and meadow have taken on a greater importance in relation to the village centre, a trend which is reflected elsewhere in the majority of villages in the valley. This is not to say that arable has declined in importance; on the contrary it has increased considerably, barley for example increasing from 21,000 to 150,000 acres in Hampshire alone between 1939 and 1964.

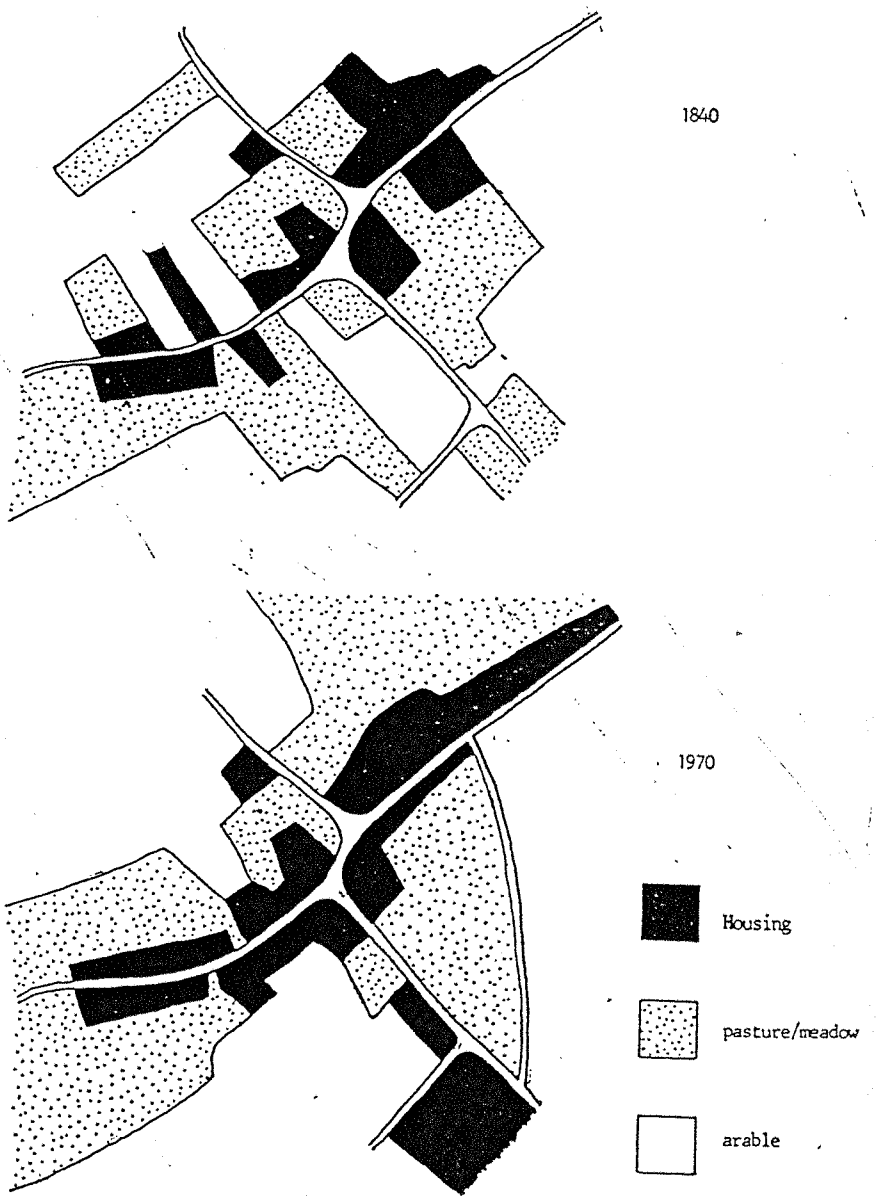


Fig 2.5 Settlement and land-use at Breamore, Hampshire.

It is suggested therefore that a general land-use model can be established in order to provide a framework for controlling agricultural bias. This may be presented in the form of a centre-periphery model, the centre in this case representing either the village centre or the river. As one moves away from the centre one passes through two distinct land-use zones; on the one hand pasture and meadow which have in the majority of cases continued from 1840 to the present day and which display low disturbance potential. The second zone contains arable which has either continued from 1840 or from the late 1930's to the present day. In either case the potential for disturbance of subsurface assemblages is considerable. A further and more problem-orientated discussion on this theme is presented in Chapter 4.

2.4 Data Recording

The policy for both the Meon and Avon valley surveys was to collect everything which may be of use in the reconstruction of settlement and land-use continuity patterns and to bag the finds according to their position in the field. The record sheets used in both surveys are presented in Figures 2.6 and 2.7. As a general policy both forms were filled out on the day; each field is given a six-figure grid reference by which it may subsequently be identified and a plan of the field and the location of the transects and other features drawn on the reverse. As well as recording the landowners name and address, the individual responsible for each line as well as the geology, topography and physical aspects of the field, it was seen as necessary to record all aspects of lighting, soil conditions, the measure of agricultural disturbance and the state of the crop. The reason for this was discussed in some detail in the preceding sections.

The finds from the Meon and Avon valley surveys were processed according to the same basic criteria. After

FIELDWALKING DAY RECORD

Date Walked:	Field No.

Have you marked on map the lines, squares and boundary of field as walked?
YES/NO

Visibility: GOOD/INDIFFERENT/BAD

State of land when walked:
1. WET/DAMP/DRY/FROZEN
2. WEATHERED PLOUGHING/UNWEATHERED PLOUGHING/ HARROWED/SOWN/OTHER - specify
3. If sown specify state of crop NOT THROUGH/JUST THROUGH/THICK
4. EVEN LIGHT/SUNLIGHT WITH SHADOW

Are there indications that recent ploughings have cut into the subsoil?
YES/NO/DON'T KNOW

Purpose of walk: PRELIMINARY SURVEY/DETAILED SURVEY/OTHER - specify

Method of walking: LINE DISTANCE APART OF WALKERS DIRECTION
GRID SIZE OF GRID DISTANCE APART OF WALKERS WITHIN GRID

LINE/GRID NO.	WALKER'S NAME	LINE/GRID NO.	WALKER'S NAME	LINE/GRID NO.	WALKER'S NAME

Form completed by:

Fig 2.6: record sheet used in the survey projects

FIELD RECORD

Owner Address Phone	Field No.
	Parish
	O.S. 6" sheet
Tenant Address Phone	Field Name
	Field Area (ha)

Surface Geology

Slope	Natural Features

Boundaries

Earthworks

Soil and Crop Marks

Site C.R.s

Documentary Refs.	Aerial Photo Refs.

Fieldwork (Walked, Surveyed, Geophysical, Excavation)

Date		Date

Fig 2.7: record sheet used in the survey projects

washing and rebagging, the material was separated into two sets, the worked flint on the one hand and any additional information such as burnt flint and prehistoric pottery on the other. The attributes recorded for each stone artefact are shown in Table 2.1.

As in any survey, the vast majority of artefacts recovered were waste flakes. Generally it is this category which receives the least attention - both in terms of analysis and interpretative value - but for this analysis they were considered to represent the most important source of behavioural information, not so much as chronological markers but rather as indicators of technology and the core reduction sequence.

The core-reduction sequence is, as its name implies both reductive and sequential. To produce any artefact from a flint nodule requires first, the removal of the primary or cortical flakes, second other large flakes to reduce the core or a required flake to the appropriate shape/size, and third to trim the core/flake into the desired end product. Each stage in other words produces a characteristic waste assemblage. By studying the waste and the way assemblage composition varies across the region, it should be possible to identify those areas where each stage was carried out. This in turn may provide information regarding the nature and location of the settlement/subsistence system.

Specific artefact types such as core-trimming flakes and scrapers which are not attributable to a precise cultural episode were regarded useful indicators of spatial zonation in terms of human behaviour, providing clues as to the nature of activity which predominated within particular areas. Axes, arrowheads and microliths on the other hand could be used to tie down this very general picture to particular cultural episodes, demonstrating for example those areas where hunter-gatherers and farmers can be seen to display continuity or discontinuity in land management

1. 6 figure grid reference for field.

2. geology.

3. topography.

4. line number.

5. artefact category: a, flake; b, blade; c, core.

6. length (mm)

7. breadth (mm)

8. extent of cortex: a, primary; b, secondary; c, tertiary.

9. retouch: a, present; b, absent.

10. type of retouch: a, unidirectional; b, multidirectional; c, unifacial; d, bifacial.

11. patination: a, present; b, absent.

12. type of raw material: a, chalk-derived; b, gravel-derived.

13. hinge fractures: a, present; b, absent.

14. condition: a, complete; b, recently broken; c, broken in antiquity.

Table 2.I lithic attributes recorded for analysis.

and resource procurement.

These attributes are therefore considered the most useful in terms of the questions raised. A more general discussion of the problems with understanding surface lithic collections will be presented in chapter 4.

2.5 Correlation and covariation: statistics and lithic analysis

The results presented in chapters 6 and 7 are based upon analysis of variance, chi-square and regression analyses which sought to explain the nature of relationships between a series of selected variables. Analysis was based upon the use of two packages - SPSSx and MICROSTAT - both of which provided the necessary statistics.

Perhaps the single most important measure concerning the goodness of fit for a linear model is r^2, sometimes referred to as the coefficient of determination. As Norusis (1983, 140) points out, it is a statistic which may be thought of in a variety of ways. Besides being the square of the correlation coefficient between variables X and Y, it is the square of the correlation coefficient between Y - the observed value of the dependent variable - and y, the predicted value of Y from the fitted line. If all the observations fall on the regression line, $r^2=1$; if there is no linear relationship between the dependent and independent variables, then $r^2=0$. We should note however that r^2 is a measure of goodness of fit and that an r^2 value of 0 does not necessarily mean that there is no association between the variables. Instead it indicates no linear relationship.

A second measure was the analysis of variance, a rapid means of testing the hypothesis that several groups - the individual zones within the two study areas - derive from a common population. If an actual calculated variance ratio

turns out to be greater than the F-value corresponding to accepted levels of statistical significance, then aspects of lithic assemblage composition cannot be considered as differring from one another merely as a result of sampling error. The variance ratio is described as follows:

$$F = \frac{\text{Mean square between groups}}{\text{mean square within groups}}$$

Where less than three groups are available for comparison, the t-test is adopted. This was particularly relevant in the Meon valley survey.

Simple statistical analyses are also used for lithic analysis. The chi-square test for example is used to establish whether the relationship between variables is significant and at what level of probability, while mean and standard deviation scores are used to present relative proportions of specific items, highlighting areas of high and low frequency.

In each of the two chapters in which the case studies are presented, all the statistics and relevant diagrams (distributions and scatterplots) will be presented at the end of the chapter.

2.6 Summary

I suggest that although two broad approaches have been adopted in the two study areas, one long-term and extensive, one short-term and intensive this should not affect the comparability of the results. So long as density characteristics and aspects of assemblage size and composition may be discerned and the relation between discard and the physical environment analysed, then this should not prove to be a limiting factor.

Having now established how to produce a data base which

best suits the questions of regional settlement and land-use continuity with which this thesis is concerned, the next question concerns how best to interpret that data. In the following two chapters one such model is presented. It is based not upon subjective observations such as the 'site' but rather upon the question of density and how that varies as a function of ecological variability. In chapter 3 a discussion of ecological and palaeoenvironmental data will suggest that the prehistoric environment is best interpreted as a mosaic of ecological patches, while the basis of chapter 4 is to assess the extent to which lithic technology may vary in relation to associated aspects such as resource stress. This chapter will also serve as a discussion of the more traditional notion of the 'site' and the more general problems associated with the interpretation of surface artefact collections.

Chapter 3

The Environmental Mosaic: towards a regional model

> 'Ecology provides a set of principles to investigate relationships between phenomena and as such provides one of the most powerful analytical tools for the measurement, modelling and explanation of past human behaviour' (Gamble 1982,529).

The aim of this chapter is to provide a theoretical framework through which it may be possible to define 'patches' in the palaeoecological record. The idea is not to produce a palaeoenvironmental reconstruction of the Meon or Avon valleys but rather to demonstrate the extent of spatial and temporal variation which existed across the region as a whole. If it can be demonstrated that patches did exist and that various types of environment maintained a degree of 'ecological superiority' by means of exhibiting a resource package particularly favourable to consumer populations, then it is argued that the distribution of prehistoric communities may be analysed within such a framework. The details of this approach may be divided into two main sections:

(1) ecological theory,
(2) palaeoecological data.

A number of general points should first be considered.

The question of interaction between human society and the environment is one which has received a fair amount of attention in recent years. Ingold for example has suggested that the economically productive activity of man is initiated and directed by the system of social relations with which he is involved and which determines both the constituents of the environment that are to be valued as

resources and the rationality of their exploitation (1981). Thus he describes a reciprocal interplay between social and ecological systems, the former dominant and the latter determinant. It is in this sense an over-simplification to talk in terms of environmental determinism as has so often been the case in terms of both foraging (for example various papers in Winterhalder and Smith 1981) and 'complex' societies (for example Meggers 1954). This implies that the natural environment directly affects the psychology and work habits of people, thus determining the nature and complexity of their culture. Jochim points out that by this assertion southern Californians in their warm, benign climate would be 'lazy' and 'pleasure orientated', while New Englanders, living in a region with great climatic change and cold winters would be more industrious and rational! (1981,5).

Neither can we suggest however that the relationship is one of environmental possibilism, that is where the natural environment as a unit sets broad limits on the kinds of behaviour and cultural institutions possible. For example we see herders in the deserts of the Near East because the area precludes agriculture hence limiting the kinds of human adaptation possible. What this fails to appreciate however is that the whole essence of human technology is to transform the environment, for example by using irrigation to make the desert suitable for farming (Jochim 1981).

What we are seeing therefore is an interplay between human society and the environment, an interplay which sees a changing emphasis through time with the shift towards settled agriculture and larger sedentary communities. It is however an interplay which, in the context of prehistoric settlement and subsistence has often been simplified to an enormous extent, being regarded as spatially or temporally constant. One example is that of the 'Great British Forest' which, according to some authors occurred as a homogenous environment both in time and space. Shore for example spoke

in terms of a 'continuous forest broken only by large open areas of chalk downland' (1888,40) while Whittle suggested that 'closed woodland must be considered to have covered the whole country' (1977,10). A similar generalisation is to be found in other interpretations of past landscapes; both Grinsell (1964) and Renfrew (1973) for example have produced artefact distribution maps for the prehistoric period, depicting the chalk as open downland, the sandy soils as heath and the clay as dense woodland.

Surely if we are to appreciate the true extent and nature of settlement from a regional perspective then two areas of ecological research and theory must be included within the overall research strategy: First, defining the various levels at which the region may be discerned, and second the extent to which the environment in the real world represents a mosaic or scatter of patches. These points may now be discussed.

3.1 Regions and the Palaeoenvironment

For the purpose of this thesis environmental variation may be considered at two levels of resolution, the first relating to broad ecological zones, the second to specific niche habitats:

3.1.1 The macro-region

Where there is some degree of generalisation but broad geological, topographical or soil variations may be identified. The macro-region forms a mosaic with other macro-regions, eventually going to form a terrestrial continent. Examples include the Hampshire chalklands, the Hampshire Basin and Poole Harbour.

The broad geological divisions within the Hampshire chalklands consist of the upper, middle and lower chalk, divisions which are influential in terms of floral and

faunal distribution; for example the upper chalk is the purest in calcium carbonate and therefore has the least proportion of other chemicals which are potential plant nutrients. The middle chalk is harder than the upper chalk and contains a greater proportion of chemicals other than calcium carbonate, while in the lower chalk as much as 50% of its content may not be calcium carbonate.

This level of variation can also be identified between macro-regions, for example between the Hampshire and Dorset chalklands. The Hampshire chalk is unique in ecological terms, the result of subtle differences in base-rock and climate, and with other areas less pure in calcium carbonate. In more specific terms we can see that the Dorset chalklands contain a higher number of maritime species than exist in Hampshire, for example Carex humilis or dwarf sedge (Prescott 1983,14).

This is the scale at which the majority of palaeoenvironmental studies have been interpreted. It remains a useful category for certain questions such as regional land-use variation, but for the specific avenues of research with which this thesis is concerned, it remains largely insufficient.

3.1.2 The Micro-region

Where generalisation takes a back seat, and the specifics of aspect, sunlight, water supply, soil type and phosphate content and slope angle are highlighted. One example is Hobbs Copse, Ecchinswell, Hampshire. This is cited by Colebourn (1983,31) as an illustration of how flora can vary within a single micro-region -in this case a wood in Hampshire. The flora varies both depending on and independently of tree and shrub stand. It is a particularly good example of a mosaic environment as it straddles the junctions between a steep scarp slope of the upper chalk,

Reading Beds and an outcrop of London Clay. The upper chalk is characterised here by a thin humus and a ground flora dominated by Dogs' Mercury. As one crosses onto clay outcrops of the Reading Beds, Quercus (oak), begins to replace Fraxinus (ash), and Dogs' Mercury disappears due to its intolerance of ferrous iron caused by waterlogging in the soil. Here also can be seen the sedge, Carex pendula, wild daffodil and bluebell. With the change from Reading Beds to London Clay, Quercus and Fraxinus are replaced by Quercus and Betula, probably the result of increased acidity in the soil. Bramble becomes increasingly abundant and Carex pendula is absent.

Another micro-region is represented by the Itchen valley flood plain in Hampshire. Physically and chemically this is a chalk stream being largely spring-fed by base-rich water with relatively constant temperatures all year round, at least in the upper reaches; it therefore provides a stable and nutrient-rich system. Tubbs (1978,11) suggested that three variables will determine the structure of individual plant communities within such a microenvironment:

a. soils,
b. ground water regime,
c. grazing intensity.

In general terms it is suggested that the wetter the site the more peaty the soil, and the richer it will be in species. Tubbs (ibid,20) recognises a gradient of biological enrichment within this particular micro-region from the estuary to the source in the sense that herb-rich meadows, fen and riverbank vegetation become progressively more frequent. This gradient is also reflected in the distribution of water birds, voles and otters.

We may suggest therefore that this is the level at which we must work in order to fully understand the complexity of human adaptation. In the past it has been sufficient to

distinguish between woodland and downland on a macro-regional scale; this is no longer adequate. The environment must now be considered as a, 'constantly changing mosaic with areas of grassland (and arable) interspersed with woody vegetation' (Waton 1982,43) and the nature and composition of that woodland or downland must be considered. This final point is best illustrated by quoting Colebourns observations (1983,53):

a. That new plants and animals arrive in a wood by chance and the older the wood, the more there will be.
b. That ancient woods tend to be large and relatively undisturbed, therefore sensitive species like deer can breed.
c. That only in older woods is there the rich assortment of spaces and holes for nesting, hiding or hunting, and the mosaic of light/shade patches is crucial for both insects and plants.
d. That older woods tend to have a high humidity and deep soil and leaf litter attractive to invertebrates, upon which the success of many birds and animals depends.
e. That native tree species support enormous numbers of host specific insects which are not associated with exotic tree species; Quercus supports almost 300 insect species, and Betula over 200.

The various levels of spatial analysis discussed above all have advantages and drawbacks in specific problem areas; for this thesis and the questions with which it is concerned, emphasis must be at the micro-regional level, with limited use of macro-regional generalisation. It is quite apparent from some of the ethno-botanical observations that have been discussed that the environment must be considered in more specific terms than has previously been the case.

3.2 The 'Patchy' Environment: towards a general ecological model

According to Putnam and Wratten, 'the very word 'environment' conjures up an impression of a structural, physical stage-set upon which background biological processes are acted out. In practice of course any organisms environment includes other organisms as well as this 'physical set' (1985,15). It is against this kind of a background that the importance of microenvironmental variables should be discussed. The ecosystem by its very definition is the complex set of inter-relationships which exist between variables, and only by understanding the effect such a system may have on the distribution of man in the landscape may we hope to understand the distribution of settlement debris.

The scatter of ecological patches and its adaptation as an archaeological model brings together two of the great related themes of ecology: On the one hand zonation, the segregation of various species and communities in space, and second succession, the changes which occur in communities with time. Both processes go to make up the shifting mosaic or 'kaleidoscope' of species abundance, diversity and richness. In the context of this particular project the term 'patch' is considered to represent a 'hole', a 'bounded, connected discontinuity in an homogenous reference background' (Levin and Paine 1974). Patchiness is revealed in a nearly endless spectrum of spatial scales, from biospheric or continental distribution patterns to patterns of clonal growth or individual responses to resource distribution. The most important aspect however is that patchiness is organism defined, and must be considered in terms of the perceptions of the organism rather than those of the investigator (Wiens 1969). Two aspects of variation or 'patchiness' may now be considered, both of which are relevant to the

palaeoecological analyses which follow:

3.2.1 Temporal Variation

Temporal variation or 'succession' is defined as a seasonal or non-seasonal directional change in the types and numbers of organisms present in a particular habitat over a period of time (Packham and Harding 1982,108). Successional changes within plant communities provide a variety of niches for heterotrophs so that, for example successions of insects, birds and mammals or of soil fungi have been recognised as accompanying plant successions.

Watt (1947) discussed the relationships between the distribution patterns found in various plant communities and the processes by which they were produced. He described seven examples of mosaic vegetation in which the patches or phases are dynamically related to each other while being in a state of cyclic change. During the pioneer phase of a woodland, tree seedlings frequently grow in an open area in which many herb species flourish. The canopy is closed by lateral contact between saplings early in the building phase during which intra-specific competition is so intense that many trees are suppressed and die. Accumulation of woody biomass reaches a peak in this phase during which, particularly among evergreen conifers, the ground flora is greatly diminished. In the mature phase competition between the trees is reduced and they bear their heaviest seed crops, the canopy becomes less dense and shade tolerant herbs are able to establish. Finally we see the degenerate phase in which biomass accumulation is small and eventually negative, branches die, dead organic matter accumulates and herbs receive more light.

Figure 3.1 shows this sequence in diagrammatic form. It shows the spatial distribution of bare Oxalis and Rubus phases in an old unmanaged beechwood together with the gap phase in which regeneration occurs following the death of

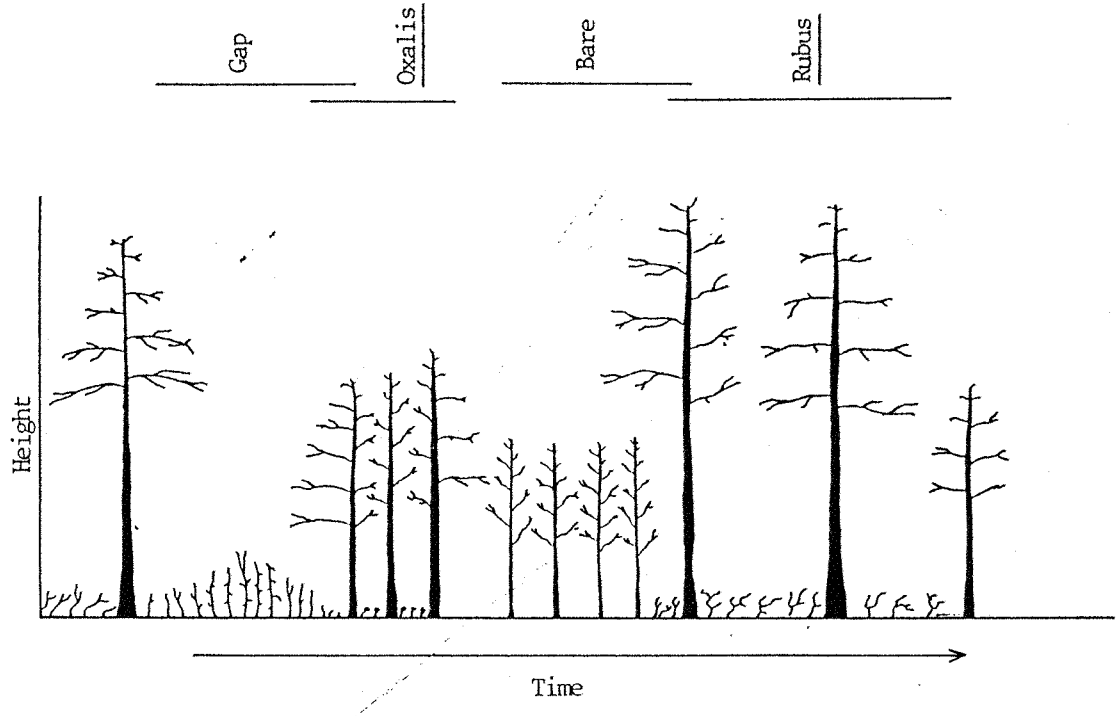


Figure 3.1: The distribution of phases in time when an old beechwood is left to itself (after Watt 1974).

old beech trees. The gaps may at first be dominated by another kind of tree such as ash, oak or birch whose lighter shade allows young beech to grow more successfully than beneath beech itself (Watt 1947).

Another example from Watts article describes the young stands of Fagus sylvatica on the South Downs. In this case there is intense shade and root competition between the young trees. The initial high density decreases markedly as the woods age and a ground flora dominated by Oxalis develops, later succeeded by bramble as the dominant ground layer species.

An example which integrates the temporal variation in woodland composition with the abundance of species dependent upon the trees for their subsistence requirement is provided by Peterken and Tubbs (1965,15). Their primary concern lay in principles concerning New Forest woodland regeneration, and the analytical framework which they adopted was one based on the 'feeding unit', in this case the deer. They showed that woodland regeneration was sporadic and periodically defined in terms of feeding unit availability. In other words when the rate of feeding units (deer) per acre was low, regeneration occurred and vice versa.

What these examples serve to demonstrate therefore is best summarised by Putnam and Wratten: 'Not only is a community always shifting and changing in the sense that it is an operational unit, but it is always in a state of flux, changing with time as species are continually lost and replaced, as their dominance or actual role in the dynamics of the community shifts and alters' (1985,86). Change maybe either short term in the nature of cycles within the system, for example recognising time components such as night and day in the community of animals occupying an English oak wood (Elton 1927). Change may be more subtle, plant species being together in the community at the same

time because of a temporal separation of growing season, while at a third level change may represent the shifting dominance or presence and absence of species over a much longer time span.

3.2.2 Spatial Variation

Spatial variation is a factor discussed by a number of authors in relation to mans' distribution in the landscape (for example Mellars and Reinhardt 1978, Winterhalder and Smith 1981). It is a factor however which exhibits a highly complex set of relationships at a variety of spatial scales.

Some of the most critical factors determining plant population patterns are those which influence seedling establishment, screening seeds and dictating germination and survival probabilities; variations in edaphic and microclimatic conditions are especially important at this stage. Climatic regimes for example vary over several scales of spatial resolution, producing potential variations in seedling establishment or successful plant growth. Differences in soil texture also influence germination success and it may interact with microtopography to produce small scale variations in microclimate, run-off patterns or nutrient levels. Soil and microclimatic variables may in turn influence local patterns of hydrological cycling within systems. Differences in soil concentration of heavy metals may produce especially sharp patterns in plant distributions (Antonovics 1971).

It is tempting to suggest that general trends exist regarding the patchiness of various, broadly defined vegetation types. Unfortunately as Wiens suggests, the diversity of spatial scales of patch structure reduces the clarity of these relations if indeed they exist at all (1976,88). Whittaker for example was unable to detect any

clear correlation of primary production with plant community diversity over a wide range of vegetation types (1965).

The habitat patterns produced by this variability can only be regarded as a mosaic or 'scatter' of patches, based on the variety of attributes or adaptive responses of populations within those regimes. If those patches differ in quality (however that may be defined), individuals should be expected to exhibit some degree of patch or habitat selection, thereby increasing the discontinuity or non-randomness of the dispersion of individuals.

In order to clarify the distinction between patches and patch-quality, two response strategies may be identified (Figure 3.2, after Pianka 1983,277):

a. coarse-grained response: in which organisms spend disproportionate amounts of time in different patches.

b. fine-grained response: where an organism encounters and uses resources in the same proportions in which they actually occur.

Bryant (1974) has shown through a simulation analysis that a coarse-grained strategy is optimal if the environmental patches differ in quality but are relatively stable and predictable through time. As environmental variation increases, habitat selection tends increasingly towards fine-grainness and this is intensified where patch selections are relatively predictable. In simple terms what this means is that where resources are less predictable and exhibit a low density scatter, population response will be towards a uniform dispersal pattern over the entire area. Where resources are predictable but occur in discrete clusters, the population response will be towards a general clumping in those areas (Figure 3.2). It is very important to keep this distinction in mind as it holds the key to

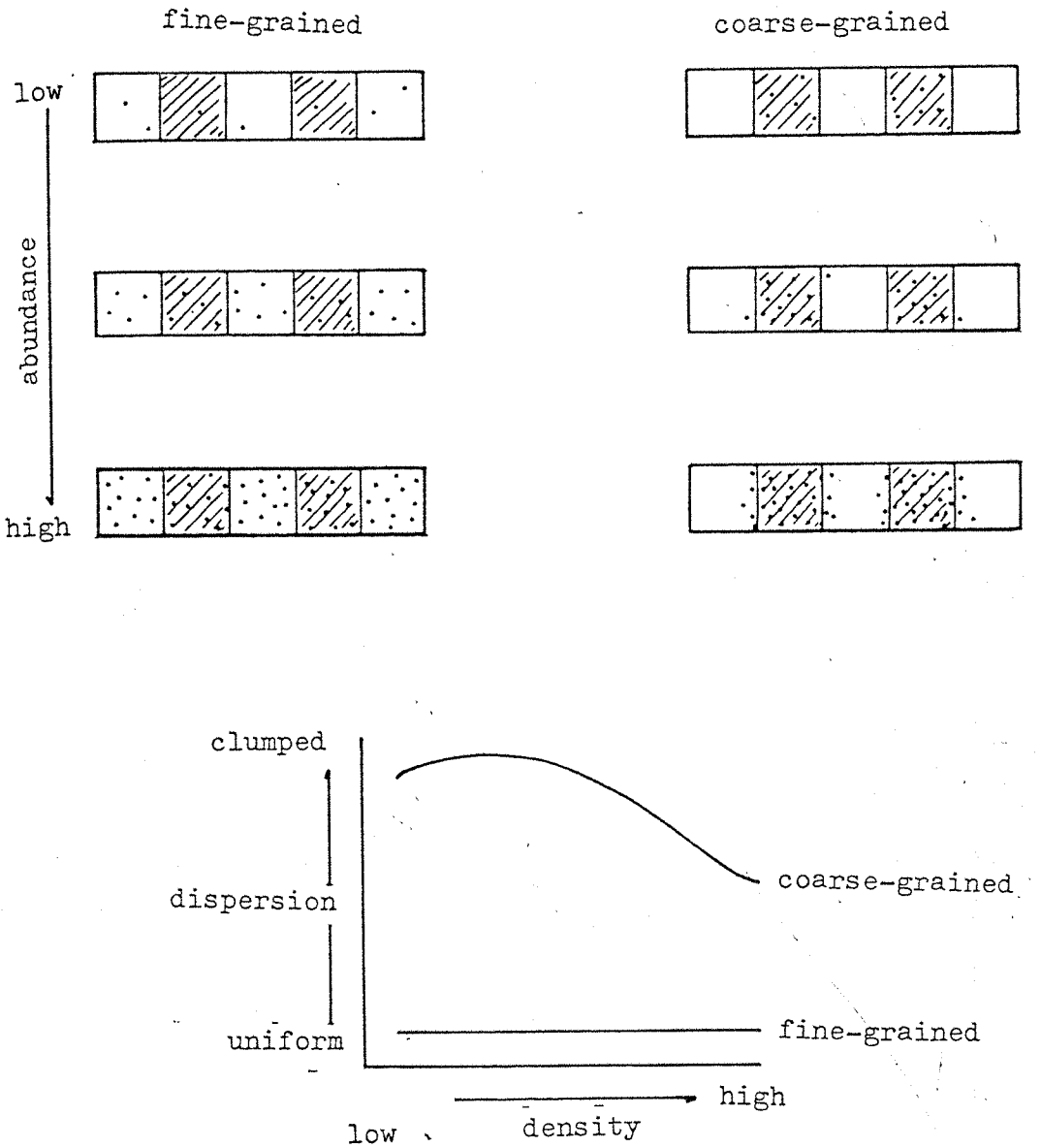


Figure 3.2: Patch occupancy patterns for a fine-grained and coarse-grained population as density increases. Shaded areas indicate preffered patches (after Wiens 1976).

understanding human adaptation to be discussed below.

Another aspect to spatial variation is differential niche overlap. In animals for example, many co-existing species show a large overlap in food type and hence resource space. An example already discussed was that of the owl and the hawk in the English oak wood (Elton 1927) and the way in which their diurnal and nocturnal habits allow them to co-exist. When co-existing species utilise similar food at the same time then they may be separated either horizontally or vertically through the habitat.

Specialisation along niche axes does not seem to have evolved to the same extent in plants, probably because in general all green plants have similar requirements for food, water, carbon dioxide and a basic set of mineral nutrients. In this case therefore plant populations tend to overlap broadly along environmental gradients; sharp boundaries tend to be the exception, although as we have seen they do exist. Habitat space is more likely to be divided amongst plants on the basis of adaptations along gradients of quantitative variation, for example elevation, slope angle and soil type (for example Hobbs' Copse, referred to above). In a broad sense these will explain plant distributions and some measure of reduced resource overlap and co-existence of a species in an area.

In conclusion therefore what observations can be made regarding the distribution and diversity of species? One hypothesis which can be related to a past context is that regarding environmental stability and the effect of environmental variance on species diversity. MacArthur (1975) for example has observed a strong correlation between temperature fluctuation on the one hand and species richness in West Coast birds and gastropods on the other. Such relationships are not universal however, the diversity of terrestrial vertebrate fauna in Australia and America both showing positive and negative responses to

seasonality. Indeed in some cases disturbance rather than stability seems to enhance species richness.

A second aspect which may be examined in relation to the palaeoecology of a region involves spatial heterogeneity. Habitat selection is a major means of co-existence between competing species and therefore heterogenous and complex physical environments should contain more complex communities and hence maintain a high species diversity. An example of heterogeneity at a micro-spatial scale concerns the temperate zone deciduous forests. In this type of environment herbaceous species are offered a wider range of light intensities beneath open tree strata and therefore possess a higher species diversity than evergreen forests which provide uniform shade (Whittaker 1965). Similarly soil heterogeneity has a marked influence on the diversity of species, the complexity of the vegetation in turn influencing the diversity of animal species, as seen for example amongst birds (MacArthur 1972) and mammals (Emmons 1980).

3.2.3 Summary

The diversity, abundance and distribution of species involves a highly complex set of inter-relationships. In short, the geological and topographical landscape determine the diversity and relative heterogeneity of vegetation types as well as their ecological stability and predictability. This in turn influences the distribution of fauna and micro-fauna, while all three categories may serve to direct the nature of human adaptation (Table 3.1). Therefore to determine whether the palaeoenvironment was coarse-or fine-grained, we need to clarify three points:

(a) That the geology, topography and soils show a distinction both in the extent of heterogeneity as well as the potential for raw material exploitation between different parts or 'zones' within the environment as a

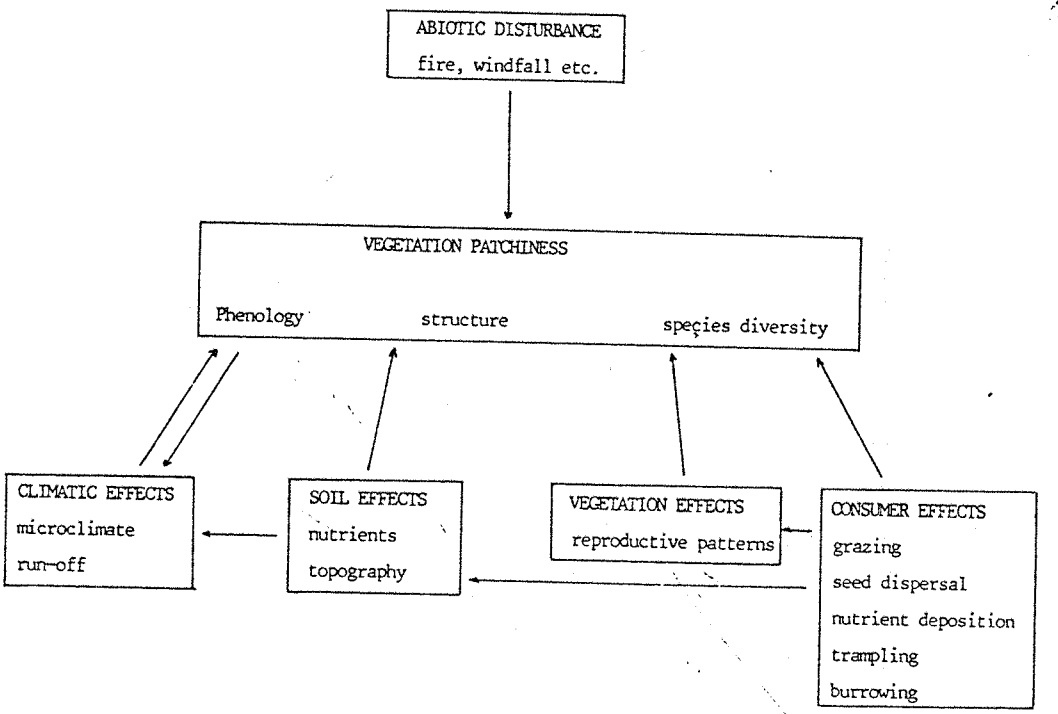


Table 3.1: Flow chart showing factors which may affect the patchiness of a given environment (after Wiens 1976).

whole.

(b) That the climate in the post-glacial period was conducive to species richness, diversity and predictability.

(c) That the flora, as represented in the pollen record suggests a degree of diversity and microvariation in time and space, and that this microvariation may be seen to 'pattern out' into the various 'zones' within the environment.

3.3 Towards Reconstructing the Palaeoenvironment

The data recording the palaeoenvironmental sequence for central-southern England may now be discussed, dealing with the climatic, pedological, hydrological and palaeoecological records respectively.

3.3.1 Climate

The climate of post-glacial Britain has been discussed in detail elsewhere and it is only necessary here to present a brief summary of the evidence (Lamb 1966, Simmons 1981). As far as a sequence is concerned the evidence suggests, above all else a very rapid amelioration of the climate with the curve for average air temperature climbing from a yearly below zero average at around 8000bc to a period of sustained high temperatures around 12^{o}C soon after 6000bc. Simmons has suggested a summer average of 16.5^{o}C having become established and persisting into the Neolithic, one of the sources of evidence (though not closely dated) being the remains of a Pond Tortoise in the East Anglian Brecklands. In the earlier Neolithic, Lamb (1966) has suggested that summer, although hot would have been short, the rest of the year being colder than at present. However after Britain became separated from the Continent at around 5800bc, an amelioration in sea temperature probably served

to increase winter temperatures to about 2°C above those of today and to increase the length of spring and autumn seasons.

The climate in the Neolithic period has been the subject of great debate, stemming initially from Iversens' work in Denmark (1941) in which he interpreted features in the pollen diagram as being due to climatic factors. From the effect of hard winters between 1939 and 1942 he demonstrated that winter temperature is critical for ivy, mistletoe and holly. By defining the 'thermosphere' for these particular plants and by comparing them with fossil pollen assemblages, he was able to graph temperature change at the atlantic/sub-boreal transition, suggesting an increase in continentality at this time. The arguments raised against this, initially by Troels Smith (1960) present an example of how problematic the interpretation of pollen really is. His suggestion is that the plant species referred to by Iversen were used as fodder and hence any 'vegetational changes' were the result of anthropogenic rather than environmental factors.

The whole question of climatic variation is highly complex, suffice it to say here that fluctuations do consistently arise in the overall climatic curve and that the Mesolithic/Neolithic sequence was no exception. What the sequence does suggest in terms of resource availability is that, following a pioneer phase probably around 10,000bc, the complexity and all the other characteristics conducive to a truly 'patchy' environment, began to emerge. The stability and range of temperature would have encouraged the co-existence of a wide variety of vegetation 'types' in the landscape as a whole.

3.3.2 Pedology

The main factor which serves to influence the soil type in a particular region is the geology, and Shore (1890) was

one of the first to examine this relationship in the context of southern England. He observed for example that on the Reading Beds soils were largely alternations of clay and sand, the Lower Bagshot Beds were characterised by sand and loam and the Bracklesham Beds by sand, sandy clay and loam. Barker and Webley (1978,163) have also noted this general fit but stress that micro-variation in drainage, aspect and exposure may produce a mosaic of soil types in a limited area and across a single geological deposit. One example is the greensand in the Abingdon and Wilton regions which supports at least four soil types varying according to such local factors. Although on the whole they tend to be sandy, light and freely drained, impeded local drainage could alter their character completely (ibid,165).

One of the most important questions in this context however is the extent to which soils may change with time. Murphy (1977,9) suggests that past soil types were much as they are today with the greatest changes occurring on slopes where ploughing would have made soils more prone to downwash and hence to more rapid erosion. Barker and Webley pursue a similar theme suggesting that, 'there has been little change in the nature of the soils since the early postglacial' (1978,163). Others suggest however that soil change has tended to be greatly underestimated while the degree of variation depends largely on the individual context. At South Street, Wiltshire for example the Neolithic soil had a higher silt content than it has today and a subsoil of periglacial drift which has since been eroded. Furthermore the erosion on slopes and disturbance of the chalky subsoil by cultivation have led to the creation of rendzinas from former brownearths. In general soils have become either lighter or heavier with time (Evans 1978,185).

Moffat and Cope (1984) in their discussion of soils on the Hampshire chalklands make a similar case for temporal variation. They suggest that despite lithological

uniformity on the chalk, weathering and erosion in the quaternary have substantially rearranged the materials of which today's soils are formed and that a more complex pattern now exists. Evidence for erosion for example comes from colluvial deposits, particularly in dry valley bottoms and in lynchets. Small for example in his analysis of Rake Bottom, Butzer Hill suggested that 5m of deposits had accumulated since the postglacial period (1958,29). Colluvium in these contexts often contains archaeological material valuable in assessing the age and origin of deposits. These have recently been the subject of detailed analyses in Hampshire and Sussex (Bell 1983) while Kwaad and Mucher have sought to emphasise the extent to which man himself was an important 'geomorphic factor' and suggest that slope deposits can be formed as a consequence of cultivation by man (1979,174). Allen (1985) has suggested that tillage from the Bronze Age onwards caused the large scale erosion of Downland soils and this is clearly apparent in the dry valley colluvial soils examined by Moffat and Cope (1984) and in the local colluvia at Itchen Abbas Road. More detailed analyses of such deposits by, for example Bell (1983) and Allen (1984) have shown them to represent largely man-induced erosion accentuated by tillage, thus indicating the nature and extent of ploughwash erosion. In addition Catt (1979) and Scaife and Burrin (1985) have demonstrated a loessic distribution in central Hampshire and east Sussex while Moffat and Cope (1984) have identified its presence in valley fills and soil profiles. Allen's suggestion therefore that greater soil depth and a soil of more acidic nature existed on the South Downs in prehistory is significant (forthcoming).

In terms of a socio-economic reconstruction, soil type has, in the past been used as a basis for predicting or modelling land-use strategies; Ellison and Harriss (1972) for example made the distinction between the quality of land and its arable potential in areas of Wiltshire and Sussex while Barker and Webley pointed to a similar

relationship in their ecological analysis of causewayed enclosures (1978). It is not the case as may be suggested by the preceding discussion that soil type cannot be regarded as a reliable anchor by which to 'tie-down' the settlement pattern. Clearly we cannot translate the modern soil map into the past because changes in nature and quality have undoubtedly occurred. Despite this, the distinction between the various micro-regions can still be applied, the extent of spatial heterogeneity and autonomy between the various spatial units tending to remain constant. Ecological zones therefore may still be defined in terms of soil type and used in the analysis of human settlement. The specific pedological characteristics of the two study areas will be described in more detail in the relevant chapters.

3.3.3 Palaeohydrology

This is generally defined as involving the study of the composition, distribution and movement of earth surface waters at a time before hydrological records. Both buried channels and alluvial sediments indicate the former presence of rivers of particular dimension, flow characteristics and discharge. Evidence from numerous valley contexts in southern England, for example the Kennet (Cheetham 1980) and the Ewerne (Smith 1985) both indicate that channel morphology has changed dramatically since the beginning of the earliest postglacial. It is clear that deforestation led to some of these alterations in the short-term at least, to increase erosion and in the longer-term to a possible decrease in evapotranspiration and more rapid run-off (Lewin 1977,119).

Both Smith's work at Everley Water Meadow (1985) and Cheetham's work in the Kennet valley (1980) suggest that braided river systems were characteristic of the earliest postglacial in southern England. That these two rivers of such different scale should maintain a similar form

suggests that most, if not all chalkland rivers were of braided configuration throughout early prehistory. This has major implications for the two survey areas with which this thesis is concerned. As Smith (1985) suggests, braided river systems are maintained in stable condition by frequent but moderate flood discharges; the balance is destroyed when discharge becomes progressively more severe and less frequent, especially when large amounts of sediment are entrained in the floodwater. For this reason, river systems that meander through silt-choked floodplains are most commonly encountered in agricultural and disforested landscapes such as may have appeared in the Mesolithic and early Neolithic periods. That the Ewerne maintained braided characteristics was confirmed by contour survey and limited excavation in the meadows beneath Hambledon Hill, Dorset. Contour survey revealed that the river formerly occupied a braided system of palaeochannels flanked to the east by a weakly defined gravel terrace and to the west by the sharply rising slopes of the Stepleton Spur. A similar pattern was observed by Cheetham (1980,213) in the Kennet valley through aerial survey. Here, two main types of channel were identified (Figure 3.3): The first was a relatively narrow -up to 10m wide -low sinuosity channel formed around large islands, and the second type consisted of a complex system of channels and bars arranged within one large channel belt.

To what extent therefore is this pattern replicated in the two survey areas? For the Avon valley and from excavations at Downton, Smith (1985) has observed that braided channels did indeed exist in the early postglacial, while it is apparent from the stratigraphy that the site experienced periodic flooding -a feature of braided channels (above) - in the form of a redeposition of reddish alluvial silt, apparently containing an element of loess. In the Meon valley, photographs taken down onto the floodplain to the west of East Meon clearly show braided palaeochannels in soil marks.

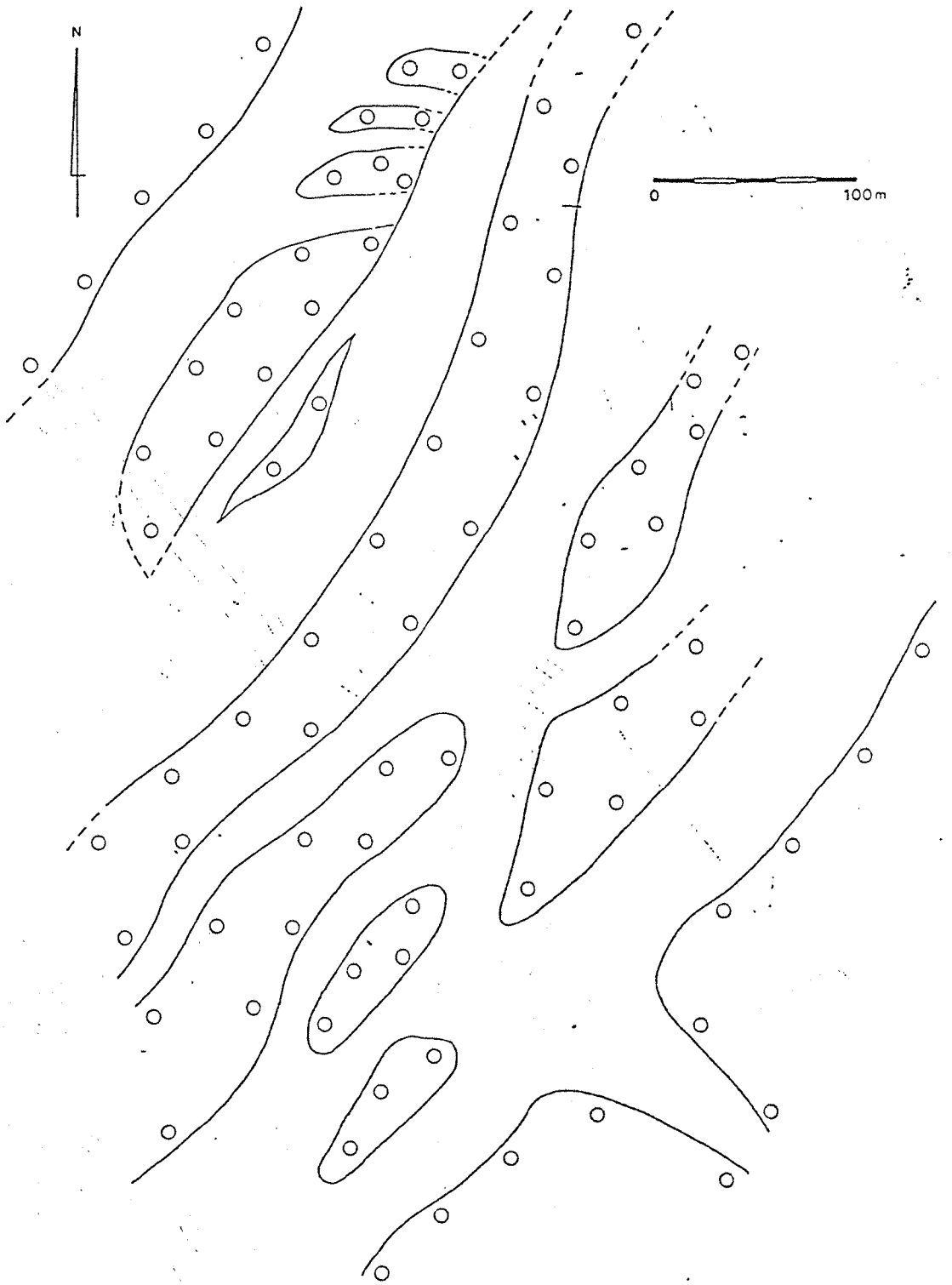


Figure 3.3: Braided palaeochannels in the Kennet valley, Berkshire (after Cheetham 1980).

But what of the dry valleys which exist on the chalklands today? Do they indicate the former presence of permanent water courses or seasonal streams which may have influenced the distribution of prehistoric communities? It is certainly the case that as locations, they were occupied from the Mesolithic to the early Bronze Age (Bell 1983), but was this because of the availability of water or simply because they offered a sheltered niche within an otherwise exposed landscape? Small (pers. comm.) certainly believes that dry valleys would have been dry -except during heavy storms -certainly since the end of the last glaciation. If this is the case then settlement or activity can be explained in one of three ways:

1. Long-term occupation within a sheltered habitat.

2. Short-term activity, possibly associated with lithic extraction and primary reduction.

3. Using the dry valley as a hunting facility, possibly as a drive or corral.

Whichever is the case, a distinct cultural assemblage will result. This will be discussed in more detail in the context of the Meon valley survey.

In summary therefore, hydrology in the earlier prehistoric period would have been very different to that which exists today and would have yielded a far higher discharge output than currently exists. In the earliest postglacial the channels were braided. With time the water level rose while flood levels may have increased by as much as 5m, rendering much of the floodplain uninhabitable. By this stage a single channel was almost certainly the predominant river form in southern England. It is likely that the Hampshire chalkland river valleys were of particular importance to early farming communities; they maintain a constant year-round temperature of 10^{o}C, providing the 'early bite' so

unique distributory characteristics and this can be illustrated by considering a few extreme examples; (for discussion of a standardising theory of pollen analysis, see Prentice 1985). One such case is that of Alnus, and an experiment carried out by Haskins (1978,102) near a mixed Betula and Alnus wood at Claywell, Newton Heath demonstrated that Alnus pollen representation decreased from 22% to 3.5% of the total in a distance of only 50 metres from the woodland edge. Another example concerns Tilia pollen; this is poorly represented relative to Quercus pollen, for example in lake sediments from forested regions of Europe and North America. Tilia produces fewer pollen grains per tree than Quercus and is therefore less well represented in basins of all sizes, a factor which maybe termed production bias. Tilia pollen is also heavier than Quercus pollen and its more rapid deposition from the atmosphere still further decreases its relative representation in large basins. This maybe referred to as dispersal bias (Prentice 1985).

Another example along similar lines is Fagus, a very low pollen producer, the heavy grains from which only travel short distances, while Pinus on the other hand has a high dispersal rate. Work by Handel (1976) on sedge pollen showed that Carex platyphylla rarely travels over one metre from the emitting plant, while Andersen has noted that, 'bracken spores are rare, even in places where the species grows abundantly,' (1970,69-70). Hence a pollen diagram dominated by Pinus may represent an area dominated either by Alnus or bracken/sedge dominated scrub! Maguire (1983) has also examined such taphonomic factors and notes the potential bias of trees over grasses; a low pollen producer like Tilia for example will produce more grains per square metre per annum than some grasses, solely due to its greater vertical extension. Another factor is that of differential preservation. Corylus is one example which is particularly resilient to fire, a factor which may explain its abundance in post elm-decline pollen diagrams.

In terms of the seasonal aspect discussed by Tauber (1965), we can note that wind speeds will decrease after tree leaves have opened, therefore suggesting that plant pollen in wooded environments will tend to travel further if liberated before that occurs. In the case of cereal pollen grains however, because of their large size and the tendency of Triticum, Hordeum and Avena to remain in their hulls, they will tend to be poorly served by natural agencies. It has been suggested that modern cereal cultivation will attain a 3-4% limit when arable farming is being practised within 2km's of the sampling site (Maguire 1983,6).

Pollen dispersal ratios can therefore be summarised as follows:

trees > pastoralism > arable

In terms of the sedimentation process, obviously the context of sedimentation (ie. lake, peat bog etc) and the site catchment of that context are going to be influential. An example here is Thorleys analysis of the Lewes pollen sequence, taken from a 2-3km diameter alluvial basin known as the Vale of Brooks (1981). The site is important because it has radiocarbon dates and suggests woodland predominance on the South Downs until the Middle Bronze Age. Thorley believes the pollen from this basin was being derived from the chalk whereas Waton (1982) considers the diagram to represent activity and conditions within the basin and not on the chalk itself. This is a question which has also been approached from a theoretical perspective by Edwards (1982) taking a lake as the sedimentary context with an arbitrarily defined catchment zone (ibid,Fig.1). This represents a hypothetical 'area' prior to mans intervention and is almost totally wooded with poor understorey flora, and non-arboreal pollen along stream edges and around the lake. In the early Mesolithic, hunters set up a camp by the

headwaters of a stream; this, Edward's suggests will produce small scale vegetational disturbance, but as it is beside a stream and may involve bankside erosion this will produce perturbations in the lake pollen profile. In the early Neolithic a large area is cleared for cereal cultivation and pasture beyond the stream borne catchment area. Cereal pollen will be filtered out by the woodland while grass and plantain will be well represented. One interpretation may be small-scale clearance related to pastoral activity.

A final problem relates to the identification of agricultural activity in pollen diagrams. Again there are two problem areas; first that certain species may have existed as weeds prior to cultivation. Godwin (1975) suggests that Secale cereale L was one such example, rising to the status of crop plant probably towards the end of the Iron Age. A second problem lies in the identification of so-called agricultural indicators, namely species whose very presence is assumed to signify plant cultivation. Godwin (ibid) notes two examples: Chenopodium album and Plantago lanceolata, both of which were present in previous glacial and inter-glacial periods and hence prior to cultivation. Edwards (1979) has suggested that pastoral indicator pollen types may represent the growth of 'field-edge weeds', therefore erroneously invoking an influence of mixed farming. Furthermore, with the recent attribution of agricultural episodes to a time preceding that of the elm-decline, neither can relative chronology be applied to help remedy this situation (Edwards and Hirons 1984, Waton 1982).

Bias factors are therefore of considerable relevance in terms of pollen analysis and one which often takes a back seat in ecological discussions. Edward's (1982) theoretical ideals are simple yet potentially invaluable for understanding the complexities of pollen dispersal, sedimentation and interpretation.

3.3.4.2 The data

This maybe examined in the form of four macro-regional contexts in the area of central-southern England: (see Figure 3.4 for site locations).

3.3.4.2.1 The Hampshire and Dorset chalklands

The results in this section stem largely from the work of Waton (1982), Allen (1986) and Mason (1982) at sites including Winchester, Rimsmoor, Kingswood, Snelsmore and Amberley (Figure 3.5).

As far as the boreal period is concerned, the core from Winchester records the vegetational history most accurately and for the longest period, the base of the deposit being dated to c.8700bp. The pollen record suggests that woodland on the surrounding chalk was probably dominated by Corylus, Pinus, Quercus and Ulmus, in order of importance. Low Betula and Alnus values in WT-1 (6720-6190bp) imply their restricted existence in this area, a factor also true at other sites and in support of Godwins' contention that Alnus was only present sporadically prior to the atlantic period and then only in favourable locations (1975).

Dryland herb frequencies see a decrease from about 10% of the total in WT-1 to only 3% in WT-2, while at the same time Pinus values increase at the expense of Quercus and Betula. There is no clear explanation for this, and the possibilities of climatic dryness cannot be demonstrated. It is most likely that purely local factors were responsible, for example changes on the floodplain as the result of river channel migration.

The relative importance of Corylus is another feature of this period. Previously the hazel has been considered solely as an understorey shrub and is only now becoming

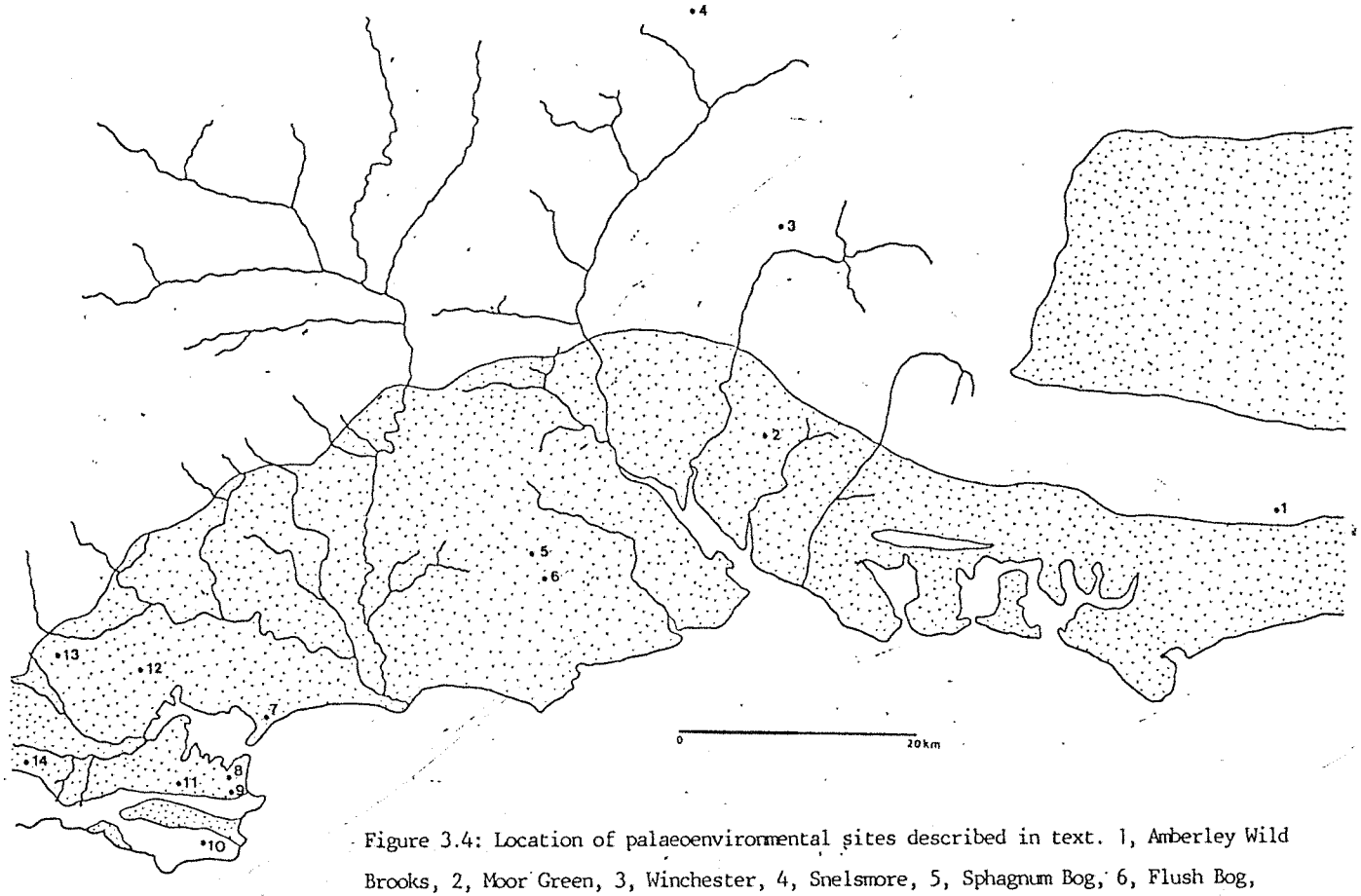


Figure 3.4: Location of palaeoenvironmental sites described in text. 1, Amberley Wild Brooks, 2, Moor Green, 3, Winchester, 4, Snelsmore, 5, Sphagnum Bog, 6, Flush Bog, 7, Luscombe, 8, Godlingston A, 9, Godlingston B, 10, Kingsmore, 11, Rempstone, 12, Morden A, 13, Rimsmoor, 14, East Stoke.

site	Winnall Moors	Winnall Down	Easton Lane	Easton Down	Rake Bottom	Snelsmore	Buckskin
source	Waton 1982	Mason 1982, 1985	Allen 1985	Mason 1982	Gordon and Shakesby 1973	Waton 1982	Allen 1987
evidence	pollen	mollusca	mollusca	mollusca	mollusca	pollen	mollusca
E.Mesol.					woodland cover		
L.Mesol.	mixed deciduous woodland; possible clearance.				more enclosed and shaded woodland.		possible LM/EN disturbance.
E.Neol.	3680bc major clearance			dry grassland, arable and pasture. Later regeneration.	clearance phase. Increase in number of open country species.	oak, elm, lime, hazel. Virtually no open ground.	disturbance but not of primary woodland therefore activity prior to that date.
L.Neol.			open woodland and local clearance. later regeneration.				
EBA	absence of cultivars			clearance phase			regeneration
MBA		?	open grassland; permanent pasture and arable	open gassland; arable and pasture			further clearance
LBA		open, dry grassland. Permanent pasture and arable				first major clearance phase	

FIGURE 3.5: Summary diagram for the Hampshire/Dorset area.

regarded as a 'woodland forming' tree, reaching heights of up to twelve metres. (At Wytham wood near Oxford for example, coppiced hazel has been allowed to grow up, and now competes with the once dominant ash (Dimbleby 1981,99)). Clearly in this context it must represent the latter since, as an understorey shrub beneath a closed woodland canopy it would not be able to flower and hence would fail to be recorded in the pollen count. Where it is recorded it probably represents hazel as a marginal belt to woodland, in clearings or as pure stands. However in this context the preservation qualities of hazel pollen over other species should not be overlooked.

One final feature of the Winchester sequence is the proportion of grasses, nearly 40% of the total pollen count throughout the boreal period. Does this imply that the earlier Mesolithic landscape was open at the outset? The increase in herb frequency continues into the atlantic period and suggests a further thinning of the forest canopy, but is this representative of the Hampshire chalklands as a whole ?

Certainly there are changes at the boreal/atlantic transition, for example a general decline in Pinus and increase in Alnus values, although not totally synchronous. This significant shift in proportions almost certainly reflects the increasing climatic humidity at this time with the northerly shift of polar fronts bringing a greater incidence of depressions to Britain, and hence an increase in total annual rainfall (Magny 1982, Lamb 1977).

The beginning of the Neolithic sequence is defined at three sites by a decline in Ulmus pollen, dated to 5680bp at Winchester, 4980bp at Rimsmoor, and 4800bp at Kingswood. The dates do differ significantly from the British mean of 5350/5150bp and clearly could not be used to argue for regional contemporeneity. Summary diagrams for this period show clearly the marked yet variable changes at the three

sites; at Winchester for example, there is an increase in herb pollen corresponding with a decline in tree and shrub species including Corylus, while at Rimsmoor and Kingswood Corylus increases at the expense of Quercus, Ulmus and Tilia. As far as the actual elm decline is concerned, both Rimsmoor and Winchester have evidence for disturbance of the vegetation prior to this episode, corresponding to what has been termed the 'earliest Neolithic' (ApSimon 1976). At Rimsmoor the evidence is most convincing with a late atlantic herb immigration correlated with two cereal pollen grains at 5400 and 5720bp, about 400 years prior to the elm decline. Also corresponding with this are fluctuations in Ulmus, Tilia, Betula, Quercus and Corylus pollen, and a steady increase in the quantity of charcoal throughout the period, suggesting either an intensity of small clearings outside the catchment area, or an increase in the frequency of camp fires.

At Winchester the evidence is slightly less definitive; an increase in Alnus and Tilia pollen possibly suggesting the development of fen margin woods, or alternatively and in accordance with an increase in Plantago lanceolata, (a species of open pasture) the woodland edge may have been pushed back permitting the expansion of Alnus-rich fen woods. This episode is dated to c.6220bp, 540 years prior to the elm decline. The evidence at Kingswood is virtually non-existent, an abundance of charcoal and herbs possibly suggestive of some minor interference.

The actual intensity and duration of the land-use phase which continues after the elm decline is another demonstration of the variability between these sites. At Winchester for example tree, shrub and Corylus pollen is at a total of about 20%, well below the 25-50% figure which Tinsley and Smith (1974) interpret as a site within 100 metres of a woodland edge or one surrounded by dispersed trees. Grass was prevalent, especially Plantago lanceolata and Liguliflorae. Cereal cultivation may well have been a

significant feature of the landscape, but as Waton suggests, possibly confined to the valley slopes (ibid).

At Rimsmoor the picture is very different; Waton has identified a sequence of clearance > pasture > minor regeneration > pasture with arable > regeneration. What this does tend to suggest is that the picture at Rimsmoor represents a long fallow system, with increases in Ericaceae and Pteridium representing the re-use of previously cleared areas. Waton believes the extent of the cleared area at any one time would have been very limited, probably confined to the area of Rimsmoor itself (ibid).

Kingswood sees a much less significant change at the time of the elm decline, Ulmus pollen decreasing by 5%, and with Corylus doubling in frequency. Herbs are minimal throughout the period while charcoal is indicative of fairly widespread clearance. This, coupled with the notable lack of cereal pollen may suggest an emphasis on forest grazing.

Following the elm decline sequence at Winchester comes a period of permanent clearance up until the end of the Bronze Age and beyond, a trend also reflected at a number of other sites across the region. Mason (1982) for example has suggested that the environment surrounding the Winnall Down ring-ditch near Winchester (dated to 2850-2700bc) was open, the site possibly lying in a ploughed field or at the junction of two different land-use zones, while at Graces Farm ring-ditch in the Itchen Valley, a Bronze Age date was suggested for a similarly open environment (ibid). At Rake Bottom, Butzer Hill, Gordon and Shakesby (1973) have noted that a mollusc population suggestive of enclosed, shaded conditions predated the Neolithic, while from that point onwards the fauna was dominated by grassland species. Gordon and Shakesby suggest a landscape in transition from woodland to grassland with the presence of Vallonia suggestive of human clearance (1973,19).

A different picture is presented by the Easton Down assemblage (Mason 1982); in this case the trend is towards open, dry grassland kept short by grazing in the Neolithic but with some regeneration in the late Neolithic followed by further clearance in the late Bronze Age. Allen (1985) however suggests that the downs at Easton Lane were continually and heavily exploited from at least the middle Bronze Age, with clearance probably occurring in the Neolithic. This therefore compares in a broad sense with the data presented by Mason (1982) and Waton (1982) for Winchester although a degree of variability does appear to exist. This is further accentuated when one considers the four pre-iron-age samples from Bridgets Farm in the Itchen Valley which suggest an area of woodland while at the nearby site of Burntwood Farm the late Neolithic part of the sequence displays shady conditions with localised clearances appearing in the Bronze Age (Mason 1979).

With the early/middle Neolithic therefore, the general picture would appear to be one of the woodland edge being pushed back with continued exploitation of cleared areas accounting for increased herb levels. The continued presence of woodland on a small scale is demonstrated by instances of Quercus and Corylus pollen, possibly representing either individual trees or small copses in an otherwise open environment. From 4650bp the cereal pollen curve ceases, herbs decline and arboreal pollen begins to increase. This apparent 'stepping down' of land-use intensity is a feature mirrored widely throughout lowland Britain; in the Somerset Levels for example, Beckett and Hibbert (1978) record a period of forest regeneration from about 4350 to 4050bp. In support of this, Evans (1975) noted an increase in the quantity of pig bones and 'chisel-ended arrowheads' in the archaeological record at this time, both he suggests being associated with woodland development.

A feature of the later Neolithic and early Bronze Age at

Winchester is the total absence of cereal pollen, but as Jones (1980) has recently demonstrated, this does not necessarily mean that cultivation was not practised; indeed Waton (1982) has suggested that the period would have been one of cereal cultivation and woodland exploitation. This standstill phase which seems to have encapsulated much of the later Neolithic and early Bronze Age, terminates abruptly at about 3500bp with the clearance of Betula, Quercus, and Corylus possibly indicating a general clearance of established oakwood with cleared areas being set aside for tillage.

The sequence at Snelsmore provides further support for the 'scatter of patches' model providing a totally different picture to that from Winchester or Rimsmoor. In the middle Neolithic it is one of Betula and Corylus dominance, with low but increasing levels of Ulmus, Quercus, Tilia, Alnus and Fraxinus. Herbs and grasses are also low suggesting a period of scrub or woodland regeneration. The later Neolithic sees a continuation of these trends with a forest canopy dominated by Quercus and Tilia existing in the early Bronze Age. The decrease in Ulmus, Tilia and Fraxinus pollen by this stage may indicate either selective exploitation, forest grazing or the clearance of better soils; open ground continues to be sparse.

The Bronze Age period as a whole sees a total of tree/Corylus pollen never falling below 65%, suggesting the prevalence of woodland conditions in complete contrast to the suggested clearance and agricultural development at Winchester. It is difficult to compare the two sites because of the variation between their pollen catchment areas but one explanation may lie in the nature of the soil. Around Snelsmore the heavy soils may have been conducive to the development of dense vegetation, making it harder to clear than on the sandier soils around Winchester; it may also have proved costly to cultivate due to both its texture and base deficiency. A more likely

explanation however may lie in terms of a topographic setting, Winchester lying in a valley context while Snelsmore does not. This will be discussed in more detail below.

Turning now to the sequences at Rimsmoor and Kingswood, we can identify high Corylus values in the early Neolithic, possibly representing woodland management in the form of hazel coppice. Iversen (1973) notes that Corylus pollen is often high at this stage, possibly being managed for its nuts, and as we have seen, for Corylus to have flowered so prolifically it must have been present in unshaded conditions.

From about 4200bp, some disturbance can be identified in the form of a fall in Quercus and Ulmus values, and a rise in Corylus and Alnus. This continues to gain momentum and at about 3890bp a minor but distinct clearance can be recognised. From that date on into the later Neolithic, a notable decline in Corylus pollen occurs, with Quercus, Ulmus, Tilia and Fraxinus also affected. The area cleared was apparently very limited in extent with pasture predominant, but the most interesting feature of this later Neolithic stage is the behaviour of Tilia pollen; there is a notable fluctuation in the curve, eventually declining to a point which Waton (1982) suggests may represent the shift from arable to pasture.

At Amberley Wild Brooks, the sequence begins at about 3740bp and is similar in many ways to those at Kingswood and Rimsmoor. For the earliest phase pollen suggests Quercus and Tilia dominated woodland, with Corylus, Alnus, Fraxinus and Ulmus also present. Herbs and grasses exceed 10% at this time, many of which being characteristic of marshland habitats. After 3360bp there is evidence for the creation of more open areas with a decline in Quercus pollen suggesting the clearance of oak woodland. In conjunction, herbs increase with grasses to a lesser

extent. A single cereal pollen grain dated to approximately 2820bp suggests that cereal cultivation did occur, although pasture would appear predominant.

A final confirmation that early clearance appears to have occurred in the valleys of southern England, is provided by the mollusc sequence from the site of Buckskin, Hampshire (Allen 1987). Situated on upper chalk and on a gentle north-facing slope of the Loddon valley, evidence appears to suggest late Neolithic /early Bronze Age disturbance of the woodland. However the woodland assemblages identified at Buckskin do not indicate primary woodland -as was the case for example at Wen Barrow (Allen 1984) -and hence may suggest even later Mesolithic/ early Neolithic clearance such as was suggested above for the Itchen valley to the south. Allen's suggestion that early Bronze Age activity was probably focused in the valley certainly appears to be supported by the evidence from Buckskin as well as that from three ring-ditches on the north side of the Loddon valley, a short distance to the east. Here Meddens (1983) noted that the focus of early Bronze Age activity was clearly taking place in an area of open grassland, which - it may be argued -had remained since the early Neolithic.

The picture on the Hampshire chalklands therefore and especially in central Hampshire from where most of the data derives, is both complex and variable, clearly exhibiting the shifting mosaic of microenvironments discussed in the previous section. The area around Winchester is of particular significance in this context as it represents the unique integration of detailed palaeoenvironmental and archaeological investigations (for example Mason 1979, 1981, 1982) which have been the subject of a recent summary by Allen (1986).

I suggest that as a general picture, clearance of mixed deciduous forest occurred in the earliest Neolithic within the river valleys with large scale clearance across the

region appearing by the early/middle Bronze Age. This is reflected not only in the Winchester area where a gradual expansion from valley floor and terraces onto the surrounding chalk can be identified, but also in the form of early cereal pollen grains at Rimsmoor in the Frome valley. Away from the valleys, disturbance is only registered at a later date; in Surrey for example evidence of primary woodland has been recovered in the primary ditch fills of the Bronze Age Wen Barrow (Allen 1984) while a Bronze Age date for erosional episodes on the heaths suggest only limited activity in the Neolithic of Surrey.

3.3.4.2.2 The Wiltshire and Sussex chalklands

Taking this concept of micro-spatial variation as asserted for the Hampshire and Dorset chalklands as a model, we may now proceed to test this by considering chalkland data from outside that region (Figure 3.6).

In the Vale of Brooks near Lewes, Sussex, Thorley (1981) sought to determine whether or not the Downs were well wooded in the early postglacial period. The first of two cores, Lewes 1 with a date of 6290bp, shows the area to have been well wooded by that date. She identifies two phases of disturbance, one prior to 6200bp, the other after it; the latter is characterised by a fall in Tilia and Ulmus pollen, an increase in grasses and the appearance of Artemisia, Compositae and Chenopodiaceae. Lewes 2 has two dates, 5674 and 3190bp. At the earliest level, low Tilia and Ulmus values are identifiable, accompanied by a general increase in herbs and Pteridium. Thorley associates this with Mesolithic activities, 'in the pursuit of game' (ibid,100). At around 5500bp a period of woodland regeneration is suggested, continuing into the Neolithic but with a fall in Pinus and Fraxinus values. In the later Neolithic/early Bronze Age, a large range of cultivation indicators are present, suggesting woodland clearance but probably only on a small scale. It is only in the middle

site	Lewes I	Lewes II	Itford Bottom	Offham	Horslip	Beckhampton	South Street	Cherhill
source	Thorley 1981	Thorley 1981	Bell 1983	Thomas 1982	Ashbee et.al. 1979	Ashbee et.al. 1979	Ashbee et.al. 1979	Evans 1983
evidence	pollen	pollen	mollusca	mollusca	pollen/mollusca	pollen/mollusca	pollen/mollusca	pollen
E.Mesol.								woodland predominant
L.Mesol.	high alder values. Increase in grass pollen suggests minor disturbance phase.	pionneer colonization of disturbed habitats. Reestablishment of woodland cover.	shady woodland condit- possible clearance (fire?)		open country grassland, possibly some arable.	woodland cover	hazel, oak, elm woodland.	
E.Neol.	elm decline prior to usual date.	large range of cultivation indicators.		predominance of shade-loving species. Poss- localised clearance in primary woodland.		3250bc initial clearance.	clearings possibly for pasture in a background of scrub woodland.[2]	
L.Neol.	regeneration of woodland.				recolonization by hazel.[1]	absence of regeneration suggests grazing.		increase in open country species.
ERA						woodland regeneration	woodland regeneration and cross-ploughing.	
MBA		arable/pasture. First significant woodland clearance.						
LBA								

FIGURE 3.6: Summary diagram for the Wiltshire/Sussex area.

Bronze Age that this area of the chalk downland, in Thorleys opinion, sees any real clearance activity, identified in the pollen record by a broad spectrum of non-arboreal pollen types characteristic of arable and pasture (ibid,100).

A number of points arise from this; first is the question of pollen catchment. As has already been discussed, Thorley considers the pollen from this source to represent activity on the chalk, while Waton (1982) remains unconvinced, suggesting the pollen record may only represent the sequence within the Vale of Brooks itself. Tauber (1965) states that pollen in a basin of this size must be derived from several kilometres distant and hence must include the chalk within its catchment. If we assume for a moment that Thorley is correct in her assumption, a major problem arises when we begin to consider straight archaeological data. There is very little in the way of Bronze Age evidence, both in terms of artefacts and monuments. This disagrees totally with Thorley's idea of, 'a distinct community on the moist base-rich valley side soils, potentially attracting game, pastoralists and agriculturalists,' (ibid,102).

This picture of environmental variability therefore continues to take shape, with the east end of the South Downs demonstrating a total contrast to the predominantly open environment in the valleys of central and west Hampshire. Work by Bell (1983) in the same area has produced two significant sets of data. His work involved colluvial deposits in chalkland dry river valleys with a view to interpreting land-use patterns in relation to known archaeological sites. At Kiln Combe a predominantly beaker assemblage comprising lithic and ceramic material, and a radiocarbon date of c.3680bp produced a snail assemblage dominated by Trichia hispida and Helicella itala. These and other open country species comprise 43% of the total assemblage, with shade loving species representing only 5%.

A second site, in closer proximity to the Vale of Brooks is that of Itford Bottom. Two dates have been published, 6820bc and 1770bc, with a lithic assemblage of Neolithic/Bronze Age date and Bronze Age pottery. There is a marked ecological change between the 115 and 130cm levels, with each of the formerly abundant woodland species decreasing and species characteristic of dry, open conditions becoming predominant. There is a chance that cultivation may have disturbed this upper part of the sequence, yet even bearing that in mind the clearance phase was fairly sudden and almost certainly earlier than that suggested by Thorley for the Vale of Brooks; a similar date has been suggested for Ashcombe Bottom (Allen 1983).

Evidence from the Avebury district on the Wiltshire chalklands suggests a further contrast to those trends examined above, and has been the subject of a recent investigation by Smith (1985). At Horslip Long Barrow for example, large numbers of Vallonia and Helicella, and a paucity of Pupilla tends to suggest an open grassland environment prior to barrow construction. The sparseness of chalk fragments -a feature probably brought about by earthworm sorting -tends to support this (Evans 1979,275-276). The molluscan fauna in the barrow ditches, dated by pottery to the 'beaker' period and analysed by Connah and McMillan (1964) suggests an increase in the proportion of woodland species up to 32% of the total, probably representing scrub or dank herbaceous vegetation in the late Neolithic/early Bronze Age period. The pollen evidence however does not support this; it suggests an open phase prior to barrow construction (ie. early Neolithic) but followed rather by woodland recolonisation both by Corylus and other tree species. Pollen evidence further suggests the initial clearance to have been for arable-orientated agriculture, supported by the presence of cereal-type pollen grains and arable indicators.

A similar sequence is suggested at Beckhampton Road though within a slightly different time frame. Evans identifies a first stage of woodland cover suggested by land snail analysis, followed by one of open grassland with some cultivation in the vicinity and nearby scrub and woodland edge vegetation. Two radiocarbon dates from the sequence - 3250bc on charcoal from the base of the turfline, and 2517bc from antler on the buried surface -suggest a persistence of such open conditions for up to 700 years (Evans 1979,281). Finally, scrub or woodland regeneration in the Bronze Age is suggested by land snail analysis of round barrow ditch sediments.

At South Street, snail and pollen data were once more combined to produce a similar, though again not identical picture. Five snail samples were taken, the earliest deriving from a subsoil hollow, tentatively dated to the late boreal. The fauna suggested an environment predominantly of woodland, possibly with some areas of open ground. However under open woodland conditions a greater abundance of Vallonia and lower Pupilla values would be expected (ibid).

From the lower chalk soil (probably early Neolithic), open country species predominate. This suggests that clearance had now occurred, although a 15% proportion of shade loving species does suggest some woodland presence. A second assemblage from the same context demonstrates even greater proportions of open country forms, with Pupilla muscorum reaching a peak at this stage. This is a species characteristic of unstable, partly vegetated surfaces, and suggests to Evans the practice of tillage in the area (1979,284).

Pollen tends to support this general sequence, the subsoil hollow producing a woodland spectra with Corylus dominant, the Neolithic portion suggestive of scrub woodland with grass, ribwort plantain and knapweed indicative of

clearings for pasture, and the Bronze Age characterised by largely treeless conditions. It must be remembered however that the dating of these environmental sequences is based largely on pollen association, and correlations are extremely problematical.

The Mesolithic soil at Cherhill (Evans and Smith 1983) produced dates giving it a range of about a millennium, from 6520bc to 5550bc. It probably corresponds therefore to the later boreal and is characterised by a predominance of woodland species. Evans suggests the possibility of a fairly generalised environment incorporating a specialised and widespread niche or microhabitat (1983,104). A second zone with dates of 5280 and 2765bc corresponds to the atlantic phase and sees a massive increase in freshwater and swamp components. Into the Neolithic the proportion of open country species, especially Vallonia increases at the expense of woodland species, with a final phase of vegetation becoming increasingly overgrown.

This general view of Wiltshire's environmental sequence (woodland > clearance > pasture > scrub and regeneration) is one totally in conflict to that from a similar chalkland environment analysed by Thomas (1982). He examined the land snail data from five causewayed enclosures on the Sussex Downs, resulting in a picture of woodland predominance throughout the Neolithic, a picture also suggested by the mollusc sequence from Brook, Kent (Kerney et.al. 1964), Burntwood Farm and, to a lesser extent Easton Down. At Bury Hill the trend is the same with only one snail in a total of 333 representing an open environment. Thomas suggests on this basis that the enclosure was constructed in a newly cleared area of woodland, the clearance itself being of localised occurrence. Evidence from the Trundle also suggests localised clearing, although in this case there are higher proportions of open country species. Combe Hill was also dominated by shade loving species, in this case complemented by a number of teeth of Clethrionomys

glareolus (bank vole) a common woodland species, while Barkhale failed to yield a single open country specimen (Thomas 1982).

It has been suggested that this dominant woodland element may represent the fauna living in overgrown ditches in an otherwise open environment but such assemblages from Badbury Rings and South Street are in sharp contrast to those produced by Thomas. This material also goes against the suggestions made by Barker and Webley (1978) concerning the location of enclosures in open environments and in close correlation with pastoral resources. The difference between the two approaches and correspondingly the validity of the results must lie in the fact that Barker and Webleys approach was very much based on predictions of Neolithic decision-making in relation to factors of soil suitability, while Thomas relied on palaeoenvironmental data, and is supported in many respects by Thorley's analysis within the same area (Thorley 1981).

We may suggest therefore that once again a contrast may be drawn between valley contexts and areas of chalk downland. In river valleys such as the upper Kennet, disturbance was registered at an early date, apparently demonstrating a degree of continuity from the late atlantic phase. As Smith has demonstrated, all the evidence for pre-Neolithic woodland clearance in the Avebury area is firmly concentrated on the floor and terraces of the Kennet valley (1984). On the chalklands of west Sussex and Surrey on the other hand, primary woodland apparently continued until the Bronze Age suggesting once again that it was the valleys that formed the basis of settlement ecology in the area of central-southern England.

3.3.4.2.3 South coast river valleys: the sands and gravels

(See Figure 3.7). From Southampton, two contexts have been examined, both prior to dock construction. Shore and Elwes

site	Gatcombe, Isle of Wight	Sphagnum Bog	Church Moor	Ouse/Cuckmere valleys
source	Scaife and Tomalin 1980	Seagrief 1960	Barber 1975	Scaife and Burrin 1983, 1985
evidence	pollen	pollen	pollen	pollen, geomorphology
E.Mesol.		high pine representation; increase in hazel.	high oak representation.	
l.mesol.	possible cleaance phase.	increase in elm and oak.	increase in alder.	
E.Neol.	4850bp elm decline. Local small-scale cereal cultivation..arable within open canopy forest.	no evidence for disturbance	little evidence for disturbance.	evidence for valley side clearance.
L.Neol.	further forest clearance. later regeneration.			
EBA				

FIGURE 3.7: Summary diagram for South Coast contexts.

(1889) examined a thirty foot depth of Bracklesham Beds as well as a sequence of underlying peat. This was found to contain a significant amount of Quercus with some trunks in situ, abundant remains of Fraxinus and Corylus, and some Betula and Pinus. Also present was Scirpus lacustris (bulrush), Carex (common sedge), Myrica (bog myrtle), and Pteris aqualina (bracken fern). Found in association with this, and apparently tying the sequence to a Mesolithic/Neolithic date, were some 'Neolithic flints', dark coloured flakes, a perforated pebble macehead and a bone needle (ibid,54). In addition there were a quantity of bones, probably of Bos primigenious and Cervus elaphus.

Similar deposits were identified in the George V dock (Godwin and Godwin 1940). In the boreal period Pinus was dominant, while into the atlantic, Quercus and Ulmus became established with Corylus increasing in value.

The authors suggest a late boreal/early atlantic date range for the sequence, based both on their own findings, those of Shore and Elwes (1889) and on the various archaeological correlates recovered (ibid,306). At Nursling the trend is again comparable (Seagrief 1959) with Pinus dominant in the boreal and with Ulmus and Quercus beginning to take over into the atlantic period. However it is the sudden switch to Alnus domination that clearly marks the boreal/atlantic transition. This is a concept already discussed and relates in all probability to the increasingly damp conditions which characterise the later Mesolithic environment. A final distinction between earlier and later Mesolithic is the increase in non-tree pollen in the later period. This is something again regarded as fairly widespread and recognised for example at Oakhanger. 'There were local glades in the woodland more open in character, where heather and grasses were able to flower, but these did not form extensive areas...around the site,' (Rankine et al. 1960,257).

The sequence at Oakhanger is attributed solely to the atlantic phase, with Tilia in high proportions and Ulmus present throughout. The boreal phase tends to be dominated by Pinus in the majority of cases, and its virtual absence at Oakhanger confirms this. Another significant feature is the predominance of Hedera (ivy) pollen, a pollen which generally occurs in small quantities. Simmons and Dimbleby (1974) have attempted to determine the possible role of ivy, and turn to Oakhanger as a key example. Jarman (1972) has noted the importance of Cervus elaphus (red deer) to Mesolithic communities, and if this were so then the tendency of red deer on Exmoor to turn to ivy as a diet supplement under harsh conditions may be significant (Coleman Cooke 1970). A final detail derived from the Oakhanger sequence is the occurrence of Clematis, a plant which Dimbleby suggests must have grown on the chalk, the nearest source of which is three miles distant (Rankine et al. 1960,258). The economic value of the plant is questionable but the implications for site-catchment may be of significance.

The New Forest area of Hampshire is another which has yielded important environmental evidence. At Cranes Moor for example (Seagrief 1960) three sites in fairly close proximity were examined. The lowest level at Sphagnum Bog was one characterised by high Pinus values and with Corylus on the increase. Closed forest conditions are suggested by a high tree to non-tree pollen ratio, yet with some open country plants present, for example Ericales, Chenopodiaceae, Compositae and Plantago lanceolata. Seagrief attributes this to the boreal period (1960,74). She also draws special attention to the occurrence of Plantago lanceolata, a plant which does not generally appear until the Neolithic forest clearance episodes of zones VIIa and VIIb (ibid,75).

The atlantic phase sees a marked increase in Ulmus and Quercus, with an increase in Alnus delimiting the start of

zone VII. Seagrief suggests a picture of extensive forest cover throughout. The sequence at Little Bog is almost identical while at Flush Bog, high values of Salix (willow), and high initial values and subsequent irregular values for Betula may suggest the presence of fen woods into which Pinus may also have entered (ibid,82). Corylus pollen is much lower than at the other two sites possibly due to strong local pollen production of Betula and Pinus.

Seagriefs work at Cranes Moor, therefore, provides a fairly detailed picture of the area from about 9000 to 6000bp. This is supported by the work of Barber (1975) at the site of Church Moor. In the boreal zone, Quercus values are higher and more sustained than is usual, the period being represented also by Pinus, Betula and Corylus, with Ulmus and Salix also represented. This mixed woodland phase terminates with a striking increase in Alnus pollen, and an accompanying decline of Pinus, Ulmus and Tilia.

One significant feature of all the New Forest sites is the apparent absence of Neolithic disturbance. At Church Moor for example, the only significant reductions in tree pollen come at the boreal/atlantic transition and in the late Neolithic/early Bronze Age. At Sphagnum Bog Pinus values decline, Quercus increases significantly but Ulmus is apparently not affected. Little Bog shows a similar picture, while Flush Bog demonstrates some variation on a similar theme: Sphagnum for example increases, as does Pinus to its pre-atlantic level; Betula falls in value, but again no real change is apparent in the Ulmus curve.

At Moor Green to the east of Southampton, an early Bronze Age round barrow yielded a pollen sequence which once more suggests an absence of human activity in an area of acid soil heathlands lying some distance from a major valley context (Dimbleby 1974). NAP/AP percentages show quite clearly that in all cases tree cover was dominant. Birch appears to have been the most abundant with hazel, oak and

alder also represented. There was no trace whatsoever of agricultural activity prior to barrow construction; there are low values for grasses, no cereal pollen and low values for such farming indicators as plantain and sorrel.

In terms of a vegetational history, Dimbleby (1974,16) observed a closed mixed oak forest with a high proportion of lime towards the base of the sequence. With time, light demanding species such as birch and bracken increase in importance. Even at this relatively late stage however, the environment is wooded with birchwood possibly the result of fire. The barrow appears to have been constructed -as was the case at Wen barrow (Allen 1984) -in an area of primary woodland with a minimum of ground clearance.

Another important study of recent years has been that of Scaife and Burrin on the impact of man in the Ouse and Cuckmere valleys of east Sussex (1983,1985). They noted that in the middle reaches of the river valleys there was evidence for valley-side forest clearance dating back to the Mesolithic, and cereal pollen belonging to an early Neolithic date. It is interesting to contrast this with Thorleys (1981) inference that the South Downs were still wooded in the Neolithic. Clearly, and by way of analogy with the sequence from the Itchen, the valley was a focus of early Neolithic activity, with expansion onto the interfluves only occurring at a much later date. This pattern can also be seen at Downton in the middle Avon valley where again activity was apparently intense, with alluviation involving the redeposition of a clay/gravel deposit such as might occur through the reworking and erosion of river terraces (Smith 1985,174).

On the Isle of Wight a similar pattern is suggested by a sequence from Gatcombe in the middle reaches of the Medina valley (Tomalin and Scaife 1980). In the atlantic phase, sparse representation of Plantago lanceolata and woodland herbs may be the result of local clearance by later

Mesolithic communities. The date of a primary elm decline is put at 4850bp with elm pollen decreasing from around 20% to less than 2% of the total pollen count. From 4850bp small-scale, local cereal cultivation was clearly taking place. The pollen record in fact shows a series of alternating peaks and troughs at this stage which may be evidence of ephemeral cultivation of 'crop patches' adjacent to settlements. If this is the case, it has far reaching implications for the survey results which follow.

3.3.4.2.4 Poole Harbour

(See Figure 3.8). Pollen analysis at Wareham (Seagrief 1959) immediately provides a contrasting situation to that provided for the New Forest in the previous section. In the boreal period the picture is much the same with high Pinus values and Corylus on the increase; the ratio of tree to non-tree pollen is 9:1. With the atlantic period however, a significant change occurs in the form of a dramatic fall in tree pollen ratios. Ulmus and Quercus maintain their values while Pinus decreases, a feature which Seagrief attributes to a predominance of heath/grassland conditions (ibid,319). One feature in common with the New Forest sequences is the unconvincing nature of the elm decline episode; values here fall only very slightly, therefore correlating to some extent with data from other parts of the region.

The most detailed picture of environmental conditions in the area is provided by the work of Haskins (1978) who looked at eight sites in the area as a means to determine the changing state of the environment in the postglacial period. The result was the identification of broad regional trends, but with each site exhibiting deviations from these 'norms' (ibid,77). At Morden A for example the usual decline in grass pollen does occur in the early boreal, yet the levels persisting into the later boreal and early atlantic are greater than at other sites. Another feature is the occurrence of cereal pollen in the atlantic zone;

site	Wareham	Morden A	Morden B	Godlingston A	Luscombe	East Stoke	The Moors	Rimsmoor	Kingswood
source	Seagrief 1959	Haskins 1978	Haskins 1978	Haskins 1978	Haskins 1978	Haskins 1978	Haskins 1978	Haskins 1978	Haskins 1978
evidence	pollen	pollen	pollen	pollen	pollen	pollen	pollen	pollen	pollen
E.Mesol.	oak, elm woodland				hazel-dominated woodland with some pine.			hazel, elm, oak, lime woodland. Some open ground.	birch, hazel, oak elm, lime.
L.Mesol.	increase in alder but a predominance of grass/heath.	high proportion of grass pollen. Cereal pollen grain	hazel-dominant	possible indications of woodland disturbance.	hazel dominant; some limited clearance.	alder dominant	elm, oak, hazel dominant; some open ground.	decrease in hazel pollen. Cereal pollen grain.	increase in open ground.
E.Neol.	possible elm decline but not convincing.	limited clearance.	limited clearance. no further impact.	no indications of woodland disturbance at this stage.	clearance episode.	continued domination of alder. some limited clearance.	increase in hazel pollen, with open areas apparently decreasing.	2980bc elm decline;	2800bc elm decline. insignificant and localised.
L.Neol.									regeneration of hazel, oak, elm.
EBA		clearance on larger scale.			regeneration of hazel woodland.	marked clearance episode.	further clearance.		
MBA									
LBA									

FIGURE 3.8: Summary diagram for Poole Harbour.

this has recently been the subject of some discussion as these 'pre-Neolithic' indications of arable farming have considerable significance in our understanding of the earliest farmers in the region (Edwards and Hirons 1984). Finally at Morden A we may note that Pinus values increase up to and over 10% after the normal minimisation of values in the later boreal, while Myrica pollen increases at a far earlier date than usual.

At Rempstone, signs of an elm decline in the earliest Neolithic are again not very distinct but are associated with a decrease in Corylus pollen and a peak in Quercus. These occurrences can be seen to be associated at other sites. In the atlantic phase at Godlingston A, disturbance is suggested by multiple sand layers in the stratigraphy. Also Pinus values are unusually high, between 10 and 20% of the total, as opposed to the usual 1-5%.

The beginning of the boreal at East Stoke is marked by an abrupt fall in Betula values, both in terms of the macrofossil assemblage and the pollen itself, the latter decreasing from over 40% to less than 5% of the total. Contemporary with this, there is a significant increase in Salix and Alnus pollen to over 30%, while representing less than 1% at all the other sites; one should note however that the dispersal characteristics of Alnus pollen discussed above may well have significance in this context (ibid,102).

The period from the later boreal to the final Neolithic at this site is one characterised by an abundance of Alnus glutinosa, as well as several aquatic species for example Mentha aquatica, Sagittaria sagittifolia, and Hippuris vulgaris. Haskins suggests the area to have been fen at this time with similar conditions continuing into the Bronze Age. The East Stoke sequence has two features which can be seen as analogous with portions of that from the Moors site; the increase in Corylus values for example is

restricted -never exceeding 30% -while the early and abrupt increase in Alnus pollen is also common to both sites (ibid,106).

In terms of early boreal woodland, the Pinus increase is one feature which does not tend to recur. Godwin for example recognised high Pinus values in peats at Southampton and Portsmouth (1940,1945) while similar trends appear in the New Forest (Seagrief 1959,1960, Barber 1975). Corylus tends to occur in small but significant quantities throughout the period. At Thatcham, Berkshire hazel nuts have been recovered from a Mesolithic occupation layer dated to 10,030bp and 10,365bp while at the same time their pollen values increase from less than 5% to between 30 and 60%. It would appear therefore, that this abundance of Corylus was having an effect on the resource base of forager groups in the area, but as Haskins points out, there are variations in distribution within the Poole Basin itself (ibid,128).

In the early boreal therefore the trend is towards the closure of woodland with Quercus, Ulmus and Corylus increasing at the expense of herbs and grasses. The later boreal sees a reversal of this pattern with grasses again increasing in value, and the establishment and spread of Pteridium suggesting a reopening of heathland conditions. With the atlantic phase, the concept of a vegetation 'mosaic' becomes clearly apparent and most notable in the distribution of Alnus pollen. At valley bog sites for example, values are at 5-15%; at the Moors the figure is 30%, while at East Stoke it is 70-90%. This would suggest an ability to flourish on the wet, unstable and more fertile soils of the major river valleys, but not so much in other areas.

Tilia tends to attain levels of below 2% at this time, although one site, Litton Cheney has produced a sequence with Tilia accounting for 15% of tree pollen (Sidaway

1964). Pinus also maintains low values at this time, a trend similar throughout Britain, although at Godlingston B and Luscombe it maintains values of up to 10%. The picture is therefore one of increasing herbaceous flora, with a steady decline in woodland intensity. Haskins draws analogy with the, 'heathy woodlands of today, supporting a substantial ground flora' (ibid,141) while stressing the presence of a, 'mosaic of woodland types; not a woodland of uniform composition' (ibid,140).

The elm decline of the earliest Neolithic can be seen as a distinct and permanent phenomenon at four of the eight sites examined by Haskins. At three of the sites (the Moors, East Stoke and Rempstone) the decline is less distinct or impermanent, while at Godlingston A it is apparently absent. Pinus falls to below 2% of total pollen at all sites except Morden A, while Alnus increases at most sites, the exception again being Morden A.

With the exception of Morden A therefore, the pollen diagrams from this area register few signs of interference by Neolithic communities. A gradual increase in grasses is recognisable but definite signs of forest clearance are limited to Luscombe and East Stoke. This picture is supported by archaeological distributions; the number of artefacts suggests a sparse settlement pattern, concentrated in the lower Avon and Stour valleys. The unique case of Morden A is a cause for concern in this context, but may be explained by its close proximity to the chalk (ibid,158) and factors of differential clearance activity.

The Bronze Age period sees the first significant reduction in tree pollen around Poole Harbour. There is, in contrast to the Neolithic period, an abundance of evidence for human activity with over 300 barrows in the region, and dense artefact distributions in the lower Stour and Avon valleys. In addition to the work of Haskins six barrows in the

region have been analysed, the main point of interest being the low proportion of total tree pollen with a range of between 6 and 20% and only Alnus and Quercus represented in any significant quantity. Haskins suggests an open environment in the Bronze Age with some Corylus woodland and arable farming of relatively little importance (ibid,167).

3.4 Summary

Three main points can therefore be made regarding the palaeoecological record in terms of the ecological theory discussed in the first part of the chapter:

(a) That the diversity and relative abundance of plant species shows a marked diversity both spatially and temporally, and that the extent of this variation differed between micro-habitats within the region as a whole.

(b) That the traditional theories, whether they refer to the 'Great British Forest', oak tangled river valleys or open downland are gross over-simplifications used as idealistic models to interpret the dispersal of consumer populations.

(c) When this variation in the distribution and relative abundance of plant resources and animal populations is combined with the tendency for other resources essential to man (for example water, timber, light soils, clay) to be most easily accessible and predictable in river valleys, then we may suggest as a general model that it is this type of environment which will warrant a coarse-grained or 'structured' response. In contrast, those areas away from the river valleys, although exhibiting a high degree of species abundance and diversity, do not have the same level of predictability or some of the key resources which govern man's distribution in the landscape. In these cases we may suggest a fine-grained or 'unstructured' response to be

more applicable.

In empirical terms two levels of variation may be identified in the palaeoecological record for central-southern England. At the micro-regional level localised variation in the form of a 'mosaic of ecological patches' may be recognised, taking as an example the sequences from Burntwood and Bridgets Farms near Winchester. At the macro-regional scale variation may be further identified, and from the preceding discussion it is possible to make a clear distinction between chalkland and valley contexts in the counties of southern England. It does appear that greater land-use intensity at an earlier date appears to be characteristic of those sites which lie in the major river systems, with expansion onto the interfluves only occurring at a much later date (Figures 3.9 and 3.10). In the valleys of the Avon, Frome, Ouse, Cuckmere and Itchen this intensity of activity can be seen in the form of early clearance episodes while in the Frome valley at Rimsmoor, early activity is in the form of cereal pollen grains in pre elm-decline deposits. As Allen suggests, the Itchen, like the other river valleys in the area are of value today for their fen, carr and herb-rich meadows and although conditions are unknown prior to the medieval period, the area would undoubtedly have provided a unique resource package, unavailable on the Downlands and of considerable value to man (1985,26). This is a model clearly demonstrated in the palaeoecological records and one which may be tested through the surface distribution of artefacts.

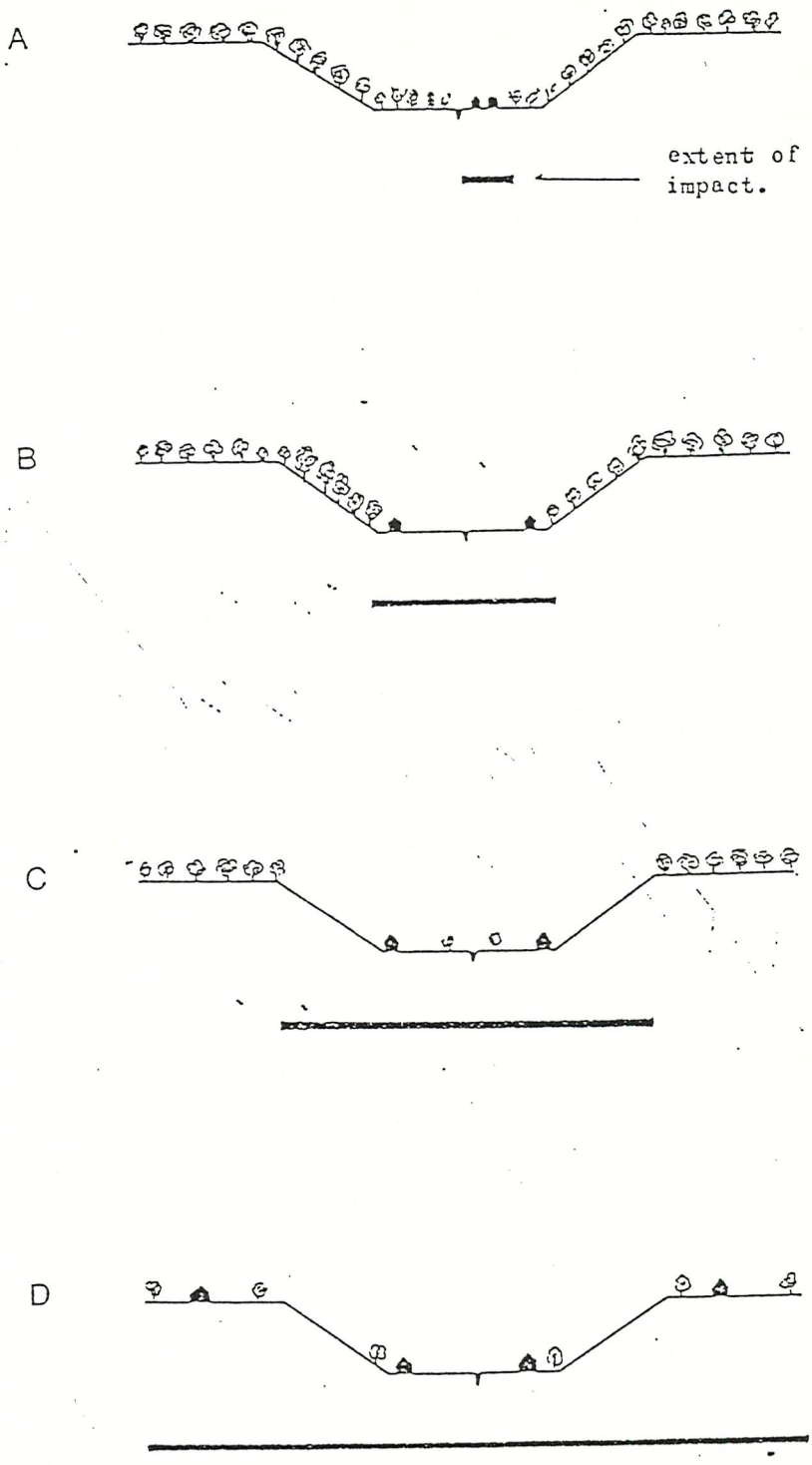


Figure 3.9: Suggested impact of prehistoric communities on the valley profile. A, Mesolithic, B, early Neolithic, C, later Neolithic, D, Bronze Age.

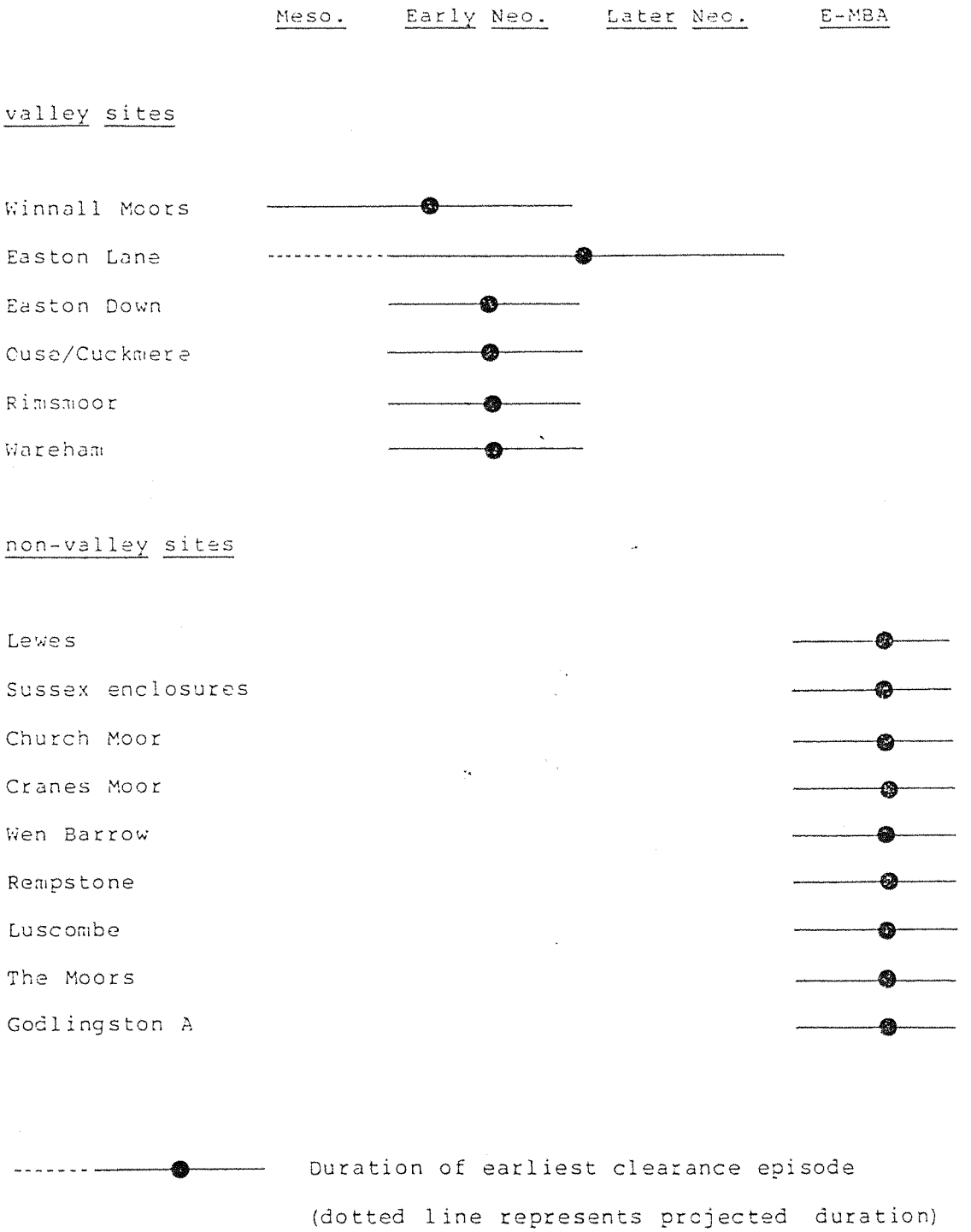


Figure 3.10: Summary diagram showing the extent of clearance episodes in valley and non-valley contexts.

Chapter 4.

The structure and content of surface scatters: general problems of interpretation

> 'All too often the dots on distribution maps are a subjective summary of extremely complex quantitative evidence. Such maps rarely provide the negative evidence necessary to prove that an area was unoccupied' (Gaffney and Tingle 1985,69).

> 'Can it be that with no sites, there can be no archaeological theory or technique? Archaeology's preoccupation with sites...has allowed some important information to pass unnoticed, and I think it worthwhile to discuss just what non-site archaeology has to tell us, and how we might go about deciphering the message' (Thomas 1975,62).

It is unfortunately the case that the results of surface collection have all too often had to depend on misconstrued ideals about how man uses space, and how mans' activities in the landscape tend to be 'site' rather than regionally defined. In this chapter surface artefact collections will be examined from the perspective of a prehistoric (ie lithics based) regional framework, looking first at the pitfalls inherent within traditional spatial and chronological interpretations, and second offering three viable alternatives based on ecological, technological and experimental data to answer questions regarding the sorting and formation of surface artefact collections. Although the approach is geared to specific questions posed by a specific data base, the implications are far reaching and have a general application to regional survey.

4.1 Chronology/Technology: the problem with 'dating'

One of the major problems limiting the interpretation of

surface lithic collections is the idea that scatters can be seen to represent a chronologically distinct episode. This is not the case, and it is on this point that many interpretative arguments become 'unstuck'. What surface collections represent is the chronological intermixing of artefacts discarded in a single place over a period of time. Many disturbance processes have operated to mix and combine any spatial or temporal trends which may once have existed, and the plough has brought to the surface only a fragment of that overall assemblage. By this argument therefore, a sherd of pottery attributable for example to the middle Bronze Age, when found in association with a discrete flint scatter would not necessarily date that scatter to the middle Bronze Age. It would suggest that the area was used in the middle Bronze Age, possibly for settlement, but not that the flint scatter represented contemporaneous activity.

By this argument therefore, it should be possible to reject both flake morphology and artefact type as chronological 'anchors', leaving only patination and the type of raw material as a possible frame for interpretation. The whole problem however is a good deal more complex than this and the three points raised should be considered in more detail.

4.1.1 Flake Morphology

The metrical analysis of waste flakes is a method which has become fashionable in recent years following the lead of Pitts and Jacobi (1979). The main idea which underlies this is that flake morphology was directly related to other aspects of the cultural sequence and that there was a gradual development from narrow and blade-like to short and squat between the Mesolithic and Bronze Age periods. Generally this involves the measurement of a breadth/length ratio, a blade commonly being defined as a flake tool whose breadth/length ratio does not exceed 2:5. In terms of

excavated assemblages Smith (1965,90) and Wainwright and Longworth (1971,60) have examined data from the middle Neolithic enclosure of Windmill Hill and the later Neolithic henge at Durrington Walls respectively. It has since become clear however that this continuum of morphological change is not as clear cut as was at first thought. Smith for example has suggested that in many cases short, squat flakes tend to be more frequent in earlier Mesolithic assemblages than they are in the Neolithic while blades tend to be equally common to both (Smith 1985,122). A similar argument can be made for flake and blade cores; blade cores occur commonly on Neolithic sites while at Wawcott III, a stratified Mesolithic site, flake cores tend to be more common than blade cores in some horizons (Froom 1976).

For surface collections, Gardiner and Shennan have attempted to identify land-use variation by identifying shape and size classes across the landscape (1985). Breadth/length ratio histograms were drawn up for 25 fields yet no clear patterns were apparent. The overall impression was one of homogeneity, suggesting that, 'assemblages of different periods cannot be distinguished...since such variation is swamped by other factors including chronological intermixing' (1985,66). Gardiner and Shennan also attempted to identify patterns by adopting a 'whole assemblage approach' based on the chronological subdivisions adopted by Richards for the Berkshire Downs survey (1978,19). The idea was to subdivide the assemblage into four groups (Table 4.1) looking at the assemblage from a given location as a whole and indicating which group or groups is predominant. Again the picture was one of considerable overlap and although broad trends could be identified, there remains little in the way of a quantifiable surface data base from which to draw any conclusions.

Group	date range	characteristics
1	Mesolithic	blades, blade cores, microliths
2	early Neolithic	large proportion of narrow flakes
3	late Neolithic/ early Bronze Age.	flakes more broad and squat
4	mid-late Bronze Age	crude cores, hinge fractures, miss-hits, oblique angle of platform to bulb.

Table 4.1: Distinctive assemblage characteristics in southern England (after Richards 1978).

4.1.2 'Type Fossils'

Another approach has been to examine the distribution and relative frequency of specific artefact types or 'tools'. While this would not date a scatter, it could serve to demonstrate the presence or absence of activity in an area during a specific period. Again however it would seem that the use of such 'tool' types as chronological anchors is not without its problems, many classes being common to one or more of the cultural episodes in question. Pitts and Jacobi for example list burins, serrated blades, punches and scrapers as 'shared types' (1979), to which may be added picks (Saville 1981a), tranchet axes (Piggott 1954,283) and transverse arrowheads (Higgs 1959,63). If this list is accepted, then only four classes of material hold the key to establishing patterns of activity across the region. Two classes (polished axes and leaf arrowheads) are distinctly Neolithic - the latter being invariably associated with early Neolithic pottery (Green 1980,83) - but both are relatively uncommon in Wessex. Microliths and microdebitage on the other hand, while being generally accepted as Mesolithic, do tend to occur on most major 4th millennium sites (Smith 1985,124). For a summary of this information, see Table 4.2.

One case where whole assemblages have been examined in a cultural comparative framework is in Healys (1984) analysis of a number of apparently 'domestic' sites in East Anglia, associated with Grooved Ware and Beaker pottery respectively. Although the comparison was far from perfect for reasons which Healy discusses, a number of points could be made: First that there was a clear distinction between the two classes of data in terms of the overall level of workmanship, reflected for example in scraper size and knife form. Second, that the overall list of implement types and their relative proportions varies little between the two periods, and third that the waste flakes show no clear trend, all tending towards the broader end of the

Artefact type	Mesolithic	early Neo.	later Neo.	EBA	LBA
microliths/ microdebitage	present	-	-	-	-
arrowheads	-	leaf	transverse	b+t	
debitage	blades pred.	blades common	broad flakes increasingly common with blades very infrequent. Hinge fractures are a more frequent occurrence.		
cores	blade prod.	blade and flake prod.		variety of multiplatform and discoidal cores.	
axes	tranchet	polished	polished axes less common. Forms are cruder.		
other			fabricators		

Table 4.2: List of artefacts diagnostic to the prehistoric period in Wessex.

scale. Although a level of variation does therefore exist between the assemblages one can equally suggest that the main reason for this level of variability is not so much cultural (or chronological) as it is technological. The small size of scrapers from Storey's Bar Road for example is explained by the use of small pebbles, available locally on the Nene river gravels (1984,15). A similar argument may perhaps be applied to the other sites exhibiting smaller sized assemblages.

The problem of chronology and chronological intermixing is exaggerated still further by the question of whether flint working continued into the Iron Age. It is a problem which has been approached by both Saville (1981b) and Brooks (1984). Brooks concluded that a lithic technology had continued but that emphasis was on poor workmanship and short-lived, throwaway tools (1984,23). This idea of continuity is given further weight by the results of recent excavations at Watery Lane, Warminster, Wiltshire. Here struck flint occurred in virtually every Iron Age context, and although most of it was rolled and hence possibly residual, one scraper was in fresh condition and believed to be in its original context (Smith 1985,399). It could well be that flint working was of greatest significance in the Iron Age to the smallest, most peripheral settlements, the one's which are less likely to be discovered by traditional detection techniques and the one's therefore which will appear as a part of the jumbled surface collection representing, as has already been suggested, continued occupation in preferred habitats.

4.1.3 Patination

Patination is another variable which has been used as an indication of chronology. Smith for example in the analysis of a flint assemblage from Meare West was happy to accept axe fragments and five leaf-shaped arrowheads as Neolithic, microliths as Mesolithic and a barbed and tanged arrowhead

as Bronze Age even though they occur in an otherwise 'Iron Age' assemblage. The conclusion is based solely upon the lack of patination exhibited by the so-called Iron Age material, even though in some cases Smith does suggest that the patinated pieces represent earlier tools which were collected and re-used in the Iron Age (Smith 1981).

Another example of the 'use' of patination is in determining the origins of an assemblage, a point of particular relevance to the analysis of surface collections. An example is the excavated assemblage from St. Catherines Hill near Guildford, Surrey (Gabel 1976). Nearly all of the assemblage was patinated to some extent implying the presence of calcareous conditions in the soil. Cornwall commented on the assemblage and noted that the flint must have laid in the calcareous soil for 'several hundred years', and that such a soil must have contained a great deal of free calcareous matter, such as one would expect in a chalk soil (1976,97). The problem however was that the site lies on lower greensand, there was no chance of the assemblage having been naturally derived from the chalk and there was no doubt that the assemblage was complete. The explanation for this anomaly lay in the nature of the parent deposit of Bargate Beds which are calcareous and have a tendency towards localised distribution often occurring close to the ground surface beyond their main distribution.

Patination however, while being a useful indicator of calcareous soil conditions is notoriously unreliable, dependent as it is upon microenvironmental conditions of deposition. As Limbrey has observed (1975,174), artefacts lying on a buried surface and covered by an earthwork of chalky composition or at the base of a worm sorted layer, may have a different patination on the upper and lower surfaces. The surface in direct contact with chalk may have a white patina while that in contact with soil appears quite fresh. It is therefore likely that where 'pockets' of

calcareous deposit occur in the stratigraphy as a whole, patination will fail to make any distinctions between various chronological 'positions'. The problem is of course exaggerated where surface collections are concerned.

4.1.4 Technology and the 'ASDA Factor'

The problem may be summed up therefore, as the extent to which aspects of either chronology or technology, such as those described here, may be visible through the investigation of surface artefact collections. Moreover, how might technology reflect the presence or absence of resource stress in terms of the nature of waste material generated.

This section is concerned largely with the latter point, considering the relationships between artefact form and the proximity of raw material source areas.

Bamforth has recently discussed the question of raw material availability in relation to tool curation (1986). She suggests that curation may be expected to produce assemblages that are technologically sophisticated with individual tools used for a variety of anticipated purposes (1986,38), and that this may vary in extent between flint-poor and flint-rich areas. It is an over-simplification however to consider lithics solely from the point of raw material availability; the settlement system may also have a major influence. For example in a forager society (ie moving consumers to the resources), why should anyone transport tools around if raw materials can be obtained everywhere? Bamforth examined the technology of the !Kung (the 'paradigm foraging society') in terms of the resource stress model and noticed from the details presented by Lee (1979) and Yellen (1977) that tools made of locally available raw materials have shorter use-lives, are maintained less frequently for a smaller time investment and require a smaller time investment overall for

procurement and subsequent maintenance than do tools made of non-local materials. Similarly Gremaschi has looked at settlement in the Po Valley in northern Italy and suggested that the nature of the flint supply and technology were largely due to the economic strategy of the culture concerned. In the Mesolithic for example Gremaschi suggested that a 'nomadic existence' allowed people to renew their tools using the various flint sources 'that they found on their way', while in the Neolithic a settled existence meant that only one source was utilised (1981,142).

Another example presented by Bamforth is the Lubbock Lake Site, Texas, the material from which comprises three basic types of raw material:

(a) high quality microcrystalline stone available no closer than 80km away.
(b) non-microcrystalline but durable chert and quartzite available in gravels relatively close by.
(c) very low quality salicified caliche available at the site itself.

In terms of the resource stress model two propositions can be made: First, that the three materials show differing rates of retouch and breakage depending on the distance from source, and second, that tools made of stone from more distant sources should be more frequently retouched and broken. The results are displayed in Table 4.3. Clearly these expectations are realised and the significance of raw material is demonstrated.

Munday has applied this idea of resource stress to inter-site technological comparisons between Central Negev Mousterian sites (1984). Analysis suggested that flint knappers in this context would be strongly motivated by a desire to use time, effort and flint resources economically, a factor which is reflected in the greater

	non-local	local	silicified caliche	Total
retouched	30	7	3	40
unretouched	26	22	19	67
Total	56	29	22	107
Broken	27	6		33
Unbroken	29	45		74
Total	56	51		107

Table 4.3. Frequencies of retouched and unretouched tools from the Lubbock Lake by raw material (after Bamforth 1986).

reduction of cores and the production of a large number of smaller and more highly prepared flakes with increased distance from the raw material source. In other words the knapper overcame flint scarcity by increasing the preparatory input into core reduction, hence extending the cores flake production output and reducing the number of trips to the source area (1984,33).

This idea of technology reflecting ecological rather than cultural factors is also discussed by Ebert (1979). He suggested that larger tools would have been manufactured expediently, used once and not transported, while smaller items may represent specific use items and are likely indicators of resource stress and in some cases mobility. Foley also points to a correspondence between artefact size and raw material (1981,147), and further suggests that as the cortical element is least useful, where cortical artefacts display retouch then that may indicate a degree of resource stress.

It is possible to apply these principles to a number of specific archaeological contexts. Woodman has suggested that we should expect to see a linear relationship between the size and extent of recycling in flint industries and the distance from source. In the Bann valley however where flint is lacking, the problem of scarcity is overcome by caching equipment (1981,114). Green, in his typology of flint arrowheads has noted that raw material was found to be a significant cause of typological variation (1984,31) while Healys analysis of scrapers from a late Neolithic site attributed their small size to the limited availability of small pebbles in the Nene gravels (1984,15). Care (1982,277) has suggested that narrow flakes which predominate in the industries of Devon and Cornwall result from the need to use raw material efficiently, particularly in the west of England where resources are poor. Similarly Healey and Robertson-Mackay suggest that the high proportion of relatively wide flakes at the

Staines causewayed enclosure can be explained by the close proximity to a virtually inexhaustible supply of gravel flint (1983,22).

All these points may be summarised under what has previously been described as the 'ASDA Factor' (Schofield 1986 and adopting the geographical concept of threshold distances to the acquisition of flint) and which has been examined further through the analysis of a series of excavated assemblages in southern England. The idea behind the model suggests that where continuity is displayed in any aspect of human land-use strategies, then steep gradients may be identified between high and low density scatters and between aspects of assemblage composition (Foley 1981). Where that continuity does not exist, 'blurring' will occur in the form of mixed assemblage characteristics (Figure 4.1). In terms of resource stress it was my expectation that this would occur in those areas where flint as a raw material was either absent or where good quality flint was in short supply. In such areas we may expect to see a degree of 'conscious preservation' displayed in the archaeological record (Bamforth 1986,39), represented for example by a high proportion of retouched material, small size classes, small cores and a larger overall assemblage size. According to the model, all these characteristics would be the result of resource stress and the constant 'knapping down' of material, a policy which prevented more trips being made to a source area than were absolutely necessary. In other words the problem of distance from lithic source areas, is overcome by increasing preparatory input into the core reduction process.

Exactly the opposite may occur in those areas where good quality flint is locally abundant. The overall assemblage size may not be so large but the proportion of retouch should be less and the average flake size greater. It was this supposition that led me to a further point; assuming

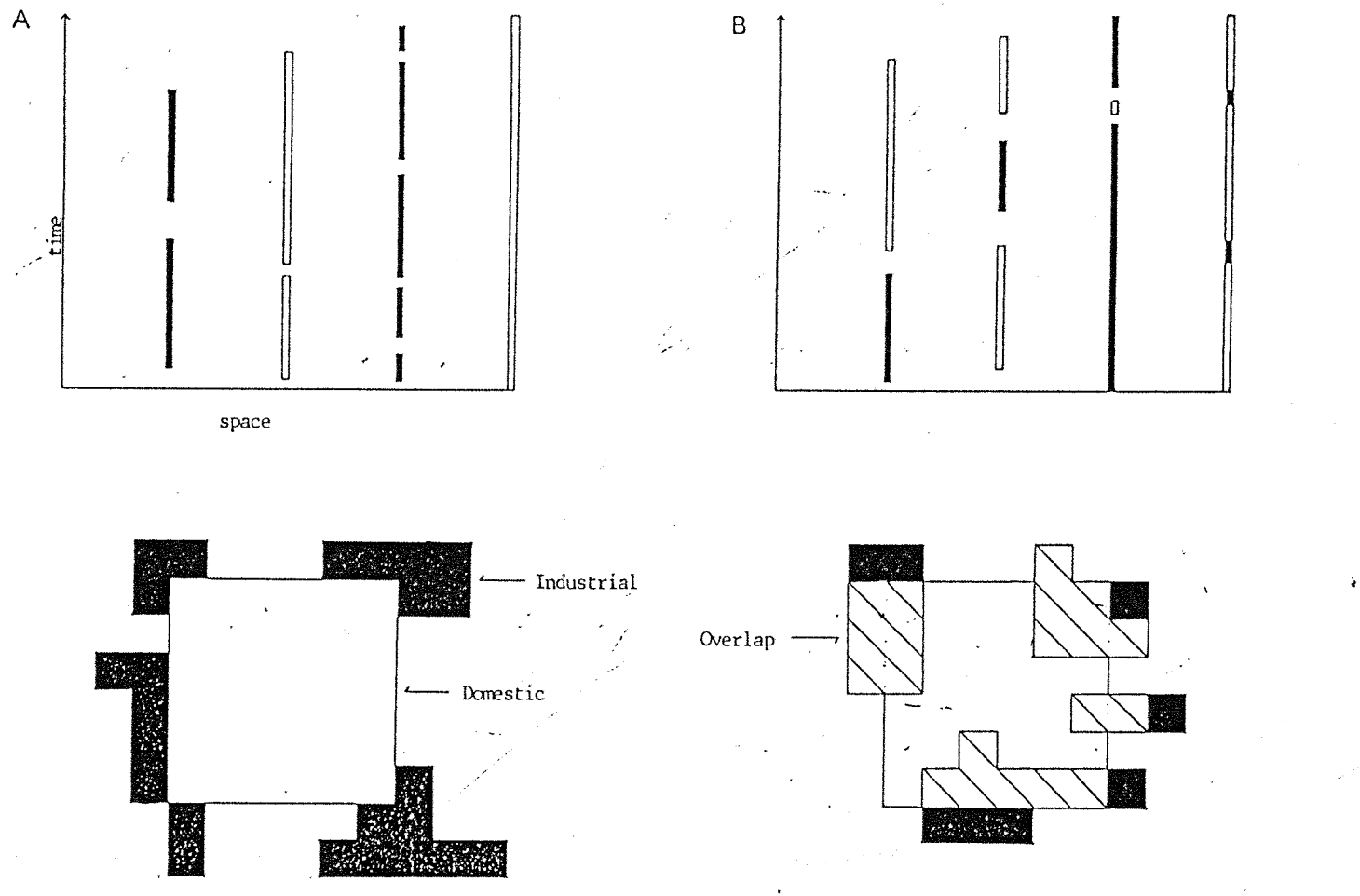


Figure 4.1: A, where steep gradients exist between activity domains. Industrial (black) and domestic (white) are distinct in time and space therefore no overlap occurs. B, overlap occurs through time and this is reflected in the spatial arrangement.

that blade manufacture is possible from almost every type of flint and that it suggests a greater degree of preparatory input and technological precision, then the abundance of blades in an assemblage could reflect resource or flint-poor contexts; an abundance of short, squat flakes on the other hand, perhaps displaying hinge fractures and so often considered to represent a lower standard of knapping associated with later prehistoric contexts, may reflect the idea, 'What the hell! There's plenty where this came from.' In other words an argument based on the availability of raw material in relation to areas of settlement may be an equally plausible explanation for assemblage variation and the difference in flake size ratios as one geared wholly to the cultural sequence.

One means of examining this concept was through the analysis of a number of 'sealed' assemblages in southern England. If any relationships could be discerned from this data, where possible chronological variation is accounted for, then we may suggest that it provides a useful line-of-enquiry in terms of the regional data collection strategy with which this thesis is concerned.

The assemblages from a number of Mesolithic, Neolithic and Bronze Age sites were considered, both in relation to their assemblage characteristics as well as their distance from naturally occurring flint (Table 4.4). The aim was to establish the extent to which a relationship existed between the variables and whether it agreed with the relationships discussed above. Two main themes were considered:

1. The relationship between 'tools' and waste, based on the expectation that the proportion of 'tools' (including retouched flakes) would increase with distance from the source area for lithic material.

2. The idea that flake size would decrease with distance

site	date	distance from flint	source character	reference
1. Oakhanger	Mesolithic	over 4km	chalk, clay-with-flint, river gravels.	Rankine et.al. 1960
2. Windmill Hill	MN	2-3km	chalk	Smith 1965
3. Offham	"	on-site	chalk	James 1977
4. Bury Hill	"	on-site	chalk	Drewett 1981
5. Alfriston	EN	on-site	chalk	Drewett 1975
6. Carn Brea	MN	over 4km	various	Saville 1981
7. West kennet avenue	"	0-1 km	chalk	Smith 1965
8. Durrington Walls	LN	on-site	chalk	Wainwright and Longworth 1971
9. Amesbury G70	E-MBA	on-site	chalk	Saville 1980
10. Amesbury G71	E-MBA	on-site	chalk	Saville 1980
11. Winterbourne G45	E-MBA	on-site	clay-with-flint	Saville 1980

Table 4.4: Sites used in the 'ASDA Factor' analysis.

from the source area, suggesting a greater level of preparatory input.

The availability of data varies enormously depending on how it was presented in the excavation report. However, a sample of Mesolithic, earlier and later Neolithic and Bronze Age sites was achieved and the following conclusions made:

a. tool frequency: A clear relationship does exist but that more data is required to adequately test this relationship (Figure 4.2a). The general tendency is for sites located close to raw material source areas to display very low proportions of tools within the assemblage - for example at Bury Hill (Drewett 1981,77) - the only exception to this rule being the Winterbourne Stoke G45 Round Barrow (Saville 1980). In this case retouched material represents 12.65% of the overall assemblage, substantially greater than the 5.27% and 2.60% represented at the Amesbury Barrows (ibid). The explanation for this may lie in the nature of the raw material on which the Winterbourne site is located; Saville suggests that the local clay-with-flint deposits are of poor quality, the evidence being the frequent thermal and shattered surfaces which occur in the assemblage. If this is the case then the use-life of the various functional components would be substantially reduced, at least from the point of rejuvenation. It would be more practical in such cases to make a fresh tool rather than attempt to change an existing one.

b. Flake size: A relationship can also be demonstrated between flake size (Fig.4.2b), scraper size (Fig.4.2c) and the location of raw material, although again more data is required to define it more closely.

The relationship is most apparent in the cases of Windmill Hill and West Kennet where distance from source is clearly the distinguishing factor between two broadly contemporary

SOUTHAMPTON LIBRARY UNIVERSITY

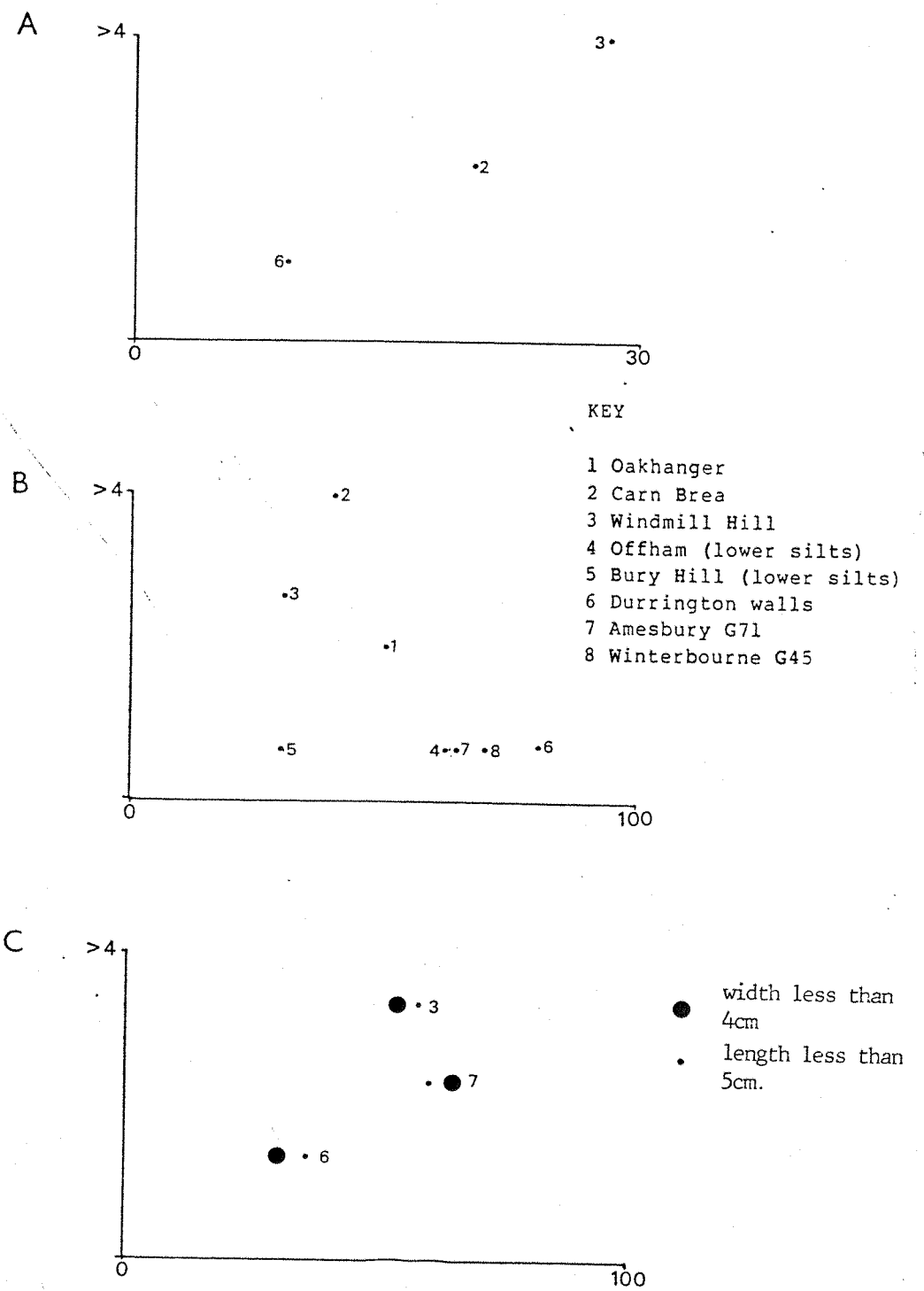


Figure 4.2: Relationship between aspects of assemblage composition and the distance from source. A, %age of true blades in assemblage (X axis) vs. distance from source. B, %age of flakes greater than 4:5 (X axis) vs. distance from source. C, scraper size (X axis) vs. distance from source.

assemblages. Another example is the Amesbury Barrow; Saville makes the point that the percentage of flakes broader than a 4:5 ratio is high (43%), and that this clearly aligns the assemblage with a post middle Neolithic date (1980,7). An equally plausible explanation is that such a flake size suggests an absence of resource stress and that local raw material was, in this case, used for flake production, possibly derived during the construction phases of the monument. This is supported by the fact that scrapers are also relatively large in size, in total contrast to other sites further from the source areas.

c. Function of distance: The abundance of knapping products at Windmill Hill suggests that flint was brought to the enclosure in the form of nodules and that a degree of resource stress did exist is suggested by the fact that old cores were collected and reused, they were flaked systematically and were invariably worked down to a small size (Smith 1965). In addition, cores are in some instances used as functional components within the assemblage. This was the case both at Oakhanger (Rankine et al 1960) where 40 of the 705 cores were used as scrapers and 4 as chisels, and at Windmill Hill (Smith 1965) where 79 out of 271 cores were used. Again these represent those sites furthest from source areas, and it may be significant that no such instances are recognised at either Offham (James 1977) or Bury Hill (Drewett 1981).

In all these cases therefore the expectations are upheld. There are, I suggest, grounds for arguing that factors of resource-stress (defined here as the 'ASDA Factor') based on a model of human activity within a mosaic environment is as satisfactory an explanation for assemblage variation as the cultural or temporal arguments put forward by Pitts and Jacobi (1979). It must be stressed however that other factors may influence the nature of lithic assemblages, and while they may only represent 'noise' on the scale with which this thesis is concerned, they are variables which

should, nevertheless be considered. Gingell and Harding (1981) for example have demonstrated that different manufacturing methods can alter the shape and size of a flake, while Burton has shown that raw material type and availability can affect technology (1980). The former is a variable which is often ignored in technological discussions yet is one which may have an effect at two levels:

1. At every point in time, the tool-kit, whether of hunters, farmers or metallurgists, was made up essentially of a variety of tool types, all prepared for a variety of tasks. Each separate tool type necessarily required a different knapping technique or reduction sequence depending upon the nature of the desired end-product. An arrowhead for example may generate a very fine waste assemblage while a scraper may produce flakes and debitage which are distinctly cruder in their overall form. Even though the two knapping episodes may be contemporary in time and space, they would not be identified as such by length/breadth ratio analysis.

2. The second point is again based on the principle that as no two objects are alike if examined at a sufficiently refined scale, archaeologists must inevitably decide which kind and scale of variation is relevant to their research questions. Unfortunately, variation has generally been understood as a cultural phenomenon with variation correlated with temporal trends. This completely ignores both the nature of a technological response (discussed above) and the purely mechanical factor, namely that the individual is the locus of tool manufacture, and that variation and patterning will originate at the level of the individual (Cross 1983,88). According to this argument, similarities may be interpreted as reflecting temporal proximity (ie the suggestion proposed by Pitts and Jacobi 1979). It is my contention that they may also represent spatial proximity to the lithic sources and the existence

of social interaction at a regional scale.

One of the aims of this thesis is to assess the applicability of such a model to survey data. The main problem would appear to lie in the accurate location of raw material source areas; if that were achieved then the detailed examination of assemblages from a technological point of view would have much greater credence.

4.1.4.1 Time-budgeting

Another approach to technological analysis has been to study variation not solely in terms of the availability of raw material but availability in the context of time budgeting, ie that technology, like other aspects of society will respond to the need for an effective use of time. Torrence suggests that limitations in the time available to complete a task are a key variable in explaining differences in the structure of hunter-gatherer tool kits as well as in the patterns of procurement, manufacture and discard (1983,11). It is argued that the degree of stress will condition the quantity of the response while the type of stress will determine the quality of adaptive technological behaviour. Torrence suggests that the quality of behaviour may be divided into two types of response (1983,12):

(a) If the total amount of time is limited, tools which increase the speed at which the activity is carried out will be employed.

(b) If overall quantity of time is sufficient, then it may be possible to schedule certain types of behaviour in order to avoid competition among various activities for particular periods of time.

On this latter point Binford (1979) has noted that production and maintenance of stone tools among the

Nunamiut are scheduled in order to avoid interference with subsistence activities. In other words the procurement of lithics is embedded in the subsistence strategy so that valuable time which could be spent collecting food is not wasted. The main consequences of large energy inputs into tool production are that tools will tend not to be thrown away after one use but carried around to be used repeatedly in order to 'reap the returns of earlier investments'.

Time stress may be reflected in the organisation of technological behaviour by three variables: First in the overall composition of the assemblage; second in the diversity of tools within a functional class, this being negatively correlated with the amount of time available; and third in the complexity of the assemblage, ie the number of components in the tool kit.

This discussion of variation stemming from the organisation of technology, further illustrates how factors other than temporal trends must be incorporated into the interpretation of lithic collections.

4.2 Sites or Non-sites? the problem with 'locating'

Another problem in interpreting surface scatters is the site or settlement unit. It may be suggested that the 'site' is only really of any use when placed in a comparative framework, either to form an overall regional pattern or as an indication of cultural change, for example as a reflection of population density. For a 'site' to be of any use in such a framework it must first be precisely defined in order that space and the organisation of activity may be divided into off-site and on-site. In this way the overall size of the site, the range of activities and the intensity of use maybe ascertained. If this level of enquiry is not possible then surely the site loses its value as an analytical tool. The question we should ask therefore is to what extent 'activity areas' (as opposed to

'sites') are indicative of social organisation on a local scale and how far might this be discernible by surface collection?

4.2.1 Social/technological constraints

The idea of 'space' being organised according to social constraints and the tendency of many such constraints to be universally applicable in often widely divorced social contexts is one borrowed initially from sociological and anthropological research, and one which is considered to have some relevance in the field of on-site archaeology. Hall for example believes that everything man is and does is associated with space (1968,84), while Yellen in his study of the !Kung states that, 'underlying social rules are clearly reflected in the spatial patterning of activities, (and hence) it is possible that the seemingly abstract aspects of social organisation may be more easily reconstructed from camp debris' (1977,135).

As is so often the case however this principle is far easier in theory than it is in practice, especially when dealing with a horizontal distribution pattern. Cribb for example studied a winter campsite occupied by nomadic pastoralists in the Near East, and analysed the distribution of activities during occupation (1982, Fig.14) and the distribution of material on the surface sometime after the site had been abandoned (ibid, Figs.17 and 18). The results of the surface collection clearly showed that while each individual distribution was clear and similarities with other distributions were apparent, the character of overall spatial relationships was difficult to assess by visual inspection alone (ibid,114). Clearly therefore, patterns are generated by everyday social activities; the question we must now ask is the extent to which such behaviour patterns are likely to be reflected in the distribution of waste material. For example does knapping activity really create spatial 'zones' which may

be identified by surface collection?

There are other factors however which may generate spatial patterning within the lithic assemblage. Behm for example draws the distinction between the deposition of chipping debris in a knapping area resulting in a primary concentration, and the removal of such debris and subsequent dumping in a new location, producing a secondary deposit (1983,9). The former may appear as a scatter of flint similar to that produced experimentally by Fischer (1979) in experiments at Lejre, Denmark, while the latter may appear as discrete piles of flakes with clear boundaries and relatively uniform densities. Gallagher provides an example of such behaviour among three groups in Ethiopia (1977). Flaking is done over bowls and baskets and is thereby transported outside the village and dumped.

Other indications of activity areas may stem from the analysis of debris itself. If for example flake dimensions were dependent upon core reduction stage and tool production activities, then flake length, breadth and thickness may have varied across an occupation floor, depending on the occurrence of:

(a) nodule decortification,
(b) later reduction,
(c) tool manufacturing activities in different areas (Munday 1984).

As well as flakes and waste material, artefacts themselves have traditionally been regarded as a measure of functional areas. As Whallon has observed, 'artefacts, classified into separate tool types should be differentially distributed on prehistoric occupation floors as a result of their differential utilisation in the various separate activities carried out by human groups at each location used or inhabited' (1973,115). Johnson however suggests that it will be far more likely to obtain information on spatial

distribution from waste products or expediently used tools than from curated tools (1984). In a similar vein, Kroll and Isaac have examined variability in the relative proportions of material classes as an indication of activity areas (1984). They suggest for example that if cores were used solely as a source of flakes, and if the refuse from flint knapping were segregated from other refuse, then we might expect significant numbers of cores to be found in association with flaking debris. If on the other hand knapping activities were not segregated from other activity areas, then we might expect to find cores associated with a wider range of material. If cores were being utilised we may expect a different pattern again.

Two main points emerge from this discussion: First that material on the surface may or may not reflect the location and content of sub-surface features, and second the extent to which the 'site' may be recognised as a discrete archaeological unit. The first of these points will be the subject of a detailed examination in the following section, leaving us here with the problem of the 'site' and whether it has a part to play in the context of ploughzone archaeology.

4.2.2 Geographical contributions

The notion of the 'site' is firmly established in archaeology, to the extent that its meaning and use are almost invariably taken for granted, both in terms of designating artefact provenance and as the basic unit upon which quantitative analyses depend; as Gamble has observed, 'flint scatters are considered poor data unless a tent or a hut can be resurrected from among the chippings' (1982,529). Dunnell and Dancey have pointed out that archaeological data are seen as originating within naturally occurring units called 'sites' and the location and exploration of these units are usually the goals of fieldwork (1983,271). Binford refers to this as the

'stationary view of a dynamic landscape' (1983); excavated sites are, he suggests the archaeologist's bread and butter and this view of the past is 'necessarily restricted' to these discrete, isolated points in the landscape. Let us then consider how the 'site' is defined in spatial terms.

There has recently emerged a renewed interest in the contribution of geographical concepts to archaeology, and this is borne out in the debate concerning what constitutes a 'site'. Renfrew (1983,317) made the point that, 'the very notion of site has become less obvious in archaeology with the development of intensive field survey methods.' It carries with it the assumption that past activity can be identified in terms of definable features on the surface of the terrain. As we have already seen, this is rarely the case. The problem was clearly stated by Wagstaff (1986) who suggested a number of points by which archaeologist's concerned with regional survey could approach the problem of what the results represent. The main point was concerned with scale: He suggested that geographers tend to concentrate on analysis at a regional or meso-scale, a level for which the identification of centroids has not been strictly necessary. Working from maps at a 1:50,000 scale reduces many of the practical problems of site definition; clustered settlement units are easy to recognise at this level. To attempt to define sites on the basis of metre by metre collection strategies is far more of a problem.

The problem then is a serious one; geographers have a vague idea of how to define sites which are operational and upstanding. Archaeologists concerned with mapping the surface distribution of artefacts have very little in the way of points of reference by which that degree of accuracy may be replicated. Let us then consider a few examples which highlight the problems which Wagstaff has described.

4.2.3 Archaeological/ethnographic examples

In the majority of cases, distinguishing a 'site' involves setting boundaries, a process which may be described not so much as an observation but an archaeological decision. With few exceptions the 'site' is defined by artefact density, 'sites' being locations with high artefact density in contrast to their surrounding area which generally displays a low density scatter (Table 4.5 and Figure 4.3). The distinction is therefore made between the traditional notion of the 'site', where a distinct behavioural boundary may be suggested (Fig.4.3a) and the rejection of that notion and the definition of a scatter by means of a predetermined hectare or field boundary (Fig.4.3b). Furthermore the assumption that high density = 'site' suggests that all 'sites' perform the same function, or at least that 'on-site' activity in all cases produces large quantities of waste. Gould (1980) however has pointed out that only 1% of lithic material of the Aborigines of the Western Desert of Australia is discarded on the settlement, while Wood (1978) in an analysis of the locational strategies in the Rio-Grande valley of New Mexico suggests a picture of secondary 'sites' containing a higher density of artefacts than the base camps. Another example is Robertshaws' analysis of artefact density on a recently abandoned pastoralist settlement in Numaqualand (1978). In this case the mean density of finds across the settlement was 0.163 per square metre, while Price's analysis of hunter-gatherer artefact density in the Mesolithic of the Netherlands shows that where technology is lithics based, the density may well be higher. Price recognises a hierarchy of 'site-types' from small extraction camps to large aggregation camps, the mean density of all these types being 20.6 artefacts per square metre (1978, Table 1).

Clearly therefore the rate of discard and the density of material within the settlement is culturally distinct, and

Table 4.5. Definitions of 'Site'.

Definition	Source
'two or more artefacts in close association'	Anderson 1984
'any isolable aggregate of five or more artefacts having a spatial midpoint that occurs inside a spatial quadrat'	Warren 1982
'that area characterised by a contiguous and continuous scatter of stone or other archaeological debris'	Jones 1985
'a spatially discrete surface scatter'	Ammerman 1985

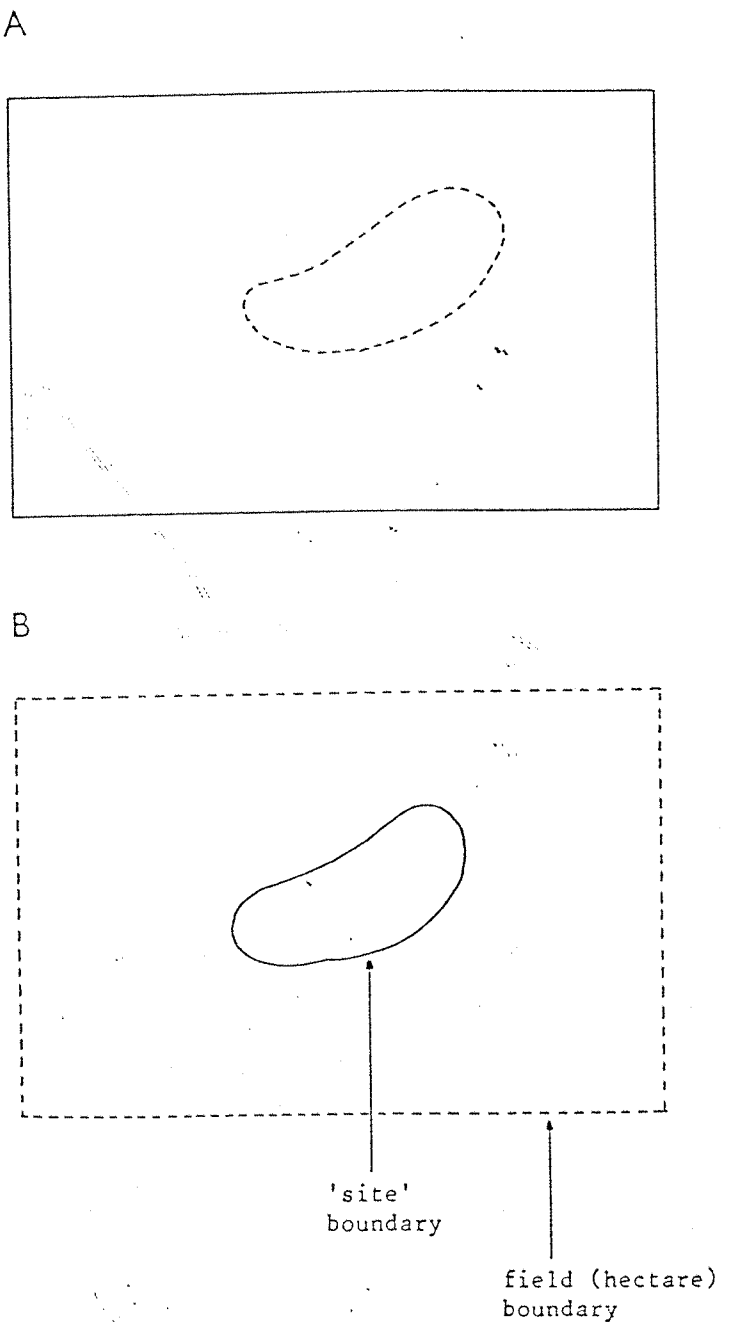


Figure 4.3: Stylised diagram showing the distinction between a 'site'- and a hectare-based interpretation.

it is a gross over-simplification to suggest that dense scatters indicate home-bases, or that the settlement has its archaeological correlate in the 'site'. It is more likely to be assemblage composition rather than assemblage size which may give an indication of any overall function. One alternative to this 'site' based approach therefore would be to look not for the settlement unit but rather adopt a more flexible off-site approach and try to identify activity areas. Not only would this shed more light on how the landscape was used as a whole, but also on the degree of continuity which that use displayed.

4.3 Ploughzone Experiments: quantifying variation?

4.3.1 Towards a general model

It has now become generally accepted that a number of processes go to make up the archaeological record. Social or human factors have been discussed at some length, Binford (1980) and Behm (1983) for example pointing out that discard patterns will not necessarily correspond with the activity areas which generated them. As Binford has suggested, 'spatial patterning of discard material does not necessarily mirror the distribution of activities, since dispersal patterns arising from 'tossing' or 'dumping' may produce distributions that are inversely related to the patterns of use activity' (1978,356). Natural processes have also been discussed suggesting factors such as colluviation, erosion and deposition as affecting the distribution of the archaeological record in certain contexts (Rick 1976, Schiffer 1976). However it is really a third category, human-induced disturbance with which this section is primarily concerned, the emphasis here on the relationship between patterns in the ploughsoil and the distribution and content of subsurface features.

The question of how far material 'moves' in the ploughsoil is one which has been approached largely by the

implementation of controlled experiments, generally forming one part of a much broader research project. Experiments have varied both in size, the number of ploughing episodes involved as well as in their geographical location. Although the ploughzone experiment will be the subject of some discussion in the following section it is necessary at this point to make a number of very specific observations regarding artefact movement in the ploughsoil.

On level ground it has been suggested that after two or three decades of ploughing, artefacts may be displaced by anything between 20cm and 10m (Roper 1976); Gingell and Schadla-Hall support this by pointing out that although material is lifted by the plough it is not greatly spread (1980,111), while Ammerman's experiments in southern Italy suggest that after two years and possibly six or more ploughing episodes, the mean distance that an individual tile may move will vary between 1.18m and 1.74m. Mean values taken at a later date show a more or less consistent pattern of increase with time, and while displacement could not be called pronounced, a few tiles had moved as much as 5m with many tiles no longer within 2m of their starting position (1985,38).

Another angle has been to analyse the various agricultural processes responsible, and a greater awareness of those principles may well lead to a better appreciation of surface data. Gill (1967) for example points out that although ploughing is only the first stage in the tillage process, it is the stage at which the most soil movement occurs. This is in fact contradicted by the experiment described in the following section. Other cultivation processes subsequent to ploughing serve to break down large clods of earth, level the surface and destroy weeds but never cause as much soil movement. Trubowitz (1978) has discussed the process by which the plough cuts the furrow thereby inverting a large clod of earth which is flipped to one side, burying any weed growth and fresh soil. Any

artefact within that clod of earth will therefore move with it as it turns. If an artefact is actually struck by the blade then it may either be pushed down or to one side, the effect really depending on the size, weight and shape of the artefact.

We may suggest therefore that despite some variation, the results briefly discussed above do tend to suggest limited lateral movement in the ploughsoil. Variation between regions in terms of geology, climate and agricultural intensity may well be the root cause of this variance, and hence it may be significant that the two studies in temperate Europe, at Bishops Cannings Down (Gingell and Schadla-Hall 1980) and in north-west Funen, Denmark (Jacobsen 1984) suggest that flint artefacts are being subjected to only limited lateral movement (ibid,191). Whether this is the result of a 'rocking motion' in the ploughsoil as suggested by Foard (1978,362) and Nicholson (1980,24) must await further results.

Downslope movement is another factor which may influence the degree of lateral displacement and again examples have suggested a variation between regions. Rick for example, working in Peru suggested a positive correlation between slope angle and lithic distributions, noting that the smaller material tended to travel further (1976). Ammerman also identified this trend but to a lesser extent (1985) with few tiles moving as much as 5m after as many as nine ploughing episodes (ibid,39). This notion of the smaller material moving further is however contradicted by work on a talus slope in southern Lesotho, where the largest of the artefact classes tended to cluster at the foot of the slope (Jobling et.al. 1984,155).

Again what the evidence tends to suggest is limited downslope movement. What are clearly required however if we are to understand this phenomenon more fully are detailed experiments such as that outlined by Reynolds and Schadla-

Hall (1980) in order to determine whether the movement is primarily the result of natural or man-induced processes. If the latter were seen to be the case then disturbance only need be regarded as a relatively recent introduction. Again however this could vary between regions, for example as a result of 'preferred slope ploughing strategies' employed by farmers (Nicholson 1980,24).

Artefact size is another factor which may vary, in this case as a result of either disturbance or collection bias. Baker for example suggests that the ploughed surface above a 'site' will contain a predominance of larger artefacts relative to their actual proportion; in other words that the, 'principle implication of size effect is that surface artefact collections are not representative of a sites' total inventory' (1978,292). The question however is really one of whether larger material is really more numerous or whether their predominance is a reflection of their greater visibility. As Ammerman has suggested, there is a greater chance for one part of a large piece to break the surface than a small one (1985,35), a fact which may well go to explain the disparity between relative proportions of Mesolithic artefact classes recovered by excavation and surface collection; from the latter cores are by far the most frequent find (excluding waste), while from excavations in Wessex, microliths predominate (Wymer 1977).

Assuming then that by studying the relative proportions and spatial limits of individual material classes within surface assemblages, and further that lateral movement will influence the distribution to a varying but limited extent, it should be possible to identify activity areas by surface collection at a small scale of resolution. One example where this has been the case and where distinct activity areas have been identified is at the Phillips Spring Site in Missouri, discussed by Downer (1977). By use of distribution maps and factor analysis, and by maintaining distinct artefact categories, clear distribution patterns

were apparent in an area under intermittent cultivation for at least a century. Downer noted for example a distinct correlation between unworked stone, primary and secondary decortification flakes and 'shatter' all of which cluster together towards the south-west of the site (1977,Fig.1). In total contrast is the distribution of utilised flakes which form a general scatter throughout the area (ibid,Fig.2), a pattern which immediately suggests comparison with Behm's secondary refuse deposit (1983).

Redman and Watson set up the hypothesis that surface and subsurface artefact distributions are related, to the extent that a description of the first will allow prediction of the second (1970,280), and attempted to test this at the site of Cayonu in south-east Turkey. The procedure was one of systematic surface collection on two sites followed by excavation in order that direct comparisons could be made. The result suggested a close correlation between surface data and the first 50cm of an excavated unit, the degree of comparison declining with depth after that point.

A very different relationship was suggested by Binfords' analysis at the Hatchery West Site (Binford et.al. 1970). Surface collection suggested that the surface distribution of various categories of cultural items were not isomorphic and that quantitative variability exhibited between areas of the site suggested that the different classes of cultural items may vary independently of each other, presumably as a function of spatial differentiation. That patterns of variability existed in the ploughsoil does not necessarily imply that those patterns reflect the subsoil distribution of features. The investigation of Hatchery West was conducted with an eye to this problem, and a number of points could be made:

(a) that within a community the spatial distribution of items and features may vary independently of each other.

(b) there is not necessarily any correlation between numbers of cultural items and features.
(c) in selecting sites for excavation, the mere presence of high densities of items in the ploughsoil does not insure a correspondingly high density of features.

Another problem is the relationship between material on the surface and the quantity and types of material in the ploughsoil as a whole. Gingell and Schadla-Hall (1980) for example have suggested that over 90% of material from a subsoil feature may be in the ploughsoil where that feature has been disturbed by the plough. Smith has noted similar problems in the Ewerne Valley, Dorset (1985,344). He noted that on the surface, patterns of struck flint and burnt flint are virtually mutually exclusive with concentrations of cores occurring in discrete zones within the general surface scatter. One pronounced cluster was investigated and found to mark the position of a stream edge burnt mound. This was followed by a more systematic experiment involving three levels of analysis: Systematic surface collection, rapid hand excavation and intensive (trowel) excavation. The results are presented in Table 4.6. and suggest that for every 330 artefacts within the ploughsoil, only one will be collected by standard surface collection practices.

This is a question also examined by Healy (1983) which again involved surface collection prior to excavation. The scatter consisted of a distribution of struck flint over the surface of a 7.5 hectare field in east Lincolnshire. Initial surface collection yielded 897 pieces of worked flint; two adjacent areas were then stripped and excavated together with a few smaller outlying trenches. Again the comparison between surface and sub-surface was made based on the expectation that the distribution of struck flint would be comparable with that of earlier Neolithic features. In reality however this was clearly not the case. Material was divided into 4 sections:

a. technique analysis

	sampling rate m^2 per hr.	retrieval rate finds/hr.	finds/m^2	sampling fraction (%)
surface collection (total coverage)	417	17	0.04	0.3
rapid excavation	1.7	2.6	1.5	12.1
intensive excavation	0.4	4.5	11.0	90.0?

b. artefact analysis

	pottery	struck flint	burnt flint
surface collection (total coverage)	1	1	1
rapid excavation	120	24	13
intensive excavation	607	290	194

Table 4.6: Results of excavtion and survey in the Ewerne valley (after Smith 1985,345).

1. from the surface of the entire field,
2. from the surface and topsoil of the area stripped for excavation,
3. from the underlying wind-blown sand over the totally stripped part of the excavated area,
4. from the earlier Neolithic pits.

The first three groups are therefore of mixed multi-period composition while the last is securely stratified and likely to be contaminated only by the presence of residual material (1983,28).

The distribution of cores is a case in point; while the multi-platform and keeled types match each other quite closely, they are not representative of the entire 7.5 hectare surface assemblage since in the case of group 1, their proportions are reversed. Similarly the cores from the earlier Neolithic pits include a higher proportion of single platform cores than those in the mixed groups. A similar pattern can be identified in the breadth/length ratios of unretouched flakes and in the distribution of retouched forms. In the former there is an incomplete agreement between groups 2 and 3 on the one hand and group 1 on the other and even less of a correspondence between all three and the Neolithic pits. For retouched forms all three mixed groups contain a wider range of 'types' than does the material from the pits and tend to be distinguished by higher proportions of borers and points. We can suggest therefore, as was the case at the Hatchery Site, that in some cases surface collection can tend to mask rather than predict the content of underlying subsoil features (Healy 1983,30).

Another test case is provided by Cribb's work in the Near East (1982). Here the point of reference was not in the excavation of an assemblage but rather in the observation of debris-generating activities at first hand. Cribb looked in detail at the workings of a single nomadic family and

noted that the interior of the winter dwelling was organised into distinct activity 'zones'. For example cooking and kitchen material was stacked around the hearth area while meals were eaten at the rear. Food preparation and consumption, the cleaning and washing of kitchen utensils, the disposal of domestic refuse and the preparation of fire wood on the other hand occurred either within the dwelling itself or in an area roughly 10m square between the dwelling and an adjacent stone sarcophagus (1982,114). After abandonment the area was subjected to intensive surface collection from which the overall character of the spatial relationships was difficult to assess (previous section).

What the preceding discussion tends to suggest therefore is that the extent to which pattern replication may be identified on the surface, and hence surface data seen as representative of the ploughsoil as a whole, depends largely upon the length and intensity of disturbance processes and the physical structure of the area in which the collection unit is situated. For example, that material is more likely to be displaced when on a slope than when on the flat, and second that a field on a hillside is more likely to reveal a higher proportion of the ploughsoil assemblage than a field in the valley bottom due to the extent of colluvium and erosion.

There is a distinct variability therefore between results from different environments, with a combination of factors, specifically the intensity and nature of agriculture and soil type, affecting the extent of displacement. It was therefore felt that in order to interpret the surface data from central-southern England, an experiment had to be carried out in that area in order to establish the expected frequency and composition of surface data. This experiment may now be described.

4.3.2 A Ploughzone Experiment

The results presented here represent the first two season's work on a ploughzone experiment carried out in conjunction with R. Clark, started in the autumn of 1985, and located at Park Farm, 15km to the west of Salisbury (Figure 4.4). It was our opinion that, although results have come from similar experiments in the last decade, those results were limited to specific regional contexts defined here by factors of geology, topography, and soil type as well as by the type and intensity of agricultural activity.

As we have already seen in the context of 'Downland Britain', Gingell and Schadla-Hall (1980) have suggested that 90% of the sub-surface assemblage should be represented in the ploughsoil at any one time, while Smith (1985), Tingle (1987,89) and Parker-Pearson (1981) have argued that between 0.36%, 2% and 2.79% of the assemblage will be present on the surface. Clearly therefore there is a need for further experiments, both to ascertain the validity of these calculations, and as a means to a more accurate interpretative framework for surface 'sites' in general.

The plan was to base our research design on the results of those experiments referred to above, and to use them as models or hypotheses which could then be examined in relation to a specific area. The results could then be applied to the surface data accumulating in the area of central-southern England, with the possibility of methodological implications in a wider regional context.

The field chosen for the experiment lies on a stonefree, sandy grey loam, thereby preventing any confusion between the experimental material and coarse components already in the soil. The field will be under cultivation for the next five to six years, hence affording the possibility of recording longer-term changes in material distribution. The

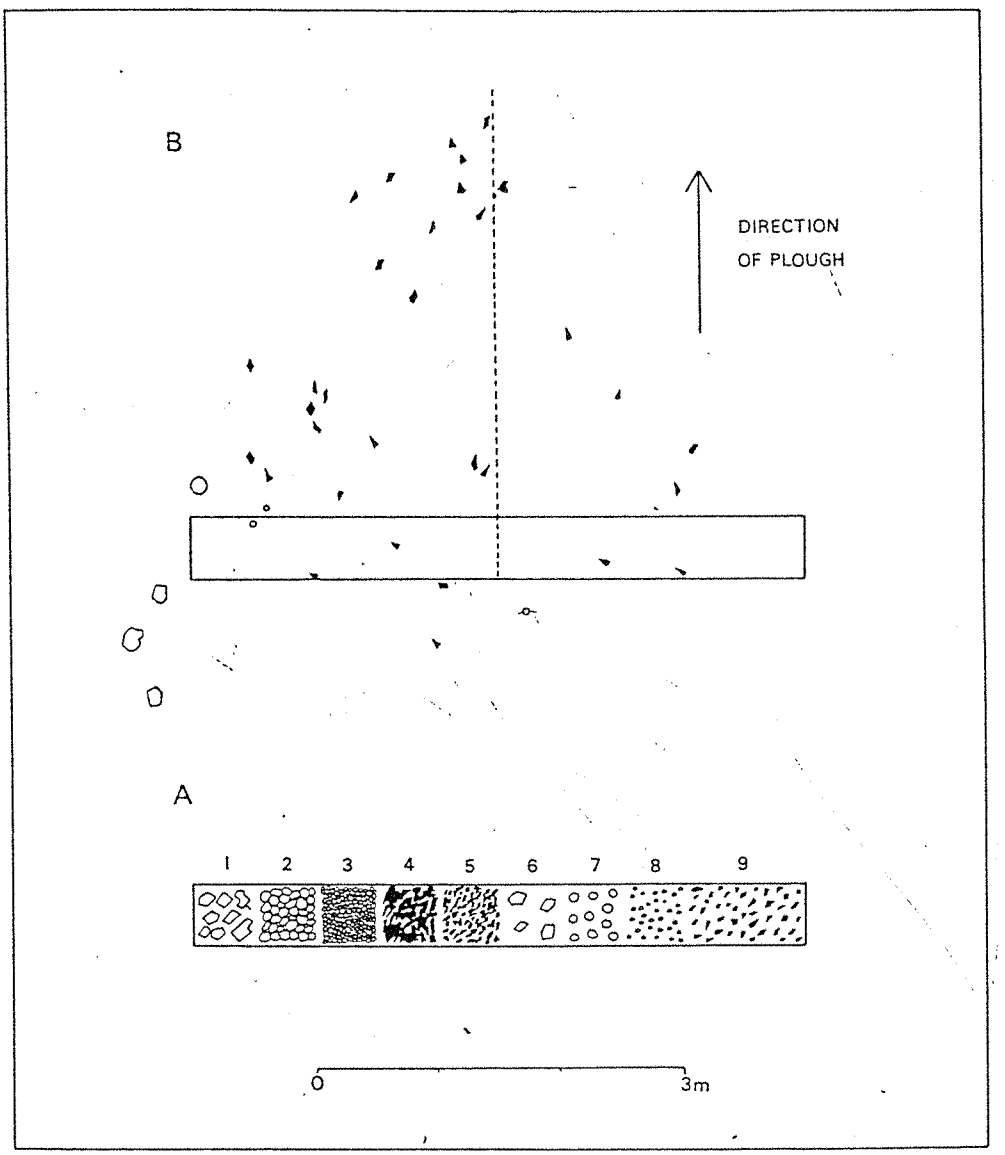


Figure 4.4: A, Plan of the trench, set up in September 1985; see Table 4.7 for explanation and contents of individual sections. B, results of the first ploughing/cultivation episode.

field lies on a gradual north-east/south-west slope, and has been under intensive cultivation for wheat and barley for over a decade. In September 1985, a total of 1030 flint flakes and pebbles were deposited in a trench measuring 5.0m by 0.5m, and to a depth of 0.2m. The trench was sub-divided into nine zones into which the various classes of material were placed (see Table 4.7 and Figure 4.4). The flint was buried at a depth of 0.2 m to correspond with the depth of ploughing. However, to avoid any inaccuracy in this area, full records of plough depth and direction are being kept by the farmer. In the first two seasons, ploughing and subsequent cultivation ran perpendicular to, and hence across, the excavated trench. This direction provided the most effective lateral dispersion of the experimental assemblage.

The agricultural equipment used consisted of a Deutz DX1 10 four wheel-drive tractor weighing 4.75 tons, and a Downswell four-furrow reversible mouldboard plough, with 14 inch (0.35m) furrows. Further cultivation included the use of an S-spring-tine cultivator, in order to break the soil furrows up prior to the drilling of the seed corn. For the first year, cultivation followed in the same direction across the 5m trench, by means of the technique known as 'one-way ploughing'. By this method, a reversible plough makes it possible to turn all the furrows in one direction, thereby moving all the soil the same way (Lambrick 1977,4). Unfortunately, it was impossible to record the movement of flints at each stage of the cultivation sequence and the effect of each operation, as the weather conditions at the time of the experiment necessitated a rapid application of the seed corn. For the second year, ploughing occurred in both directions and it was possible to map the distribution of artefacts following each episode of ploughing and cultivation.

The experimental data were recorded by means of metre-square drawing frames, with the precise location of each

area in trench	flint type	size range (cm diameter)	spacing	quantity
1	large flint nodules	12-20	clustered	25
2	large river pebbles	10-20	clustered	80
3	small river pebbles	2-10	clustered	250
4	large flint flakes	10-20	clustered	65
5	small flint flakes	2-10	clustered	300
6	large flint nodules	12-20	scattered	10
7	large river pebbles	10-20	scattered	30
8	small river pebbles	2-10	scattered	70
9	small flint flakes	2-10	scattered	200

Table 4.7: Contents of the trench (see Figure 4.4).

findspot recorded on a plan at a scale of 1:20. Material was not collected but left on the surface; this was to enable the monitoring of data visibility throughout the year, thereby including weathering, soil movement and surface conditions as variables. This would maintain the entire assemblage (ie a constant sample population) within the ploughsoil at any one time.

Although only two seasons results are as yet available, they appeared significant enough to establish a basis for analysing surface collections. In terms of horizontal displacement, there was enough movement of flint to suggest that displacement was limited, while the overall percentage ratio for surface-subsurface representation suggests that many of the figures quoted elsewhere must be seen as an over-simplification. The results may now be presented.

4.3.2.1 Lateral Displacement

Of the 31 pieces of flint recorded on the surface in the first year, the furthest distance travelled was 3.96m, while the mean displacement value was 0.95m and the standard deviation 0.66m (Figure 4.4 and Table 4.8). It is also interesting that, although sideways movement is minimal, it does nevertheless occur, material in this case being consistently shifted to the left of the plough. Obviously this will not be repeated from year to year as the direction of movement is affected by such factors as plough direction and the intensity of activity. It is however clear from the plan that the zones were still discernible at a general scale at this early stage of the experiment, even though the discrete divisions are lost; the process is most clearly illustrated by the three flint nodules to the south of the trench, and in the overall distribution of clustered flint.

In the second year of the experiment and after both ploughing and sowing, both the maximum distance, the mean

and standard deviation had all increased to at least twice that of the first season (Figures 4.5 and 4.6 and Table 4.8). The maximum distance moved had increased to 6.30m, the mean score was now 1.87m and the standard deviation 1.41m. In addition, the 'general zones' apparent after the first season were less clearly defined, affected largely by plough direction which for the second year was opposite to that of the first.

Perhaps the most significant factor however, particularly in terms of interpreting the results of surface collection concerns the enormous discrepancy between the movement of pebbles - which, it may be argued replicate the behaviour of cores - and flint flakes. In the first year only 4 of the 330 pebbles were visible on the surface. They displayed a maximum displacement value of 0.90m, a mean score of 0.72m and a standard deviation of just 0.17m. This is significantly less than that displayed by flint flakes and is perhaps explained by the standardised form of pebbles in relation to the more irregular shape of flint flakes. Rounded pebbles would react to the action of the plough in such a way that they would turn on their own axis within the soil (Figure 4.7b), much as a ball would in water. Flakes on the other hand do not have the same regular shape and would be affected in different ways according to how they were struck, position and orientation within the soil, weight and tendency to breakage (Figure 4.7a). Unfortunately only 3 pebbles were visible from the second years investigation after both ploughing and sowing and hence the results may not be representative. In this case however, both the mean (1.76m), standard deviation (1.23m) and the maximum distance travelled (2.76m) were all less than those values displayed by flakes.

A further point which may simply be a reflection of overall density or 'packing', is the tendency for clustered material to travel further than that in the scattered category. The maximum displacement value for scattered

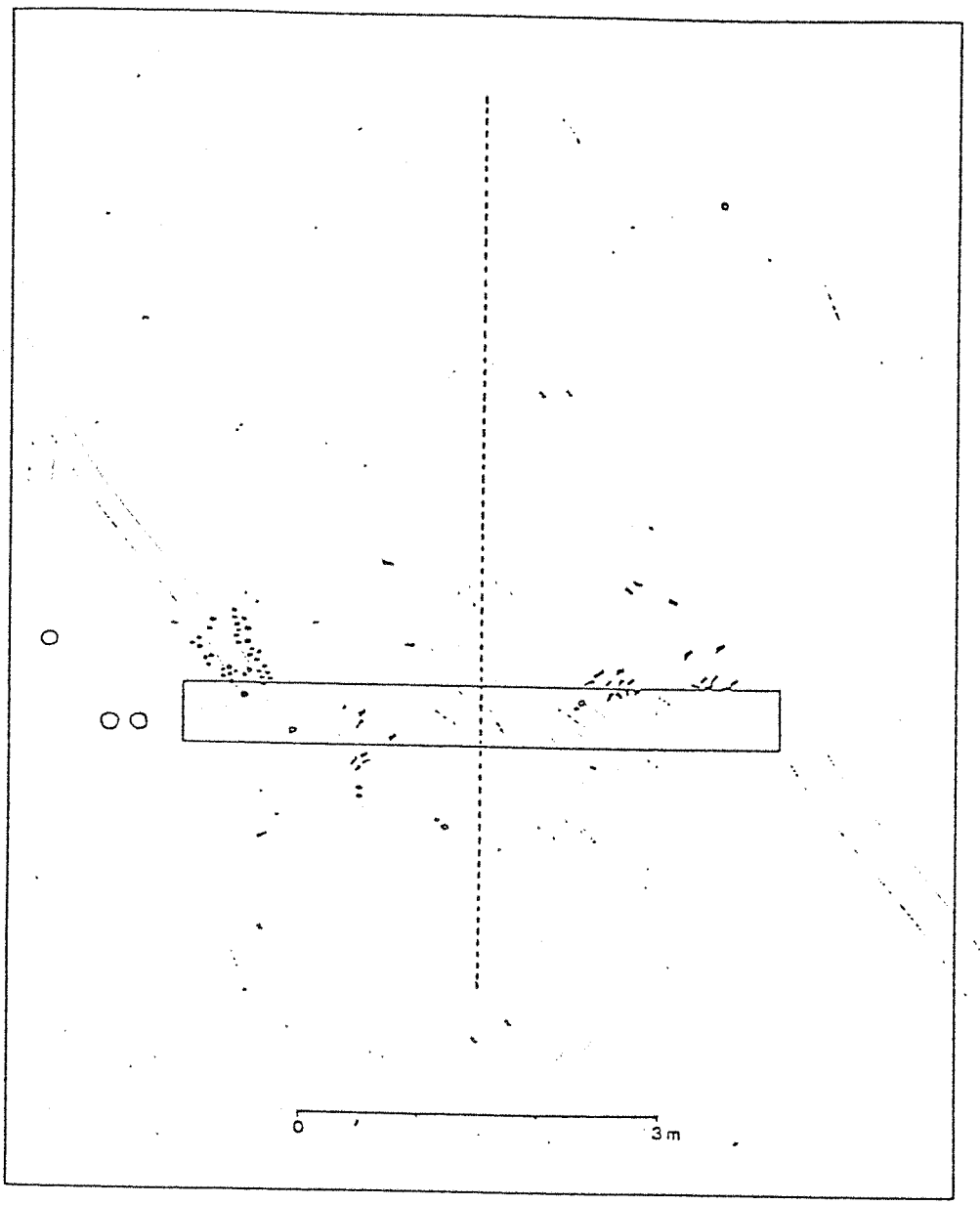


Figure 4.5: Results of the second season after ploughing.

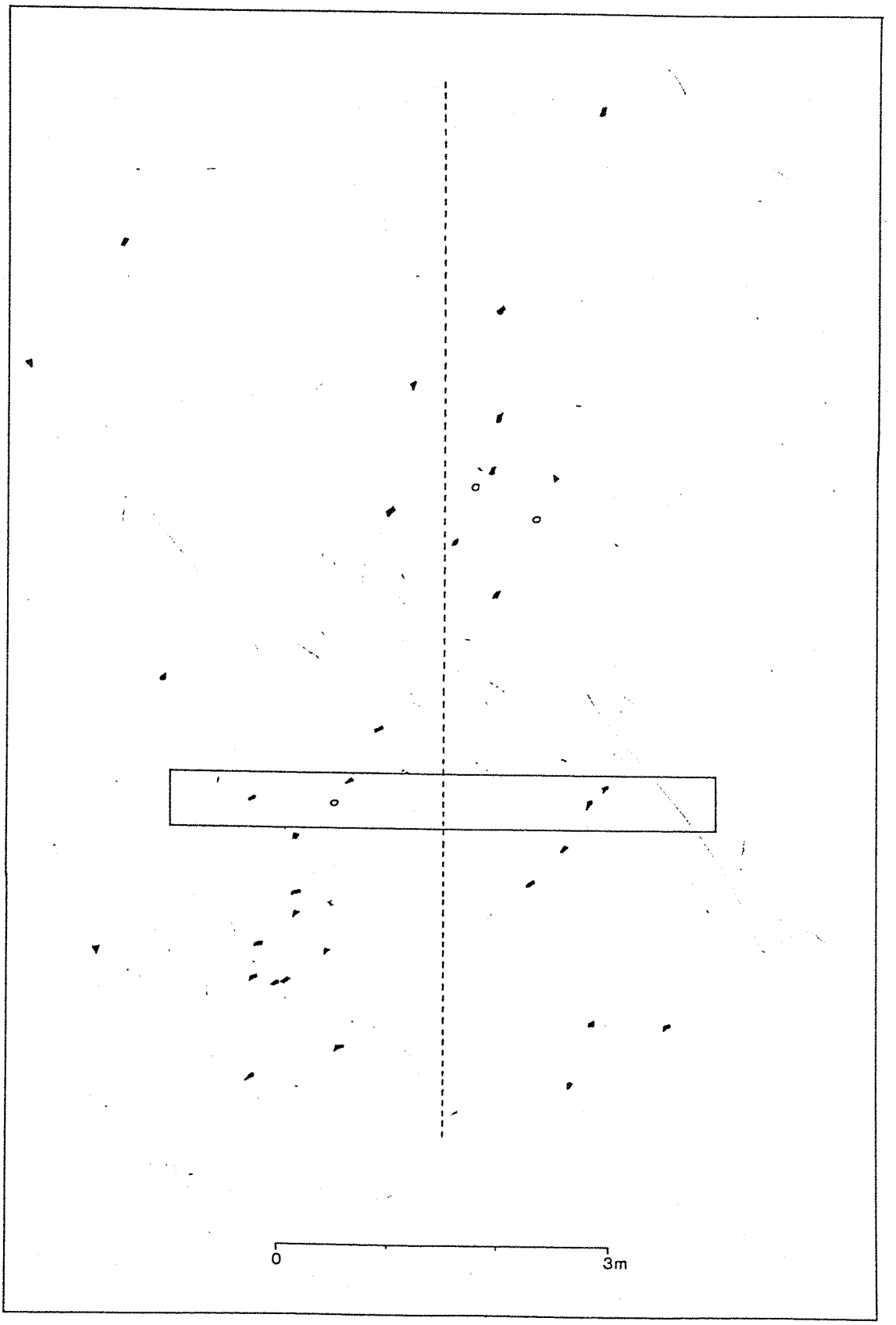


Figure 4.6: Results of the second season after ploughing and cultivation.

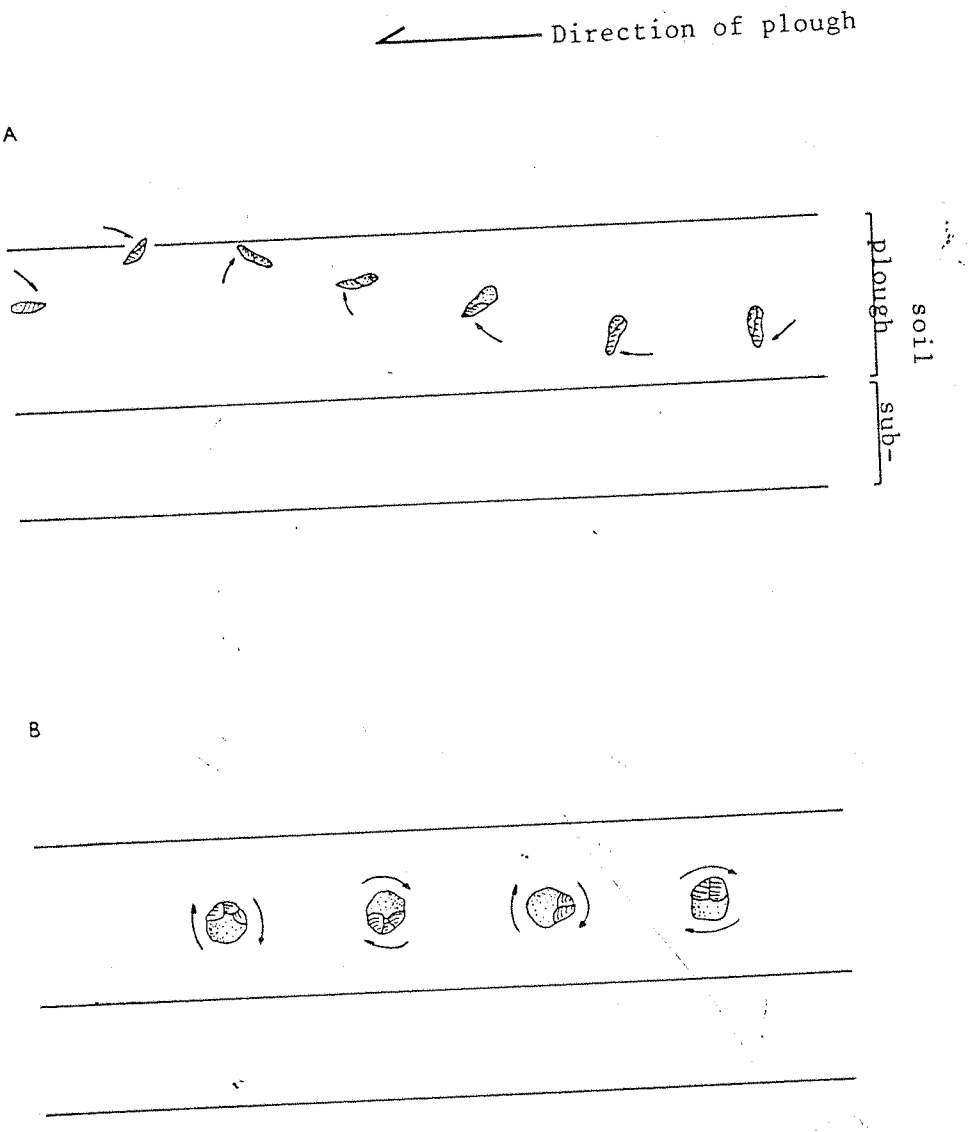


Figure 4.7: A, the effect ploughing may have on the distribution of irregular shaped artefacts. B, the effect ploughing may have on regular shaped artefacts.

flint, for example, is 171cm, as opposed to 396cm in the clustered category, while the mean displacement values are 73.0 and 162.4 cm respectively. Results from future years may help to clarify this situation, yet one may suggest that, where material is densely packed into the ploughsoil, not only will it appear on the surface in greater quantity, but it may also tend towards greater lateral displacement.

4.3.2.2 Surface Representation

The results of the various collection episodes are shown in Tables 4.8 and 4.9. A number of points arise from this; First, there is variation in the displacement and intensity with which both scattered and clustered flint from the first years results, appear on the surface ie 3.00% and 6.85% respectively. Second, there are the figures for scattered and clustered pebbles, ie 1.00% and 0.91%, which exhibit little variation. When we take into account the total numbers of each category buried in the ploughsoil (565 flints and 430 pebbles), then the difference in recovery rates is even more surprising. The overall assemblage figure of 3.69% is also of interest, especially when we consider the 2.00 and 0.36% figures referred to above. It is quite clear that if we are to appreciate the true value of surface assemblages, we must first begin to understand the nature of its relationship with the ploughsoil as a whole.

It is particularly interesting to note that following both sowing and ploughing in the second season, the figures were remarkably similar to those from the first. Flint flakes for example, although greatly dispersed, were represented by 6.02% of the total assemblage as opposed to 5.49% in the first year. It was impossible to tell by this stage which were derived from 'clusters' or 'scatters' although there is no reason to suggest that the trends noted above should be reversed. Pebbles also showed little variation. 0.93% were visible in the first year as opposed to 0.70% in the

		distance moved (m)		
	n	$\bar{x}$	s.d.	% on surface
flint	31	0.95	0.66	5.49
large pebbles	2	0.68	0.23	0.47
small pebbles	2	0.77	0.07	0.47
total pebbles	4	0.72	0.17	0.93
nodules	3	0.73	0.34	12.00
TOTAL				3.69

Table 4.8. Results from the first season of the ploughzone experiment, after ploughing and sowing.

A.		distance moved (m)		
	n	$\bar{x}$	s.d.	% on surface
flint	30	0.36	0.25	5.31
large pebbles	17	0.66	0.91	3.95
small pebbles	29	0.33	0.16	6.74
total pebbles	46	0.45	0.59	10.70
nodules	3	0.15	0.09	12.00
TOTAL				12.24
B.				
flint	34	1.87	1.41	6.02
pebbles	3	1.76	1.23	0.70
nodules	0	-	-	0.00
TOTAL	37			3.59

Table 4.9. Results from the second season of the ploughzone experiment, after ploughing (A) and ploughing and sowing (B).

second, while the total assemblage showed a difference between the two years of only 0.10% - 3.69% in the first year and 3.59% in the second. The suggestion is therefore from the first two seasons work that a discrete cluster of material - the 'site' perhaps - may be represented evenly through time, although the structure and extent of the scatter will be lost and displacement will be a cumulative process.

4.3.2.3 The cause of displacement

The cause of displacement and the reason for a bias towards misshapen and perhaps larger artefact classes is commonly put down to the action of the plough; indeed the term 'plough-damage' is one widely used in the discussion of surface artefact collections and formation processes. It was however an aim of the experiment to examine to what extent this was really the case and to ask whether it really was the plough that did the damage. Certainly Tingle (1987) has observed that far greater quantities of material are brought to the surface by the plough than by other types of agricultural equipment. Table 4.9 demonstrates both in terms of displacement and representation, the extent to which results may vary between ploughing (referring here to use of the mouldboard plough) as a single isolated episode, and ploughing and sowing whereby the use of an S-spring-tine cultivator is a subsequent process. The results are clearly different in two ways: First, that overall a far higher proportion of material is visible on the surface, 12.14% where ploughing has occurred as an isolated process. This difference is largely accounted for by the vast increase in pebbles visible on the surface - 10.70% as opposed to 0.90% and 0.70% under normal circumstances. The second distinction concerns displacement. Where ploughing has taken place without cultivation, the mean distance travelled by flint is 0.36m with a standard deviation of 0.25m and a maximum of 0.96m. For pebbles the mean distance is 0.45m, the standard

deviation is 0.59m and the maximum 4.18m. This latter case is clearly an exception and accounts for much of the standard deviation. Without this outlier the maximum value is 0.86m, the mean 0.37m and the standard deviation 0.20m.

It is therefore the plough which causes most material to appear on the surface. What the plough does not do however is first, sort that surface collection into size or shape classes, and second, displace material laterally across the surface (Figure 4.8). It is therefore the cultivator which causes disturbance on the largest scale. In relation to the logistics of surface collection it must therefore be stated that 'ideal conditions' are between ploughing and sowing at a time when the ploughsoil has been sufficiently weathered to cause maximum visibility. It is also significant to note in terms of fieldwalking that under stubble conditions, in even light and after substantial weathering, only one flake and two pebbles were visible by surface inspection.

4.3.2.4 Calibrating the excavated assemblage

As an example of how these results may assist in the identification of occupation areas through surface collection, it was decided to consider the flint assemblages from a number of excavations in southern England. Ten examples were chosen at random, the only requirement being that each should represent a settlement or occupation area of some form (see Table 4.10). These vary both in scale and in date with the smallest assemblage - 416 artefacts - from the Mesolithic site of Wakefords Copse, Hampshire (Bradley and Lewis 1974) and the largest - 76,400 artefacts - from Oakhanger, Hampshire (Rankine 1952). It should be stressed however that the assemblage from Oakhanger is exceptional, the next largest being only 36,000 artefacts from both Farnham and the Mesolithic assemblage from Downton. These should perhaps be regarded as more typical of an 'average settlement'. For the sake of argument, cores will be examined in relation to those

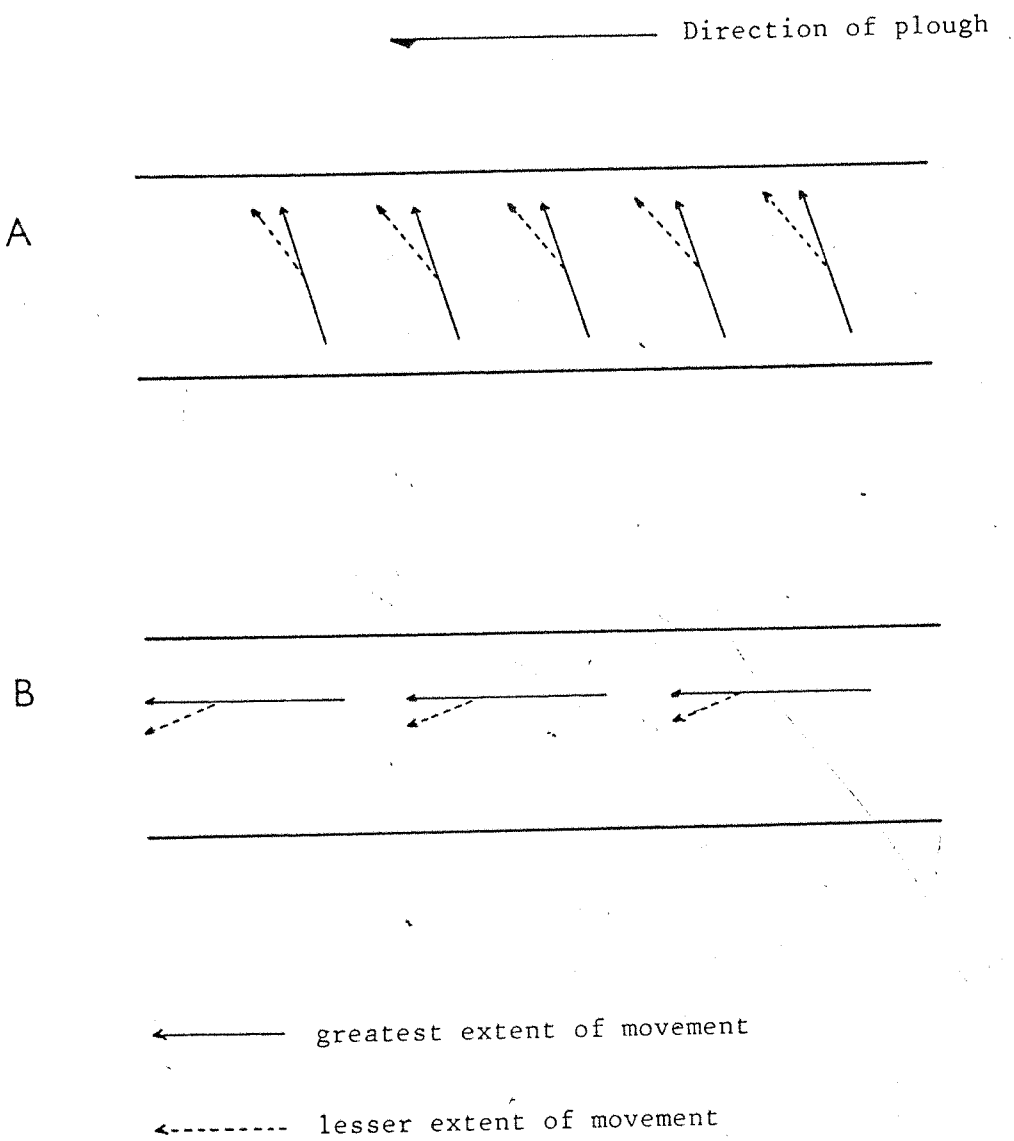


Figure 4.8: Schematic diagram showing the extent of disturbance caused by the plough (A) and the cultivator (B).

figures displayed by pebbles in the experiment (0.8% representation), while flakes will be used to represent the remainder of the assemblage (5.7% representation). These figures were calculated from the mean score after ploughing and cultivation over the first two seasons. It should also be remembered that the maximum figure is based solely on the results of the experiment described above and the minimum figure of 0.36% after Smith (1985); other estimates suggesting varying results may be equally valid. It is also assumed that the total assemblage would be in the ploughsoil; If we were to adopt Gingell and Schadla Hall's (1980) estimate that only 90% will be present in the soil at any one time, then the proportions presented in Tables 4.10 and 4.11 should be further reduced by 10%. The results may now be considered in terms of the two 'site-types', domestic and industrial.

Domestic

The results suggest, in terms of the surface/sub-surface equation, that for a settlement or occupation area the size of Wakefords Copse, a maximum of 24 flakes and one 'tool' may be expected to appear on the surface over an area probably twice the size of the original site. If we adopt Smiths 0.36% recovery ratio, then it would be unlikely for a single artefact to be recovered by line-walking at a 15m interval, while the results of the experiment suggest a possibility that 5 flakes may be collected. For a more substantial site like Thatcham, the figures are rather more encouraging. Taking the same minimum and maximum collection ratios, anywhere between 58 and 914 flakes, 1 and 15 'tools' and 1 and 2 cores may appear on the surface. By line-walking however, these are reduced substantially to between 12 and 183 flakes, 0 and 3 'tools' and no cores. What this suggests above all else is that a site on the scale of Hurst Fen, Black Patch or Thatcham, will no longer maintain the status of 'site' - at least not on the basis of density alone - once integrated within the ploughsoil.

site	present			no. on surface						total visible with 15m line-interval (20%)						% of total		
	waste	tools	cores	waste min	waste max	tools min	tools max	cores min	cores max	waste min	waste max	tools min	tools max	cores min	cores max	waste	tools	cores
Wakefords Copse (Bradley and Lewis 1974)	416	13	22	1	24	0	1	0	0	0	5	0	0	0	0	92.2	2.9	4.9
Wawcott 1 (Froom 1976)	4084	74	72	15	233	0	4	0	1	3	47	0	1	0	0	96.5	1.8	1.7
Thatcham (Wymer 1962)	16029	257	283	58	914	1	15	1	2	12	183	0	3	0	0	96.7	1.6	1.7
Downton (Neo.) (Rahtz 1962)	1478	120	98	5	84	0	7	0	1	1	17	0	1	0	0	87.1	7.1	5.8
Hemp Knoll (Robertson Mackay 1980)	2045	52	83	7	117	0	3	0	1	1	23	0	0	0	0	93.8	2.4	3.8
Black Patch (Drewett 1982a)	11918	116	149	43	679	0	7	1	1	9	136	0	1	0	0	97.8	1.0	1.2
Hurst Fen (Clark et. al. 1960)	14500	800	570	52	827	3	46	2	5	10	165	1	9	0	1	91.4	5.0	3.6
Downton (Meso.) (Higgs 1959)	36529	579	416	132	2082	2	33	1	3	26	416	0	7	0	0	97.3	1.5	1.1
Farnham (Clark and Rankine 1959)	36095	1121	1137	130	2057	4	64	4	9	26	411	1	13	1	2	94.1	2.9	3.0
Oakhanger (Rankine et. al. 1952)	76400	2965	705	275	4354	11	169	3	6	55	871	2	34	1	1	95.4	3.7	0.9
mean (n=10)																94.2	3.0	2.8
standard deviation																3.1	1.8	1.6

NB minimum scores are based on the figure of 0.36% recovery after Smith 1985), and the maximum on the figures of 5.7% for waste and 0.8% for cores described in this chapter.

Table 4.10 Application of the results of a ploughzone experiment to specific domestic contexts from southern England.

site	area (ha)	flakes total	flakes per ha.	surface min.	surface max.	total visibility by 15m line walking min.	total visibility by 15m line walking max.	Reference
Sta Nychia	810.0	50,398,661	62,220	224	3547	45	709	Torrence 1986
Demenegaki	737.5	31,750,564	43,051	155	2454	31	491	Torrence 1986
RlV 1814 Hill	3.9	38,000	9,743	35	555	7	111	Singer 1984

Table 4.11 Application of the results of a ploughzone experiment to specific industrial contexts.

That is not to say that a distinction between types of activity cannot be made from the results of surface collection. Indeed if we concentrated more on the combination of density and content of surface scatters rather than trying to establish their status merely as 'sites', our interpretation of the settlement system - which is after all a primary aim of ploughzone archaeology - may appear a little more straightforward.

In terms of assemblage composition, a number of points seem to emerge (Table 4.10). First, that the proportion of tools (excluding modified flakes) appears relatively low. At Black Patch for example, only 1.0% of the total assemblage was comprised of tools, while at Thatcham and Wawcott a similarly low figure of 1.6% and 1.8% was suggested. The highest scores appear at the Neolithic sites of Downton and Hurst Fen where between 5.0% and 7.1% of the assemblage were tools. Cores are also relatively infrequent, although this may vary in relation to the distance between settlement and quarry. At Black Patch for example only 1.2% of the assemblage consisted of cores while at Downton that figure was 5.8%. Waste will also vary, although as a general comment a figure of less than 90% is unusual. In summary therefore, despite a chronological range from Mesolithic to Bronze Age, variations in size and flint density of the individual sites and geological variation in their location, the proportions of artefacts display remarkable similarity. Indeed the standard deviations for the three groups (waste, cores, tools) are 3.1%, 1.8% and 1.6% respectively. It only remains to be seen whether the density range is distinct from that displayed by equally diverse industrial locations.

Industrial

Let us now consider the expected characteristics of quarry or lithic extraction sites. All observations concerning observed and expected ratio and density figures are based

upon those suggested by the experiment and their relationship with known assemblages, either from excavation or survey. Quarry and extraction sites produce vast quantities of characteristic waste material and as such are likely to appear as discrete clusters of archaeological debris. Three examples may be quoted although the fact that none of them are either British nor indeed from a temperate European context is a limitation in the context of this thesis (Table 4.11). Torrence (1986,204) for example quotes the production rates from the obsidian quarries at Sta Nychia and Demenegaki on the island of Melos. From these examples the density of debitage per hectare is calculated at between 62,220 and 43,051 respectively, while a further example suggests a figure of 9,744 (Singer 1984,40). Adopting the minimum and maximum figures quoted above, this would produce a total of between 35 and 3,527 pieces per hectare of which between 7 and 709 would be recoverable by 15m line-walking strategies.

In terms of assemblage composition, two factors are likely to predominate at quarries: 1. The low proportion of retouched artefacts and tools. 1.7% of the assemblage at Wawcott and Thatcham and 1.2% at Black Patch appear the minimum number of retouched items to occur on settlements in the region. A figure of less than 1.0% may be considered representative of quarry sites. This is simply a rough estimate by which the two types of activity might be distinguished and where regional survey is concerned a more realistic measure may be a distinction based on standard deviations above and below the mean.

2. The second factor is the high proportion of primary waste in relation to that occurring in a settlement area. The total waste frequency will appear as greater than 90.0% for settlement areas and greater than 98.0% for quarries, with the number of cores - which we might expect to be higher than for settlement areas, particularly where the settlement area is close to the quarry - underrepresented.

In addition to these aspects of composition, density will appear considerably higher than for settlement areas - assuming as we must a standard length of occupation. At Sta Nychia for example, one of only few quarries where appropriate figures were available for comparison, a range of between 45 and 709 artefacts would be collected by 15m line walking. At Thatcham, one of the larger settlements, that figure is smaller, between 45 and 709 artefacts. Only one 'mis-fit' was encountered, the site of Oakhanger where flint density when collected within a single hectare square would be similar to that from Sta Nychia. It is therefore possible to distinguish domestic and industrial by density, although there is the possibility of overlap between 'big' settlements and 'small' quarries. A far more reliable distinction could be made on the basis of scatter composition or the contents of the flint scatter. A combination of the two may perhaps be the most suitable.

From these examples and from the results of the experiment therefore, it would appear that, 1: disturbance under intensive agriculture will make the delimitation of settlement 'sites' virtually impossible; 2: that the utility of defining 'sites' is lost when such a clear distinction can be drawn between two types of activity, and 3: that although it is argued that such an equation can be considered relevant to most lowland areas of southern England, individual equations are required for other areas. The real test however is in the extent to which this model fits in with the results of surface collection; this may be considered in chapters 6 and 7.

4.4 Summary

In conclusion, a number of general points can be made:

1. That it is no longer acceptable to 'date' surface scatters on the basis of some diagnostic artefact. This makes the false assumption that all the material in that

scatter is both spatially associated and temporally homogenous. It is more useful to look at the general distribution of a specific artefact type which may be functionally distinct, or to look at aspects of technological variation across regions as a whole.

2. 'Sites' will not exist in the ploughsoil in areas where intensive arable farming has been practiced for long periods of time. Under certain conditions, discrete artefact scatters may exist. In southern England however, analysis of variation within a continuous scatter is considered more appropriate. The problem with defining 'sites' is that it involves setting a boundary which may never have existed. It is suggested here that we take instead an arbitrary division such as the National Grid hectare divisions or modern field boundaries and use them as our unit of analysis. By this method comparison of density between units will be far more objective.

3. While lateral displacement may not influence results to any great extent, vertical displacement almost certainly will. The experiment carried out in Wiltshire demonstrated how rounded objects will be greatly underrepresented in the ploughsoil while small flakes will also be hard to detect. It is vitally important that these factors are accounted for.

4. What is required therefore is a model which does not rely on either locating 'sites' or precision dating yet one which allows us to investigate settlement and land-use variation both in time and space. Such a model was adopted by Foley (1981) to answer the same types of question for mobile groups in the Amboseli, Kenya. It is argued that this model has a much wider application and may be adapted for use among both mobile and sedentary communities. This adaptation will now be discussed.

Chapter 5

Towards an off-site methodology

> 'It should be very clear that the archaeological record as it comes down to us is in no sense a 'simple map' of where humans discarded things, much less a map of where they used things or where they went. However, it is a partial image, albeit distorted and blurred, and with care and caution inferences can be drawn about the spatial configuration of daily life and about aspects of the use of the landscape' (Isaac 1981,134).

The discussion of spatial, chronological and experimental approaches to surface data presented in the previous chapter, has suggested that a far more useful and less biased model of the archaeological record can be constructed where emphasis leis in the recovery of artefacts rather than the discovery of sites. Such an approach is described here as off-site archaeology.

5.1 Off-site archaeology: a definition

As Thomas (1975) and Foley (1981) have shown, the archaeological record is most accurately conceived as a continuous distribution of artefacts over the land surface displaying variable density characteristics. According to Foley, the non-or off-site approach represents the study of the archaeological record on a regional scale based on the assumption of underlying spatial continuity of archaeological material (1981,10). The differences between on-and off-site material are largely the result of differences in the frequency of activities rather than qualitative variability (ibid).

This area of analysis is geared largely to the idea that basic ecological constraints will influence the overall

pattern of settlement on the landscape and hence that settlement will tend towards continuity in specific zones (Foley 1981, Bintliff 1985). One could suggest that this is tending towards a level of ecological determinism; it is nevertheless true, that certain constraints do influence settlement, and the ecological approach is primarily an investigation into how the settlement pattern reflects the adaptation of a society and its technology (see below) to those constraints. As Trigger (1965,61) has observed for example, within any region people will tend to establish their settlements in places close to 'drinking water, sources of food and in places that are safe and pleasant'. The overall density and distribution of population therefore, will be determined by the nature and availability of those natural resources that are being exploited.

We can therefore suggest that the differential density structure of a flint distribution will reflect not only archaeological visibility but the overall distribution of prehistoric behavioural patterns. Settlements will tend to be located within a particular part of the study area; if ecological constraints remain relatively constant then the gradient between high and low density and between aspects of assemblage composition may be expected to be reasonably steep. In an area with a widely dispersed and uniform distribution of resources displaying richness and variability but a lack of predictability, a dispersed and uniform distribution of archaeological material may be suggested. In those cases where resources are clumped and predictable, archaeological material will be concentrated or 'structured' (this was discussed at greater length in chapter 3).

Let us then examine first, precisely what we mean by human ecology, and second the various types of activity and social zonation which we may expect to recover in structured and unstructured environments. The schema

presented represents a modification of Foley's (1981) spatial hierarchy and will be used as a basis for interpretation in the case studies which follow.

5.2 An introduction to human ecology

The main aim of this thesis is to investigate the changing relationship between human behaviour and the environment. It is imperative, therefore, that we should be familiar with the general framework which this implies (after Butzer 1982).

As Butzer suggests, five central themes are singled out for attention (1982,7). All are concepts which originate in the fields of geography and the biological sciences but which, with the added dimension of time, become essential tools in the investigation of subsistence and settlement in the prehistoric period. It is essential that these themes are quoted in full:

1. Space. Rarely are phenomena evenly distributed in space. Topographic features, climates, biological communities and human groups exhibit spatial patterning and thus are amenable to spatial analysis.

2. Scale. Spatial analysis is used to distinguish small-, medium-and large-scale objects, aggregates or patterns. Similarly, the configuration of living communities or physical aggregates are established, maintained or modified by processes that operate at several spatial and temporal scales and that may be periodic or aperiodic. Microscale and macroscale studies are obviously complementary, and both are necessary for comprehensive interpretation.

3. Complexity. Environments and communities are not homogenous. This makes both their characterisation and delimitation difficult, thus requiring flexible, multiscale spatial and temporal approaches.

4. Interaction. In a complex environment with an uneven distribution of resources, human and non-human communities interact internally, with each other, and with the non-living environment; they do so at different scales, from varying degrees of proximity, and at changing or unequal rates.

5. Equilibrium state. The diverse communities of any environmental complex are all affected to some extent by negative feedback resulting from internal processes or external inputs. In consequence, readjustment, whether minor or major, short-term or long-term, is the rule rather than the exception.

Our concern should not therefore rest solely with distributions in time and space but with the scale of land-use and with the nature of the relationship between human societies and the landscape. We should not limit our objectives to a particular type of activity, but its relationship with other types of behaviour, its relationship with the physical regime and the frequency with which that particular signature recurs. Without 'sites' and the ability to locate a hunters camp or a farming settlement, we need a more flexible approach to pattern recognition. We need a means by which to identify repetitive and accumulative aspects of behaviour rather than pin-points in time and space. Off-site archaeology provides this (Foley 1981). This model may now be presented in terms of the environmental distinction made in chapter 3 between coarse-and fine-grained responses, and a series of archaeological expectations are raised.

5.3 The coarse-grained response

5.3.1 The Home-Range and the area adjacent to it

This may be defined as the area over which an animal

normally travels in pursuit of its routine activities and should not be confused with territory or territoriality which tends to involve either exclusive use or defence. The home-range is not a 'site' but an arbitrary definition of a series of fields which contain evidence such as we may expect to see within a domestic context. It is a notion derived from the 'home-base' as defined by Foley (1981) and Rogers and Black (1976) but does not in this case confine itself to the 'site', for reasons which have already been discussed. It is the area on and immediately around the settlement unit and hence should be easy to recognise by surface collection (Tables 5.1 and 5.2). These particular areas would be expected to coincide with the 'ecological constraints' referred to above, lying close to surface water, near light soils and close to a plentiful source of flint, timber etc. In terms of assemblage composition we may anticipate these areas to exhibit a variable density of worked flint, a high proportion of retouch, especially knives and scrapers -which Binford and Binford (1966) suggest are indicative of home-base activity -and consistent proportions of the various classes of waste and retouch likely to point to areas within the home-range being functionally discrete. In other words where assemblage size and composition are uniform, a degree of functional autonomy may be suggested. Winters (1963) suggests a score of 75% of processing/fabricating tools as making up most of the functional assemblage at settlements as opposed to 20-30% at hunting camps. O'Brien and McDaniel (1982,231) suggest a similar trend; residential sites on the one hand maintaining a high artefact density indicative of intensive and/or recurrent occupation and artefact assemblages that represent light, domestic activities. Procuring/processing sites on the other hand have low artefact densities indicative of infrequent and/or temporary utilisation and assemblages that represent resource extraction and heavy processing activities.

Aspects of settlement morphology and location may now be

	home-range	secondary home-range	extra home-range
Mesolithic	low density high proportion of blades/ blade cores. high proportion of retouched items especially scrapers.	largely special purpose locations. situated on prominant hill-tops. low density. high proportion of retouched blades. industrial emphasis is on blade manufacture.	emphasis on hunting/foraging. low density. wide scatter of tranchet axes, microliths.
early Neol.	higher density than above. lower blade frequency. proportions of scrapers and retouched items very similar.	heavy industrial activity in specific locations. high density. high proportions of primary waste.	low density. wide scatter of axes and leaf arrowheads. distribution of burial monuments.
later Neol.	higher density than for early Neol. lower blade frequency. otherwise similar.	as above.	low density. wide scatter of axes and transverse arrowheads. distribution of burial monuments.
Bronze Age	very low blade frequency, but high density in some locations. high proportions of retouch and scrapers. also burnt flint and pottery.	large scale industrial activity. increasing frequency of hinge fractures.	low density. widespread scatter of barbed and tanged arrowheads. distribution of burial monuments.
overall	high density. high proportions of retouch. high proportions of scrapers.	high density. high proportions of industrial waste.	low density. high proportions of axes, microliths, arrowheads. distribution of burial monuments.

Table 5.1: Archaeological correlates for the home-range model.

RETOUCH

DENSITY	low	high
low	not indicative of any particular type of home-range activity; more a feature of the extra-home-range.	small-scale activity, possibly suggesting seasonal or temporary occupation.
high	possibly an industrial area depending upon waste proportions.	large scale occupation. either repeated seasonal occupation or permanent. If the former, we may expect the scatter to be more extensive. Whichever the case, behavioural domains should be clearly demarkated.

Table 5.2: The distinction between domestic and industrial locations.

considered for the three period divisions with which this thesis is concerned. My interest is not in the specific characteristics of individual settlement units but rather in any similarities which may occur within specific periods. One point of definition: The settlement unit as located by excavation, will be represented in a ploughzone context by the home-range. One is defined by a specific boundary, one by an arbitrary division provided by field or hectare boundaries. The two are not synonymous, but to consider the expected characteristics of one, we need to observe the attributes of the other.

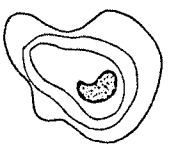
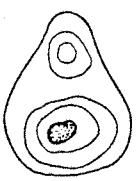
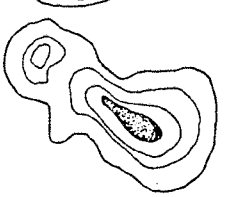
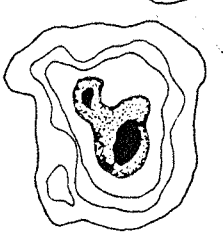
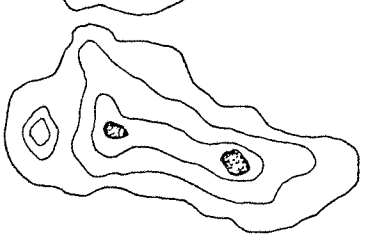
5.3.1.1 Mesolithic

For the Mesolithic, expected trends which may emerge through field survey may be predicted by observing the nature and form of excavated settlement units. In southern England this appears to be fairly diverse although few structural remains survive. At Downton in the Avon valley, an oval scatter of flint 250 m^2 was excavated and found to contain a main chipping floor of 80 m^2, hearths, pits and the presence of a possible stake or post structure (Higgs 1959). The proportion of tool types suggests a concentration on heavy maintenance activities with 41% being scrapers and 13% microliths. At Wawcott III (Froom 1976) the mean density of flints per square metre was considerably greater than that at Downton while the overall extent of the scatter appears to have been four times the size. Once again hearths and pits are present with additional evidence in the form of occupied hollows. The proportion of tools is totally different to that from Downton yet similar to that from Wawcott I (Froom 1972) and may suggest an emphasis on specialist hunting. The proportion of microliths makes up 70% of the total tool assemblage at Wawcott III and 89% at Wawcott I, while scrapers represent 14% and 3% respectively.

Thatcham I/III (Wymer 1962) is another site worthy of

consideration, comprising a total area of 2000m^2 with three major and three minor internal concentrations. Hearths are once more present but the density of flint in this case is remarkably low. Scrapers make up 21% of the total tool assemblage while microliths make up 46%. The scores are more even at Oakhanger (Rankine 1952) where microliths represent 43% and scrapers 36%. As with all these sites, the location is on a small terrace or plateau overlooking the adjacent river valley, a point which will be explored more fully below.

We may suggest therefore, from the evidence provided by excavations in southern England, that variability exists, not only in the composition of assemblages but in the size and density of occupation areas, defined here as the home-range. The only point of similarity is in the proportion of cores and retouched material, both of which appear remarkably uniform between sites. A similar problem of variability has been investigated for the Netherlands by Price (1978). He attempted to demonstrate both through scatter size and scatter composition that five types of settlement could be identified. These are presented in Figure 5.1. It is clear from these investigations that through flint density it is possible to draw conclusions relating to the length and intensity of occupation, while through scatter composition we are looking at the nature of occupation. For example where microliths are common we may suggest an assemblage as being specialised towards a particular task or type of activity such as hunting, while in a case where scrapers are dominant, the assemblage may be described as indicative of maintenance activity. By referring back to the home-range model we may suggest that the former category be described as a characteristic of activities taking place away from settlements (see 5.4, below), while the latter exists invariably within the home-range. In areas where raw material for flint tool manufacture is locally available, this latter category may further maintain a high frequency of cores, as is the case

Scatter Plan	Area (m^2)	Assemblage Type
1. 	less than 30	less than 1000 artefacts; less than 25 retouched tools. microlith dominated. small extraction camp-brief specialised activity.
2. 	less than 30	as type 1, but no marked predominance of any one tool type. small base camp-general purpose maintenance activity.
3. 	c.75	1500-2500 artefacts; full range of tool types. medium-short term base camp.
4. 	c.100	2500-10000 artefacts; much higher overall density. medium-long term base camp.
5. 	c.320	7000 artefacts; full range of tool types, but microliths common. large aggrgation camp.

Site type	scatter size m^2	scatter width m	area scanned m^2	Total flints		Total cores		Total scrapers		Burnt flint
				avail.	collect.	avail.	collect.	avail.	collect.	
1	25-50	5-7	18	1530	5	20	0	-	-	0?
2	25-50	5-7	18	3042	10	40	1	28	0	1-5
3	100-300	10-17	84	15960	53	175	2-5	160	1-2	20-30
4	100-500	10-22	120	36000	120	953	15-25	1075	8-12	40-60
5	1000-2000	32-45	410	69700	232	865	15-20	205	1-3	20-30

Figure 5.1: (after Price 1978, and Smith 1985). See text for explanation.

for example in the Kennet valley (Smith 1984,114). Through surface collection however these distinctions will be far less marked. As we saw in the previous chapter, both microliths -through their size -and cores -through their shape -will be grossly underrepresented in surface contexts. The only clue to the extent of this dichotomy will be to standardise microlith and core frequency and look to those areas with exceptionally high and low proportions.

5.3.1.2 Neolithic

In 1954, Piggott noted the lack of evidence for settlements in the Neolithic of southern England (1954,366). He suggested that, 'isolated houses were typical of the period', an observation later confirmed by excavations at Ballynagilly (ApSimon 1976) and Fengate (Pryor 1974) where Neolithic structures stood alone in large stripped areas. Thirty years on and the picture in southern England is no more convincing. Developments on the Continent have suggested the existence not only of homesteads, but also of hamlets and villages, implying a 'greater permanence or stability of settlement, made possible through improved economic adaptation' (Whittle 1985,131). Villages such as Elsloo and Sittard in the Netherlands and Bylany in Czechoslovakia, with their often substantial post-built long houses, were for a long time considered characteristic. More recently however, work by Kuper (1977) on the Aldenhoven plateau, north-west Germany, has suggested that in one area at least, individual homesteads were the dominant unit. The difference between this situation and that in southern England however concerns the frequency with which these domestic units occur. Why for example on the Aldenhoven Plateau is the density so high with houses spaced at intervals of every few hundred metres, while in southern England units are so widely dispersed? One clue to this apparent lack of structures may lie in the very nature of their construction. Holgate for

example has suggested that denudation has done much to destroy Neolithic land surfaces and shallow subsoil contexts (1985,51). Certainly it would appear that in southern England the large post-built structures of the Continental LBK cultures were not being built and instead a far less substantial building style was adopted. Such a structure will naturally leave a less distinctive 'signature' on the landscape and as a consequence we are left only with the imperishable flint artefacts and scattered pits with which to consider this question. The idea that Neolithic pits may reflect the distribution of settlements was first suggested by Field, Matthews and Smith (1964). They considered that the very nature of material recovered from these features suggested that activity had occurred nearby and that the pits were connected with 'domestic rather than ritual activities' (1964,369). Healy, in her description of Neolithic settlement in Norfolk followed a similar line of argument, suggesting that settlement sites are indeed defined by 'pits and domestic rubbish' (1984,87). Where pits and post holes have been excavated, most tend to occur in discrete clusters, pits at Broome Heath for example covering an area of 1.6 hectares (Wainwright 1972) and at Spong Hill, 0.7 hectares.

Other evidence for domestic activity has come from the excavations at a number of causewayed enclosures in the region. Bradley (1984,25) has suggested that evidence for differentiation among Neolithic burials may be reflected in the form of similar variability within the settlement systems, enclosures apparently representing the 'top end' of the scale. They may, Bradley suggests, represent 'higher status settlements'. Certainly they tend to occur in favourable locations, close to localised flint source areas -Carn Brea for example being located close to one of the main sources of Greenstone axes; they appear to concentrate in areas of productive agricultural land, and certainly represent a substantial investment in manpower.

However tenuous these links may appear, that some of the enclosures in southern England played a domestic role appears convincing, with evidence being particularly strong at Carn Brea (Mercer 1981), Hambledon Hill (Mercer 1980), Crickley Hill (Dixon 1981) and Orsett (Hedges and Buckley 1978). If for example we were to treat scrapers as an index of everyday, on-site, maintenance activities -as was suggested for example by Binford and Binford (1966) -then the fact that they occur in similar proportions on enclosed and open sites is perhaps significant (Holden and Bradley 1975,101-2). Is it possible to suggest that the major difference between these two 'types of site' is not so much one of status as Bradley suggests, but rather one of degree of permanency? Can we suggest that, through a system of shifting agriculture, semi-sedentary communities required the existence of a major central location through which they could maintain an identity? How certain are we that Neolithic communities in Britain really had 'settled down'? The evidence for structures and settlement units recovered so far certainly would not suggest that to be the case with evidence for repeated episodes of occupation occurring for example at Haldon (Willock 1936) and Downton (Rahtz 1962). Evidence from Windmill Hill also implies that this idea of movement between dispersed, isolated family units and the causewayed enclosures is a realistic one. The types of pottery vessels recovered do differ significantly in relative proportion to those from open settlements. At Broome Heath for example there are more larger storage vessels and fewer bowls 'suitable for the serving of food and drink', while at Windmill Hill the opposite is the case (Howard 1981, Wainwright 1972).

The most detailed information regarding the nature and form of Neolithic settlements comes from excavations at the sites themselves. Often discovered by accident rather than as part of a deliberate research policy, these sites have provided plans of structures, for example at Ballynagilly

(ApSimon 1976), Lough Gur (O'Riordain 1954), Haldon (Willock 1936), Fengate (Pryor 1974) and Ballyglass (O'Nuallain 1972), their stylistic uniformity over such a wide area suggesting that they represent a characteristic or dominant form and that the size of domestic unit was similar throughout the British Isles (Figure 5.2). The evidence suggests that structures were small, probably designed to accommodate single, family sized units, and were probably associated with a much wider land-use pattern which included both the rubbish pits described above as well as areas of open ground used for arable or fallow. It is possible to suggest, both through the archaeological and palaeoecological evidence (chapter 3), that these units were concentrated in the major river systems. Valleys contain narrow but compact ecological zones which run parallel to the rivers, and that these may have been important in the provision of wild food resources and serving as a means of communication, may be reflected in this distribution.

The most striking parallel appears in the north of France where Howell (1984) has investigated the distribution of early farming communities. In general the location of bandkeramic settlements are confined to the narrow valley bottom zone. The settlement areas defined by Howell range between 125 and 500 hectares and all findspots are exclusive to these zones. If we were to suggest that Howell's 'settlement zone' incorporated both our own home-range and secondary home-range, then we may suggest strong similarities between the organisation of settlement in the two areas.

Excavations at Downton in the middle Avon valley are fairly characteristic of this general picture, with pottery and flint occurring in association with a shallow pit (Rahtz 1962). ApSimon examined the pottery and suggested that occupation was probably of an 'intermittent or seasonal, temporary nature and quite possibly extending over a

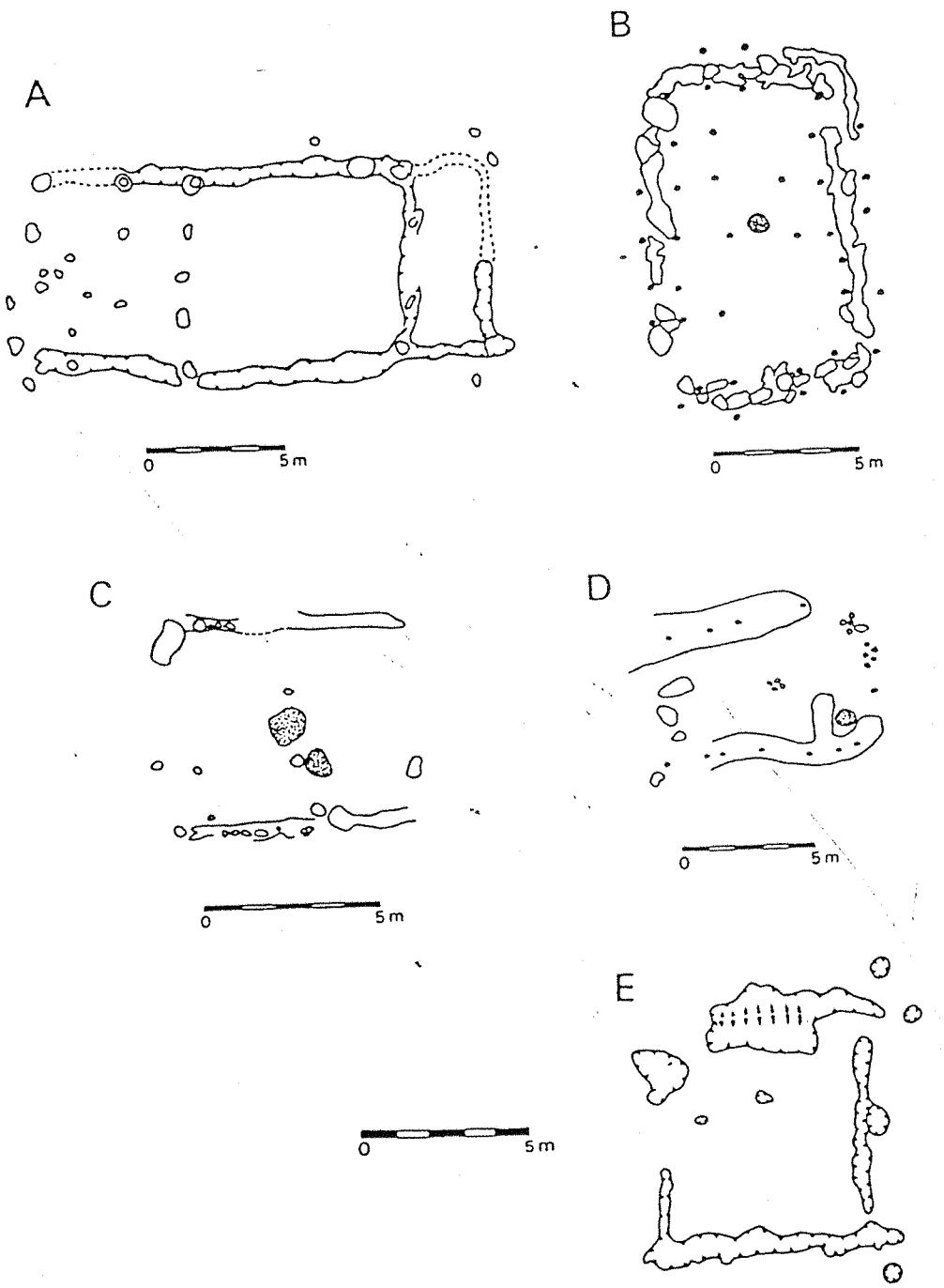


Figure 5.2: Neolithic house plans from the British Isles.
A. Ballyglass; B. Lough Gur; C. Ballynagilly; D. Haldon;
E. Fengate.

considerable period of time.' He goes on to suggest that 'the selection of a site on a river gravel terrace and the absence of structures...seems quite characteristic of the Peterborough group' (1962,129).

One feature which does emerge quite clearly from these excavations is that an oft-quoted generalisation, that density and variability within a flint assemblage suggest a degree of permanency and greater length of occupation, does not stand up to scrutiny. The flint assemblages from Downton, Pamphill and Puddlehill are very small, while those from sites such as Broome Heath are considerably larger. It may be that density does reflect length of occupation to some extent, but where a home-range is occupied for a longer period, there is bound to be variation. It is also the case that locations may be functionally distinct; where high density scatters are identified through surface collection strategies they are generally assumed to represent settlements, but what of the flint extraction sites, the quarries visited repeatedly in the search for raw material? These too will be reflected by high density scatters, although the proportion of tools to waste and of primary flakes will be significantly different.

5.3.1.3 Bronze Age

In terms of the proposed characteristics within a home-range environment, the Bronze Age provides an interesting contrast to the periods which precede it. Although the term 'valley adaptation' is hard to ignore, there is a distinct tendency towards Downland settlement in this period, a trend already examined in terms of palaeoecological evidence in chapter 3. Ellison has suggested (1981,414) that the period should be seen as one characterised by a predominantly pastoral economy associated with small, settled farmsteads. The settlements which appear on the Downs at this time are similar in many respects and it is

possible to isolate a major recurring settlement module. This can be identified both at Itford Hill, Shearplace Hill and Rams Hill. In terms of location there appears a strong correlation between site size and the productivity of surrounding land -92% of the sites investigated by Ellison have a high quality of arable land within their catchment, while the majority are located close to the junction of two or more land-use zones.

Drewett's (1982b) analysis of locational attributes for Downland farmsteads of the later Bronze Age produced a number of significant trends (Table 5.3). Most interesting of all is the distance from fresh water and the availability of flint in the immediate vicinity. At Black Patch, 12,000 struck flints were recovered, 93.8% of which were unretouched and all of which were locally derived. Flakes were on the whole broad and squat such as are characteristic of later Prehistoric assemblages. It may be however, as was proposed in the previous chapter that both the rough-and-ready form of the assemblage in this case and the quantity of debitage generated may simply be a reflection of the sheer quantity and close proximity of lithic material to Downland sites. It is also interesting to note that the two types of tool which are relatively frequent within the settlement units are fabricators and scrapers, both of which are types of maintenance item such as those described by Binford and Binford (1966) and both are tool-types for which no metal equivalents were available.

Despite this expansion onto the Downs, home-range locations continue to appear in valleys although their structure is very different. The settlement at Aldermaston Wharf for example consists of two houses of similar size and with a pair of pit clusters (Bradley et.al.1980). As the authors suggest, these features differ from the normal pattern of earlier Deverel-Rimbury settlements. The latter consist, as we have already suggested, of a standard domestic unit

Site	Resources (distance in minutes, travel time)						
	river	spring	sea	field	upland pasture	lowland pasture	flint
Amberley	96	19	218	OS	OS	17	OS
New Barn Down	98	39	160	OS	OS	48	OS
Cock Hill	113	48	175	OS	OS	103	OS
Park Brow	57	42	82	OS	OS	51	OS
Plumpton Plain	79	22	132	OS	OS	19	OS
Itford Hill	35	23	80	OS	OS	28	OS
Black Patch	48	34	95	OS	OS	27	OS

Table 5.3: Locational aspects of Bronze Age settlements in southern England (after Drewett 1982a).

consisting of a major dwelling plus subsidiary huts and storage buildings. These features contrast with those at Aldermaston Wharf.

A more general pattern of Bronze Age activity on the Kennet gravels shows a tendency towards intensive settlement and land-use, indicated both by site-frequency and palaeoecological investigations. Many of the settlements were contemporary and lasted for a considerable period of time. A further contrast between valley and Downland locations lies in the frequency and proportions with which flint and metalwork were used. As Bradley (1980,288) suggests, sufficient metal was available through the valley corridor for flint to be of little use despite the availability of quality flint. On the chalk where metalwork was less frequent, flint was a far more common occurrence. The extent of this variation is as follows:

site	% of flint	distance from river (km)
Aldermaston	3.0	0.5
Knights Farm 3	5.0	1.0
Beedon Manor Farm	25.0	12.0
Rams Hill	42.0	14.0

We may therefore suggest that although settlements do occur in valleys in the Bronze Age, they are far less likely to be found by surface collection. Flint is less frequent, while it cannot be ruled out that in the smaller valley systems such as the Meon, less wealthy and less substantial sites were the norm. If this is the case then perhaps only the weathered pot sherds and burnt flint will mark their

distribution.

The aim of this section has been to establish whether any specific trends, observed through excavation evidence, can be translated into the very different vocabulary of surface distributions. The conclusion in chapter 4 was that although extremes in density did vary between between industrial and domestic activity, there was considerable overlap. If results of excavation were to integrated into the interpretation of surface distributions, a further variable must be sought.

From the discussions presented above it would appear that, with the exception of diagnostic artefacts, no clear trends emerge. It is not possible to distinguish between Mesolithic, Neolithic and Bronze Age activity in terms of assemblage composition or the nature of the settlement system. This may be possible where only single periods are represented; this is not the case in southern England. It was however necessary to demonstrate this in order to justify an alternative approach.

5.3.2 The Secondary Home-Range

This may be defined as the area beyond the settlement domain where specific tasks may be repeated consistently over a period of time and within a given radius of the home-range. Binford and Binford (1966,268) include both home-base sites and work sites in this category, a point criticised by Yellen, suggesting there exists a degree of continuity between these classes (1977). One of the most well known examples of this phenomenon is probably the Mask Site, a Nunamiut hunting stand, documented by Binford (1978) who pointed to its crucial role in the subsistence strategy and its continued use over a considerable period of time.

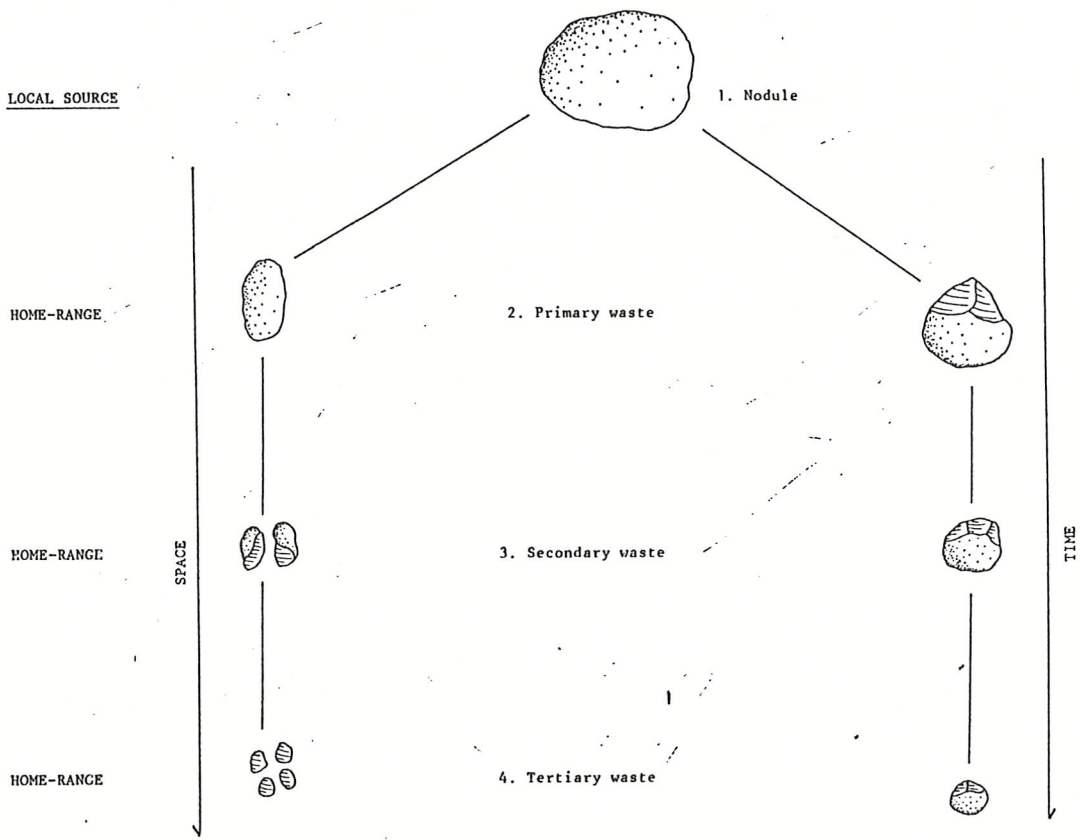
In terms of the case studies which follow it is important

to make clear the distinction between occasional secondary home-range foci in which a single location is used more than once, for example for flint extraction, and the one-off locations used possibly en route to another place. In terms of an ideal location there is a degree of flexibility according to the type of activity involved. Where flint extraction is concerned we may expect an emphasis either on the chalk or river gravels, while in terms of assemblage structure we may expect a significantly lower density and a shift in emphasis from retouch to a concentration on primary waste (Table 5.4). These are observations made both by Torrence (1986), Ericson (1984) and Sappington (1984). It is clear that we should expect to see debitage at the site of production and which reflects not only the nature of production (ie the type of blanks being removed), but the intensity of production through time. If a source area was being used over a long period, then clearly it is the dominant pattern with which we must be concerned. If such a location was used for only a short period of time, then it is far more likely that technological or chronological traits may emerge.

Variation may also appear as a function of the type of relationship which existed between the quarry and the home-range. If a home-range were situated either at or adjacent to a quality source area then both the primary, secondary and tertiary stages of core-reduction should be present. If however the two are divorced, then the two types of waste will be more widely dispersed. The two patterns may also display variation in flake morphology with resource stress represented in the form of smaller or more standardised waste forms (Figure 5.3). These points were described more fully in the previous chapter.

Schick has observed a similar set of relationships as operating in the context of Pleistocene adaptation in east Africa, and points to three components of human behaviour which may influence the distribution of artefacts in the

Figure 5.3: Archaeological correlates for the core-reduction sequence.



CHARACTERISTICS: These may include large quantities of waste and hence low proportions of retouch. Main flake/core size is generally large.

CHARACTERISTICS: These may include smaller quantities of waste within the home-range, little in the way of primary waste and greater proportions of retouch. Main flake/core size is generally small.

ASSEMBLAGE COMPOSITION	DENSITY	
	high	low
high proportions of primary waste	large scale lithic extraction prepared nodules removed elsewhere for further reduction	small scale lithic extraction prepared nodules removed elsewhere for further reduction
high proportions of tertiary waste and cores	further reduction in separate location	further reduction in separate location
high proportions of primary waste, tertiary waste and cores	lithic extraction and tool manufacture on large scale. Exploited over a long period of time.	lithic extraction and tool manufacture on small scale. Possibly used on one occasion.
high proportions of primary waste, tertiary waste, cores and retouch	as above, with some evidence for domestic activity. Possibly seasonal to coincide with flint extraction.	Possibly the result of flint extraction in an area occupied for only a short period of time, for example a 'night stop'.

Table 5.4: Characteristics of Industrial locations.

landscape (1986,113):

1. Import of manufactured artefacts to the site area.
2. Manufacture of artefacts at the site and resharpening and/or reshaping of imported items.
3. Export away from the site for any artefacts involved in either of the above processes.

These various sets of relationships were described by Schick (1986,115-118) in terms of six individual 'modes of behaviour'. All would produce a very distinct archaeological signature and all are potentially visible through the surface collection of artefacts at a regional scale. The modes of behaviour are as follows:

Mode 1: Where all stone artefacts left at a site were made there, with no importation of any manufactured items nor export of any of the fashioned products. The result is that size class distribution will be skewed towards smaller flakes, while cores and core tools will rapidly become a minority component within the assemblage.

Mode 2: These locations will be similar to those of Mode 1, although some material may be exported. Since cores or larger, more useful flakes are more likely to be exported, the size distribution curve should be skewed towards smaller sizes. The proportion of cores should be reduced depending on the extent of on-site manufacture and the amount of export.

Mode 3: In this case materials produced elsewhere are imported and further manufacture of these and other raw materials is carried out at the site. Depending on the amount of on-site production and its balance with the quantity of imports, this site could also exhibit a predictable size class distribution, possibly skewed towards larger elements if a high proportion of larger flakes are brought in. Similarly core imports could

increase the proportion of cores depending on the intensity of on-site production.

Mode 4: Here artefacts are imported and exported but on-site knapping is occurring as well. Depending on the balance of import and export, size distribution could be skewed either towards the larger or smaller end of the scale. A moderate amount of production would effectively weight the site and possibly produce a near-normal flake size distribution. Considerable amounts of imported of exported material would be needed to skew the distribution in either direction.

Modes 5 and 6: Locations produced in these modes would comprise entirely artefacts manufactured elsewhere and brought onto the site. In such cases the size distribution would be skewed heavily towards larger material with the possibility of core and core-tool import in preference to flakes.

Clearly therefore, such widely variable patterns of artefact distribution will produce variable sets of archaeological material, appearing at different scales and in variable combinations. If industrial and domestic locations can be distinguished by the application of a home-range model to regional surface data, then it must also be possible to consider the nature of a relationship between them. This has already been discussed in relation to the 'mapping' of source areas and is a point which will be considered further in the case studies which follow. A problem not relevant in Schick's study however is that of chronology, and the potential for observed variations being time-rather than space-related cannot be overlooked.

Other types of location which may be visible through surface collection are confined to the earlier periods and comprise specialised hunting or monitoring stations such as that described by Binford (1978). Distinguishing these from

quarry locations should be fairly straightforward with primary waste appearing in very low proportions. The distinction between these and short-term occupation sites may however be more difficult. One variant already discussed is that between artefact types. We have already noted a general tendency for scrapers to appear largely within a home-range context while microliths can be suggested to represent special purpose items which would have had little use close-to-home. It is far more likely that such artefacts appearing in a concentration will reflect the location of some special task activity area integrated within a specialised and logistical hunting system. A scatter of such items may reflect a more casual, dispersed hunting strategy and would probably occur in a wider range of contexts.

Within this area therefore, we should expect to see further evidence for organised activity within a limited area. Quarrying and lithic extraction will undoubtedly leave the most distinct and easily recognisable traces.

5.4 The fine-grained response

5.4.1 The Extra Home-Range

This refers to those aspects of discard that might occur beyond the home-range and secondary home-range. Rogers and Black for example regard it as an area which provides a 'back-up-insurance', supporting the population of the home-range when yields are low (1976,22). Discard would probably be the result of foraging activities in an area used both extensively and infrequently. The very fact that settlements or concentrations of activity are absent suggests that resource predictability was a key factor in the location of prehistoric settlement. In these areas we may expect to see a continuous low density scatter with a variety of artefact types, some classes appearing with greater frequency than in structured contexts. Arrowheads

for example are likely to occur in high numbers relative to their overall frequency because their use for hunting would mean discard away from the primary settlement areas. Axes should also predominate in these areas for much the same reason. We saw in chapter 3 how the vast majority of Downland areas remained wooded until the beginning of the Bronze Age. There can be no doubt therefore that the location of axes was connected with woodland clearance in areas peripheral to the main settlement zone. We can further suggest that no clear correlation will occur between topography, soil type and geology and the density and composition of flint scatters. The reason for this was discussed fully in chapter 3 and is linked to the idea of a constantly changing mosaic environment.

Referring back to our earlier analogy with northern France, this model again appears similar. In the Aisne-Marne study area we have already seen how settlement zones were 'fixed' in valley locations. In conjunction with this we may note that 60% of axes dating to the later Neolithic are located on the plateau while arrowheads show a predominance for valley slopes. This is slightly different to the situation which predominated in southern England but is explained by the fact that in northern France at this time, large areas of interfluve remained unexplored (1984,83).

What this general classification suggests therefore, is that we can establish a general model for analysing the spatial variation of artefact density. The full implications of this approach are linked to aspects of ecological patterning in the environment as a whole with settlement location as a function of the broad variability which exists between structured and unstructured microenvironments.

5.5 General aspects of location and distribution

5.5.1 Hunter-gatherers

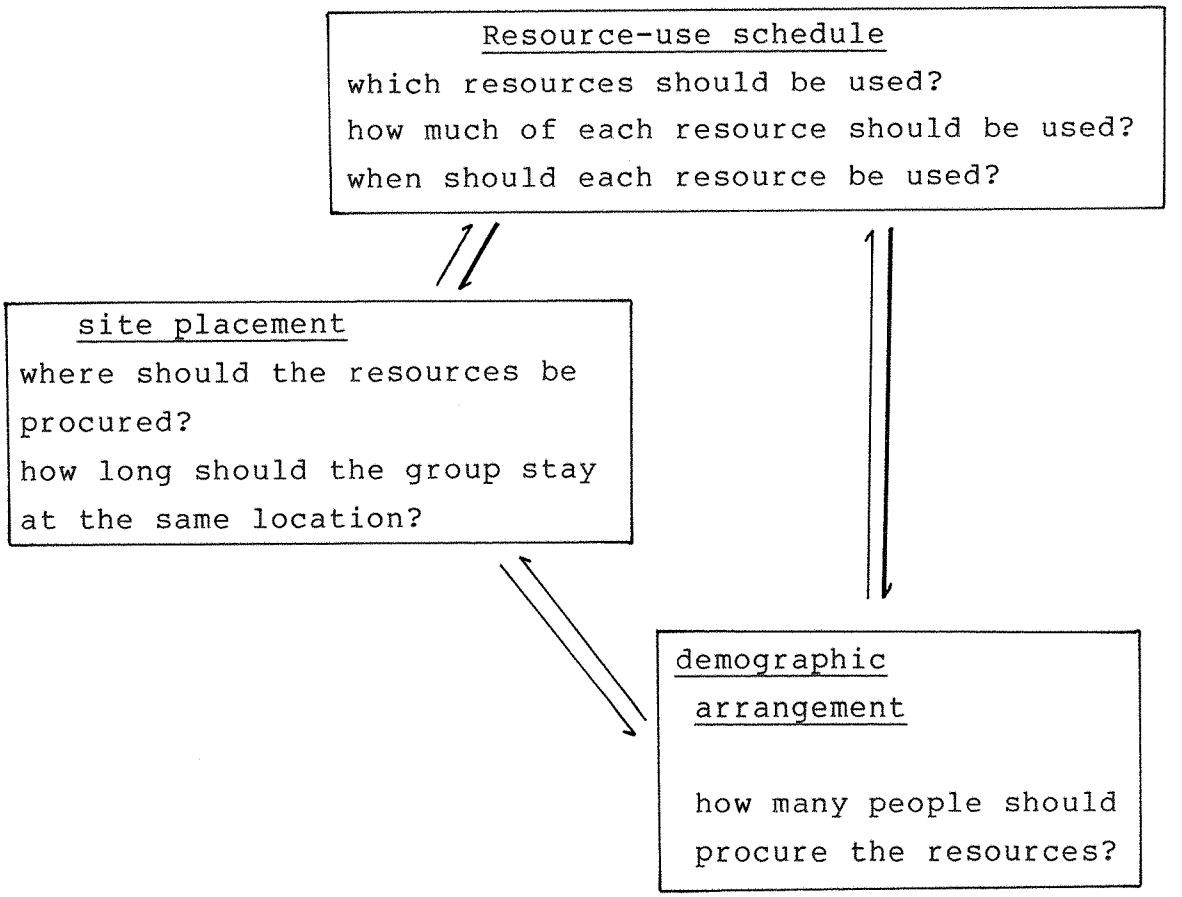
A number of generalisations can be made regarding the location of hunter-gatherer settlements and which may be tested by means of a regional surface collection strategy:

1. Groups in environments which exhibit distinct resource clusters or patches, will tend to aggregate in those areas. Where those patches appear in river valleys, settlement locations will take on a linear arrangement concentrating on those points most central to the widest variety of patch-types.

2. Groups in fine-grained environments will probably tend towards the generalised use of available patch-types, whereas coarse-grained habitats will be more conducive to specialised patch-use (Winterhalder 1981).

3. Groups may tend to optimise their use of available resources by alternating between dispersal and aggregation. Dispersal may be in response to stress during seasons of minimal productivity, or to exploit more scattered resources in other parts of the environment during a season of maximum productivity. Whichever the case, this distinction may be seen clearly between adjacent coarse-and fine-grained environments.

To support these more general points of hunter-gatherer behaviour, two specific models of settlement location may be described. The first is a predictive model devised by Jochim (1976) to investigate hunter-gatherer-fisher economies from a series of ethnographic generalisations. His concern was with the various decision-making processes involved in producing a suitable strategy. Subsistence and settlement are regarded as a single system which maintains three sub-systems:



The former is based on resource availability and is considered to 'precede and condition the site placements and demographic arrangements of a hunter-gatherer group' (1976,12). The model is tested on a group of hunter-fisher-trappers in northern Ontario and the predicted resource-use-schedule compared well with the actual pattern of utilisation.

A second model devised in recent years concerns the distinction between what Binford (1980) describes as collectors and foragers, the former being 'logistically organised' such as the Nunamiut, contrasting with groups such as the !Kung who produce a very different archaeological signature. Foragers tend to pursue a series of seasonal residential moves between resource patches, such as standing water sources. They do not store food like collectors but gather food on a daily basis, 'encountering' resources and returning to the residential base each afternoon. The extent of this mobility varies enormously

between groups; among the Punan for example, for whom 45 moves a year is typical with a mean distance of 4.2 miles between sites, occupation areas would be ephemeral and low archaeological visibility would be expected.

Critical resources such as water are vital components of this particular system and Taylor (1964) has defined as 'tethered nomadism' this tendency towards reuse in particular types of location, seeming to tie down the extent of the settlement system both in time and space. Two types of discard location may be expected within this system: one is the residential base which is the hub of subsistence activities and where most processing and maintenance tasks are performed. The second type of occurrence is defined by Binford as the location, a place where extractive tasks are carried out. These generally produce low quantities of waste but assemblages which are often highly characteristic of a specific type of activity, for example quarrying. These will not tend towards specific patches but will display a more general distribution. Lithic extraction sites on the other hand will occur in areas where quality flint is naturally outcropping, such as dry valleys or valley gravels while another type of location may be the hunting/monitoring stand, similar perhaps to that defined by Binford (1978). Locations such as this would probably be expected to appear in prominent locations and would again be characterised by a highly specialised assemblage.

In contrast to the encounter strategy practised by foragers, collectors 'map on' to resources through residential moves and group-size adjustment. They are characterised by food storage and logistically organised food procurement policies. These are groups not searching for whatever they may find, but seeking to procure specific resources in specific locations. This produces at least three additional types of site to those identified above: The field camp, the station and the cache. While field

camps may be produced by foragers (above), stations and caches will not, as both are highly specialised and involve the prior planning of particular procurement strategies.

It is important to establish that foragers and collectors are not two clearly defined and distinct groups but in fact represent a continuum from what Binford suggests is 'simple to complex'. It is however a particularly useful distinction in the context of this thesis as it concerns two very distinct types of archaeological signature. As Binford states, 'we can expect greater ranges of intersite variability as a function of increases in the logistical components of the subsistence-settlement system' (1980,14).

Which of these signatures might we expect to see in the two study areas outlined in chapter 2? Binford makes the point that a foraging mode of production may be ideal under certain conditions but not in all cases. While fully nomadic strategies characterise 75% of hunter-gatherer cases in an equatorial environment, the number may be substantially reduced in warm, temperate settings (around 10%) but increases once more in Arctic environments (42%). We can therefore suggest that fully or semi-sedentary groups are more likely to appear in temperate environments such as the areas with which this thesis is concerned.

In a regional survey therefore we may expect to find a system, possibly analogous to the 'tethered nomadism' defined by Taylor (1964), concentrating on particular resource patches and visible in the form of residential bases, locations and field camps. The latter two may be difficult to distinguish through surface collection while stations and caches may well be invisible.

5.5.2 Farmers

A detailed list of spatial determinants for agricultural settlement has been compiled by Butzer (1982,143) and this,

with some modification provides an ideal basis for our investigation. As a first point, topography, soil and the natural vegetation are important considerations. The former in effect defines which areas of land are suitable for cultivation or pasture, whether they exhibit smooth surfaces, gentle gradients, water supply, favourable aspect or the risk of flooding. In the early Neolithic of central Europe, the dry uplands were used for grazing sheep and goat and the damp lowlands for cattle. Perhaps a similar dichotomy may be suggested here?

The second point concerns what Butzer defines as the soil matrix (1982,245), a factor which is closely linked to both topography and geology. Again it serves to define those areas most suited to grazing or arable. Damp, heavy lowland soils may be too difficult to work with a particular type of technology or may be prone to waterlogging or flooding. Upland soils, especially those on chalk downland tend to be lighter but may be too thin for high yields or perhaps subject to drought or erosion.

As Sielmann (1972) and others have suggested, early Neolithic farming in central Europe was concentrated on well-drained loess soils, between 96% and 100% occurring in moist basins. Fertile soils do require careful management and either a pattern of shifting cultivation or permanent settlement with a fallow system would appear the most suitable response. Land could be farmed for periods of between 10 and 15 years, possibly longer, with the cycle being repeated around the same locations. In some areas of central Europe where such an adaptation has occurred -for example in the loess belt along medium-sized streams (Starling 1985) -there appears a continuous scatter of settlement debris for several hundred metres and with discrete clusters representing the location of habitation sites. On the north European Plain no such clusters occur, but rather a uniform dispersal across the landscape. As Bogucki (1987,5) suggests, with site contents and density

often identical, the impression is one of spatial and temporal continuity. Is this the distinction we are also seeing in southern England with 'cyclical behaviour' represented at sites such as Haldon and Downton (above)? This would certainly produce dense occupation patches displaying broad similarities in assemblage composition set against a low density background scatter. If this were the case we should expect to see these distinct clusters of activity appearing in broadly similar locations.

A third variable is defined as the biotic matrix and refers to the nature and content of the vegetation map prior to clearance. These patches will of course define potential food sources as well as timber, fuel and the location, distribution and density of birds and wild animals. Clearly the distribution of resources in space is a critical factor for site location and would play a major role in determining the pattern of settlement within a region. The symmetrical arrangement of hexagons such as is presented in Central Place Theory will be distorted beyond recognition by the arrangement of valleys and upland areas into a linear arrangement. The relevance of this to our understanding of the settlement system will be discussed below.

The important point to make therefore is that, in Britain at least, few distinctions can be made between understanding the signatures left on the landscape by foragers and farmers. Both appear to have occupied similar micro-regions, apparently on a small scale and both generated vast quantities of lithic debitage. The situation on the Continent is less clear, with low frequency of lithics on LBK sites, a particular problem. For the British Isles it may therefore be suggested that the same spatial models are equally valid in each case; only recently has any attempt been made to integrate them into the general frame of prehistory (Bogucki 1987, Schofield 1987).

5.6 Understanding the Pattern

The suggestion is therefore that by ceasing to look for 'sites' and concentrating more on general patterns of discard and accumulation, a picture will begin to emerge which provides an indication of land-use intensity and settlement strategies both in time and space. All too often in the past Mesolithic archaeology has been kept distinct from Neolithic/Bronze Age archaeology with the former subjected to intensive settlement-based research projects in an ecological frame, and the latter characterised by monument-based research in a social or political frame. If we studied both in the same way, patterns of land-use continuity or discontinuity would be far more likely to emerge. This can only be achieved through controlled, problem-orientated surface collection.

Our chief concern however should be with what our patterns represent. Clearly if we are to avoid getting involved in a 'site-hunt' and making the very assumptions of chronological association which I have attempted to reject, we must concentrate entirely on patterns which are dominant and repetitive. It is perfectly acceptable to draw distribution maps of leaf-shaped arrowheads or axes; the problem arises when we attempt to define each findspot as a Neolithic 'site'.

5.7 Summary

Patterns of variation may therefore be expected to appear at three analytical levels, spatial, technological and chronological. In terms of spatial and technological variation a number of points can be made based on the premise that the quality, quantity and locale of raw material sources is the main factor which determines the technology in any given context and in this light a number of predictions can be made:

1. Artefact size will decrease with distance from raw material. A distinct fall-off at about 5km may be identifiable in some cases reflecting the limit of the home range. In addition flake size will decrease with distance from raw material; this may be reflected in either the length or breadth measurements or in the range of flake sizes recovered; because flake size has decreased the range will become increasingly standardised. The extent to which cortical flakes are retouched may also increase with distance from raw material.

2. The density of lithic materials will decrease along a continuum from the home-range outwards. Where this is clearly discernible an overall continuity in land-use strategies may be suggested.

3. The home-range and area adjacent to it will exhibit relatively high frequencies of retouched material and certain tool types, for example scrapers suggesting a concentration on maintenance activity. This point is illustrated by the analysis of tool to waste ratios and the variability of proportions between industries. For example that those sites with a high proportion of tools in the assemblage (ie over 4-5%) may represent home-range areas is supported by excavated assemblages from Hurst Fen, Broome Heath, Fengate, Orsett and Eaton Heath (Wainwright 1972,66). Those with a low proportion of tools (ie less than 2%) are suggested to represent industrial or 'core-preparation' areas (James 1977,217). Examples of these may include The Trundle, Bury Hill, Durrington Walls and Knap Hill, all of which lie adjacent to raw material source areas. It may further be suggested that areas of raw material outcrop, for example chalk or river gravels, will tend to display a high proportion of primary flakes and cores, and that these 'industrial' areas should lie in close proximity to the home-range.

4. The extra-home-range will be characterised by an

overall low-density scatter, much lower than the home-range but exhibiting higher proportions of specific artefact types, for example the arrowhead. Green has observed that the distribution of flint arrowheads tends to cluster in particularly high concentrations in areas around the Brecklands, the Yorkshire Wolds and North Cotswold (1980) and goes on to suggest that these areas represent denser population areas than occur elsewhere. I suggest it is far more likely that they indicate areas away from settlement, possibly 'communal hunting grounds' and that the overall picture suggests not a continuous occupation but the continued exploitation of a fine-grained environment.

As well as these technological/spatial patterns, trends which are broadly chronological may also be expected to emerge. These are not based, as is generally the case, on the location of Mesolithic or Neolithic 'sites' or on some artefactual association, but rather on a combination of two factors:

1. the presence/absence of blades and/or a distinctive artefact type,

2. the nature and extent of the proposed home-range.

Chapter 6.

The middle Avon valley survey

> The river here,
> That like a serpent through the grassy mead,
> Winds on, now hidden, now glittering, now in sight,
> Nor fraught with merchant wealth nor famed in song.
> (Southey on 'The River Avon' 1797).

> 'This is a beautiful stretch of the river. There are woods on both sides; the valley has narrowed somewhat, but this serves all the better to let the two sides show themselves off, one against the other...I am inclined to think the watermeadows hereabouts are the best in the valley, which is saying a great deal'. (Walls on the river Avon, near Fordingbridge 1929).

The main emphasis in this chapter will be on the results of an intensive surface collection programme carried out in the middle Avon valley, west Hampshire. The idea will be to explore the concept of the settlement 'system' and attempt to define zones of coarse- and fine-grained adaptation in terms of the model outlined in the previous chapter. The interpretation of results will be divided into two sections, looking first at the results in terms of the home-range model described in chapter 5. In a second section the results will be considered in terms of a more traditional chronological interpretation. The value of each will be compared in a final section.

6.1 The Data

The data base comprises 9220 pieces of worked flint from a total of 72 fields. The aim was to analyse the flint in such a way that the results may prove useful in the context

of the off-site framework described in chapter 5, and in the context of inter-regional comparisons. The following variables were regarded as crucial to this analysis:

a. size of artefact.

b. type (function) of artefact.

c. presence/absence of retouch, ie where an artefact has been modified to perform a function.

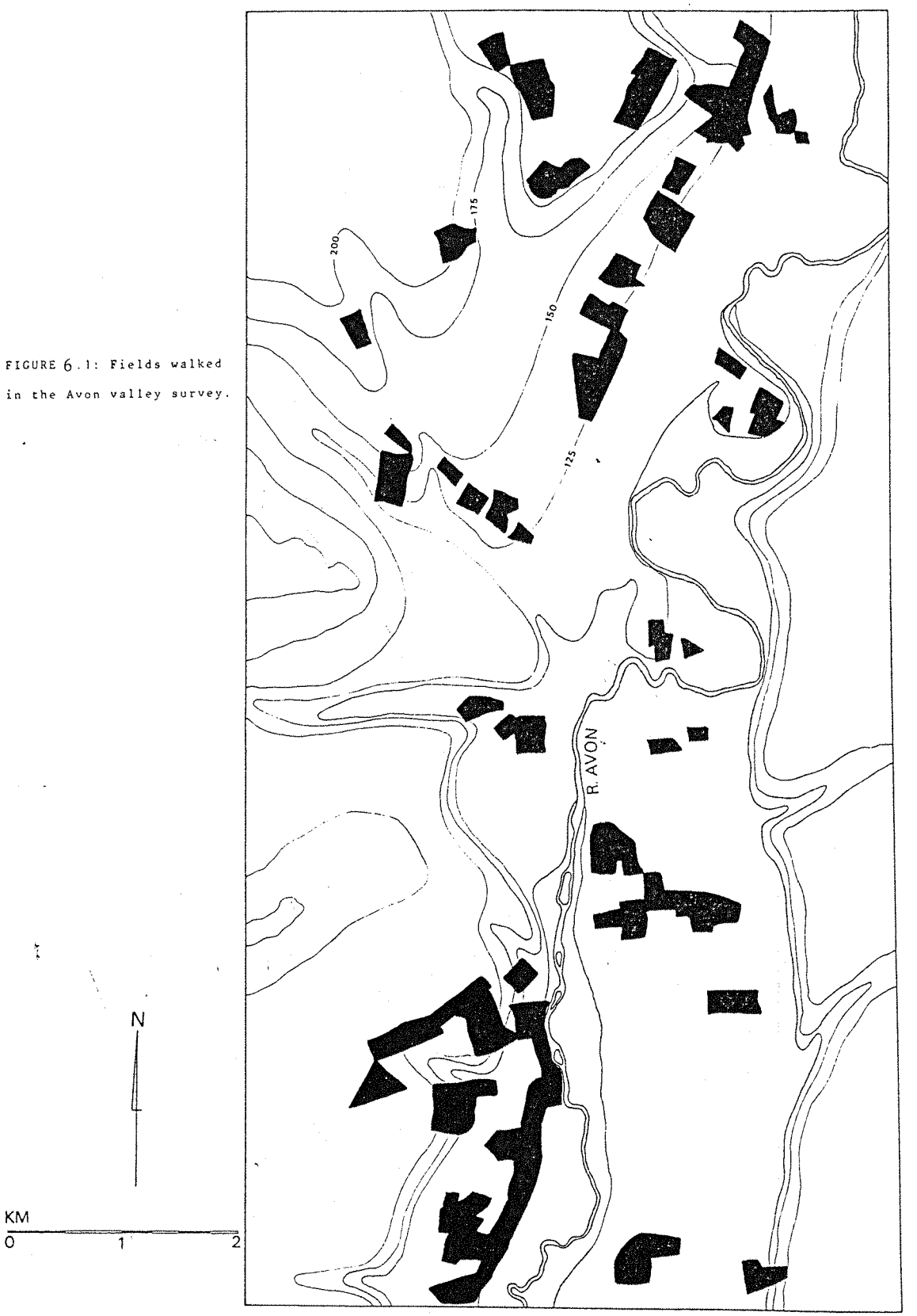
d. which stage of the core reduction sequence it represents.

From this it should be possible to determine the set of relationships which would allow regional interpretation to take place. It was also decided to record the colour and type of flint and the nature of the cortex in order that sources of raw material may later be drawn into the home-range model. Data for this chapter was analysed by means of analysis of variance, regression and chi-square tests, as well as making use of descriptive statistics such as mean and standard deviation. All the figures and scatterplots relating to these analyses are presented at the end of the chapter.

6.2 The study area

The study area represents the middle reaches of a river valley which runs from the monument-rich area of southern Wiltshire in the north, through Salisbury to Christchurch in the south (Figure 6.1). It maintains a number of distinct ecological zones, the clearest of which being the distinction between the chalklands in the north-west and the sands and gravels which cover the remainder of the region. This distinction is maintained both in the nature and distribution of land productivity but also in terms of topography, climate and soils. These factors may now be

FIGURE 6.1: Fields walked in the Avon valley survey.



considered.

6.2.1 Topography

The chalk which encircles the Hampshire basin forms a broad belt of upland country, anticlinal in structure and separating it from the London tertiary basin to the north. It varies considerably in elevation with an average height of no more than 70m. The chalkland in the survey area itself is upper chalk which, through its purity and high permeability is most resistant to denudation.

Contrasts in topography are marked with the upper chalk plateau broken and intersected by tributary streams running from WNW to ENE into the river Avon. The valley floor is characterised by a consistently wide belt of valley gravels and alluvium. River terraces to the south of Fordingbridge comprise largely plateau gravels while to the north, a clear break can be seen between gravels and upper chalk.

The geomorphology of the tertiary deposits, which make up 80% of the study area, occupy a major asymmetrical downfold in the chalk. There is little in the way of striking geomorphological features or distinct topographical contrast. Over most of the area the surface is dissected by gentle, shallow-sided valleys with smoothly rounded interfluves and hills rarely exceeding 60m in height.

An interesting contrast also appears to exist between the east and west facing terraces. The west facing terrace for example, bordering onto the sands of the New Forest is characterised by a particularly steep and well-defined scarp slope, affording commanding views south along the valley. To the west on the other hand, terraces are less clearly defined and are in the form of gentle, almost unbroken slopes leading up to the higher ground. This distinction would have had a major influence on the location of activity with access to lighter soils and a

wider expanse of alluvium appearing on the west side of the river.

There is also a contrast between north and the south with the portion of river valley north of Fordingbridge maintaining more distinct points of variation than the more 'monotonous' landscape to the south. Again this greater variability exhibited by the physical landscape may well have served to distinguish a more productive niche/habitat within the region as a whole.

6.2.2 Climate

The microclimate would also have varied between zones with aspect, temperature and rainfall patterns all important locational factors throughout the postglacial period. Aspect produces both variations in sunlight and wind strength, both of which are important considerations in the siting of settlements and arable fields. South-facing slopes will usually be preferred for crop growth while more sheltered habitats such as north-east facing slopes may offer greater protection from prevailing winds. Temperature will again be higher in areas which are sheltered while south-facing slopes will ensure the greatest possible extension of the growing season. On the most exposed areas of chalkland, conditions will be less favourable and far more extreme with higher levels of rainfall and much higher wind speeds (Figures 6.2 and 6.3).

6.2.3 Soils

The distinction can be made between those soils which occur on the upper chalk in the NW of the survey area and those which cover the extent of tertiary deposits (Figure 6.4). By a combination of factors, soil on the chalk downland may be thin in comparison to that in lowland contexts. The amount of mineral material released by dissolution is usually low and hence the depth of residues will be small.

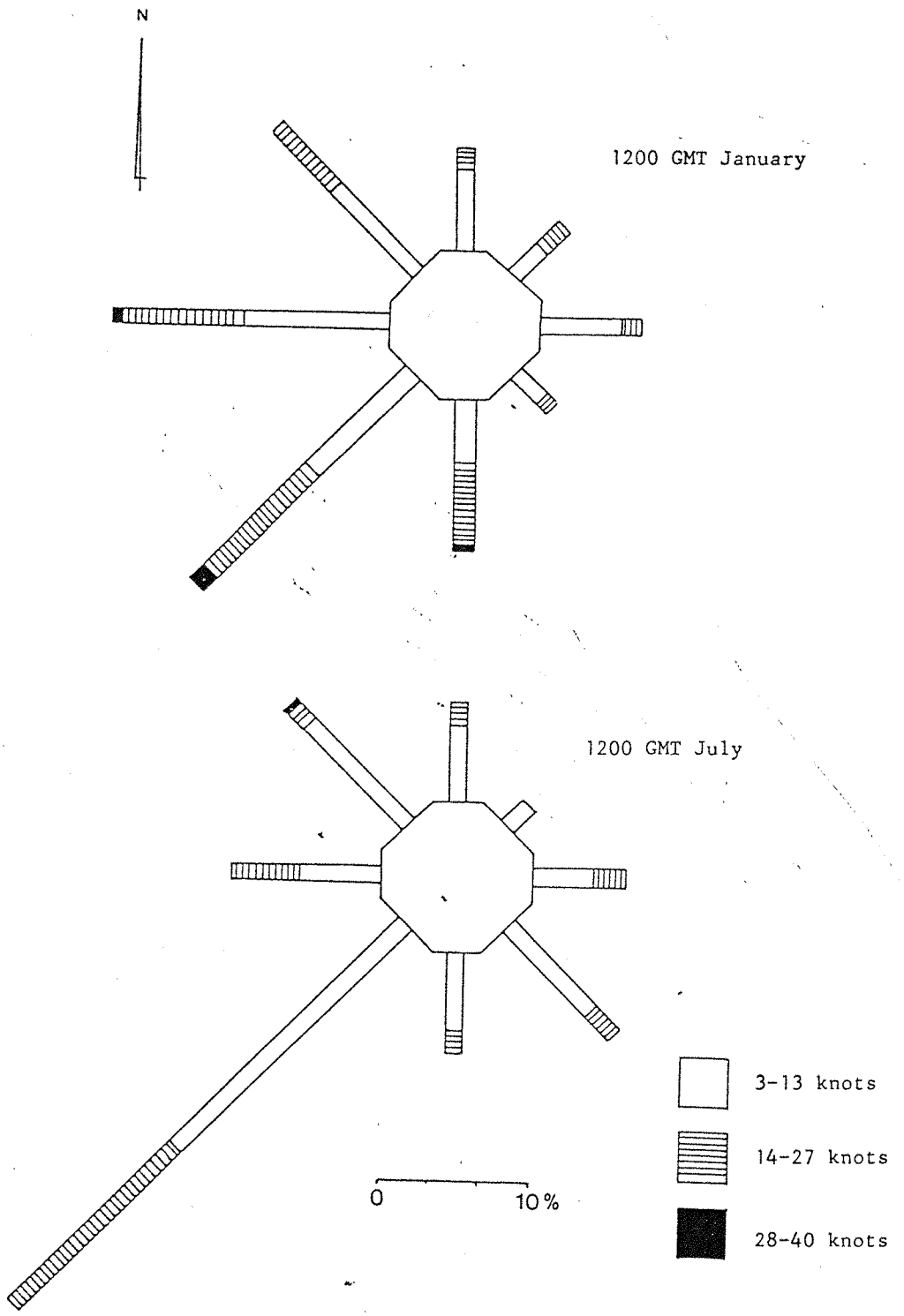


Figure 6.2: Windspeed and direction for southern England. Based on results from the metereological office.

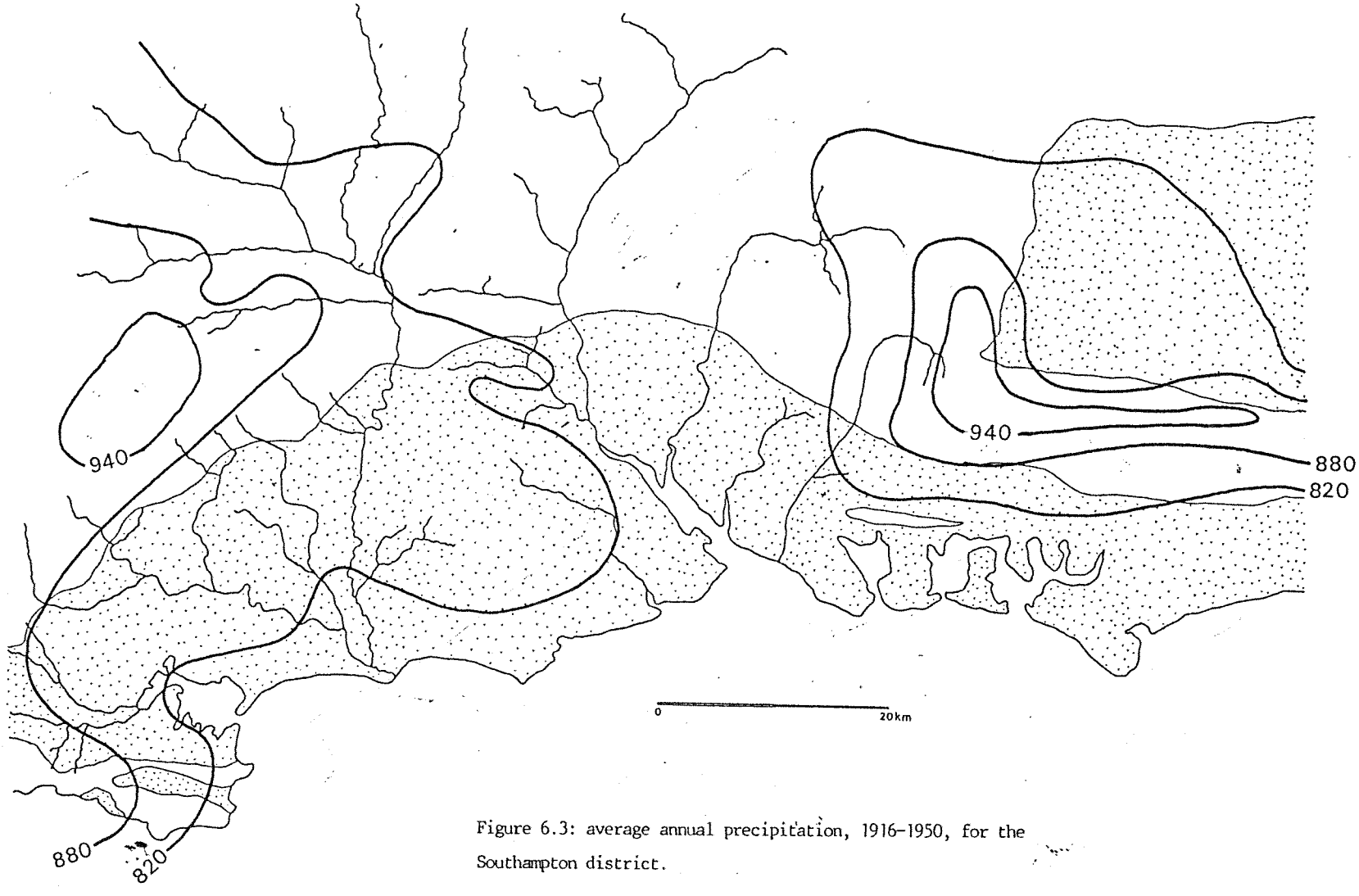


Figure 6.3: average annual precipitation, 1916-1950, for the Southampton district.

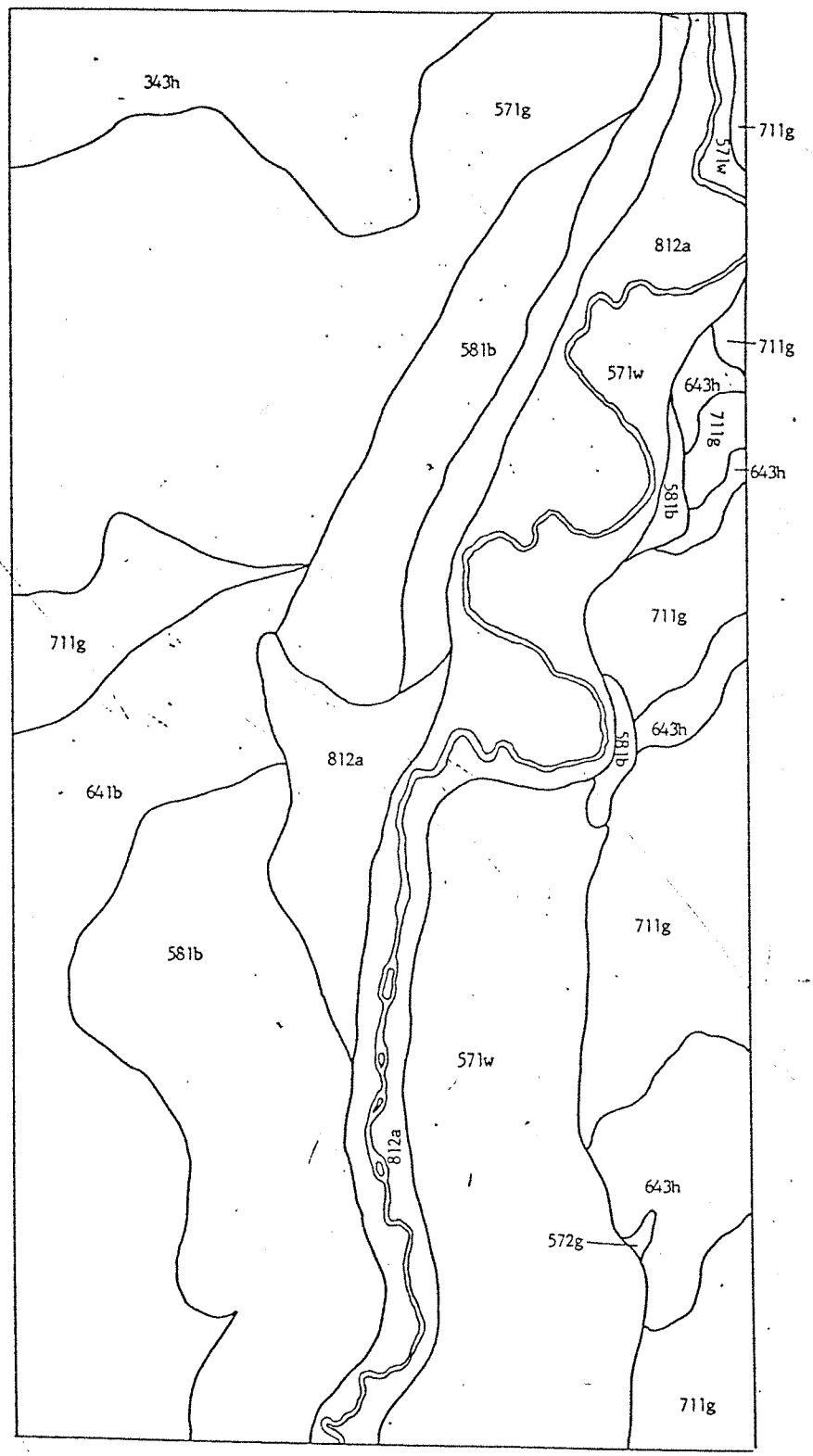


Figure 6.4: Soil map for the Avon valley survey area.

Loss from the surface by hillwash, creep or deflation is likely to be at least as rapid as gain in depth caused by soil formation, while the 'soil loss' will be converted to soil gain in adjacent lowland districts.

Despite a degree of lithological uniformity displayed by the chalk, weathering and erosion have acted to produce a variable and complex soil map. Distinctions are clearly apparent between soils that were permeable and well structured, those that dried rapidly in the spring and hence could be cultivated for much of the year, and those that remained sticky and may cause problems of compaction, especially on steeper convex slopes.

The lowland zone would have maintained an equally complex and variable soil map. On the gravels around Breamore for example, the predominant soil type is of the Hucklesbrook association; based on a geology of river terrace drift, the soil characteristics are a well-drained coarse loam with some sandy soils and some similar permeable soils affected by groundwater. On the chalk to the NW, shallow, well-drained calcareous soils are the norm. Although these distinctions appear fairly distinct and undoubtedly influence the productivity of specific habitats, the soil map would have been different in the period under investigation. Loess for example appears in valley profiles across southern England and may have been the predominant soil type either on the heathlands or on areas of clay-with-flint.

While the nature of soil distributions is therefore a useful measure of intra-regional variability, we should be careful not to lay too much emphasis on the content of the various zones.

6.2.4 The collection strategy

Fields were walked as and when they became available (see

Chapter 2); no deliberate sampling strategy was pursued and the result was a coverage totalling 7% of the survey area over eight seasons. For reasons described in Chapter 2, flint from the first two years work was excluded from the analysis; it was considered that to minimise bias factors, only results achieved by experienced fieldwalkers should be included.

The total number of fields walked can be divided according to their ecological situation. Table 6.1 shows the relationship between fields walked and drift geology. 48 fields lie on the expanse of river gravels which flank the river Avon from north to south. Other geological zones are less well represented although - with the exception of the alluvium - the proportions are fairly evenly distributed: Plateau gravels account for 6 of the fields, Bagshot sands 4, upper chalk 6 and Reading beds 7.

In Table 6.2, the proportion of fields is shown in relation to soil type. Four categories are well represented and in even proportions: 571g, 571w, 581b and 812a all accounting for between 14 and 23 of the fields walked. 571j and 841b each represent only one field.

Height OD or topography is shown in Table 6.3 and shows a predominance of units below 40m OD. 29 of the fields are at a height of less than 31m, all of which are situated on the river gravels, mainly to the west of the river. Fields between 41 and 70m are less numerous and correspond with the distribution of tertiary sands and gravels. The 4 fields which lie above 70m OD are all situated on upper chalk with commanding views south along the river valley.

Similar proportions are apparent in Table 6.4 with 22 of the fields located within 400m of the main river valley. With distance away from the valley, the proportion of fields decreases with only 4 occurring at a distance of more than 2km. The bias here therefore, as with topography

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Geology																
River gravels n=48	21.3	13.7	18.8	8.2	12.8	6.2	25.0	7.8	4.2	3.1	8.3	4.4	2.5	2.4	1.6	1.7
Plateau gravels n=6	19.1	7.0	21.9	11.3	19.8	15.1	22.7	6.4	3.0	2.0	9.3	2.5	6.3	5.4	0.8	1.0
Reading beds n=7	16.1	9.1	22.5	5.8	14.4	4.4	27.1	14.0	5.9	3.3	9.0	5.4	2.1	2.3	1.4	2.0
Bagshot sands n=4	22.8	7.1	25.4	11.1	14.0	2.2	23.1	6.3	4.5	3.5	8.3	3.1	4.4	4.4	1.8	1.6
upper chalk n=6	19.3	8.6	25.8	11.2	16.8	9.8	30.7	12.3	3.8	3.2	9.0	3.8	6.1	4.5	0.0	0.0
alluvium n=1	44.5	-	11.2	-	10.8	-	7.2	-	6.7	-	10.1	-	2.2	-	3.4	-

Note: sd = standard deviation
n = number of cases

Table 6.1 Assemblage composition per field for the various geological zones

		Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Soil type																	
571g	n=14	17.7	9.6	24.5	8.3	15.8	7.2	29.8	12.8	4.9	3.3	9.2	4.0	3.7	4.0	1.5	2.3
571w	n=18	21.3	11.8	16.9	7.7	11.7	5.5	25.4	6.6	4.7	3.6	8.2	5.3	2.2	2.7	1.3	1.6
581b	n=15	18.2	10.1	22.0	10.0	16.3	10.6	25.2	8.2	2.5	2.0	8.8	3.4	4.5	4.7	1.1	1.4
812a	n=23	22.5	14.3	20.4	9.1	12.7	6.8	23.2	7.5	4.5	2.9	8.6	3.6	2.9	2.0	1.7	1.5
571j	n=1	17.3	-	33.1	-	15.8	-	38.6	-	5.0	-	6.6	-	4.1	-	0.0	-
841b	n=1	39.1	-	21.9	-	19.1	-	18.5	-	4.8	-	9.1	-	4.3	-	0.6	-

Note: sd = standard deviation
n = number of cases

Table 6.2 Assemblage composition per field for the various soil types.

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Topography																
<30m OD n=29	22.8	14.6	19.0	9.9	12.2	6.3	24.7	8.1	4.5	2.9	8.7	4.8	2.9	2.5	1.6	1.6
31-40m OD n=17	20.6	10.2	18.6	5.0	14.4	6.0	22.7	5.0	3.7	3.5	7.2	3.4	2.1	1.6	1.7	1.4
41-50m OD n=10	16.1	11.3	24.5	9.3	12.4	5.8	32.6	13.4	4.5	3.3	10.3	3.5	3.8	4.0	1.0	2.0
51-60m OD n=9	19.8	8.2	22.9	8.9	18.1	12.2	23.1	5.8	4.2	2.9	8.9	3.0	4.3	5.3	1.7	2.0
61-70m OD n=3	21.7	9.3	21.0	11.4	20.1	8.7	27.6	13.4	2.6	1.7	10.5	4.4	3.8	2.0	0.0	0.0
>70m OD n=4	11.9	5.5	24.3	9.8	11.7	8.8	27.6	6.0	5.0	3.5	6.1	4.4	5.4	5.5	0.4	0.6

Note: sd = standard deviation
n = number of cases

Table 6.3 Assemblage composition per field for the various topographic divisions

Distance from river	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
<400m n=22	24.4	14.8	17.9	9.2	12.1	4.6	21.5	6.2	4.8	3.0	7.6	4.0	2.6	1.9	2.0	1.3
401-800m n=19	21.6	13.1	20.3	7.4	14.5	7.7	26.0	7.5	3.9	3.4	9.8	4.5	2.9	2.8	1.4	1.6
801-1200m n=12	18.9	7.4	23.0	11.1	12.6	5.2	23.7	6.0	3.6	2.5	7.7	3.3	4.5	5.1	1.0	1.5
1201-1600m n=9	15.1	8.1	17.5	6.3	14.0	7.9	29.1	10.0	2.5	2.2	9.2	4.1	1.8	1.9	0.9	2.1
1601-2000m n=6	17.0	8.4	24.5	4.5	22.4	13.4	28.2	15.0	5.7	3.7	10.6	4.2	3.1	2.8	1.7	2.0
>2000m n=4	13.8	7.8	29.7	10.1	10.3	7.4	36.6	6.4	6.5	1.8	5.5	3.8	6.8	5.3	0.0	0.0

Note: sd = standard deviation
n = number of cases

Table 6.4 Assemblage composition per field in relation to distance from the river Avon.

and geology clearly favours the river valley and the associations which appear within it. This offers a distinct contrast with the second survey area, to be described in chapter 7 in which all the fields are divided between upper and lower chalk. The expanse of gravels which appears in the Avon valley does not appear in the Meon.

6.2.5 The results of test-pitting

In February 1984, three 2x2m trenches were excavated by R.W.Smith within a field previously grid walked and on the western perimeter of the valley floodplain (grid reference SU 160183). They were situated at 5m intervals running against the contour from east to west across the field. The results provide an indication both of the quantity of material within and beneath the ploughsoil and the extent of colluviation which may have accumulated since the prehistoric period.

The three trenches were located in adjacent grid squares, each measuring 5x10m and which had provided contrasting sets of results. Square 5Ei produced 2 flakes and contained trench 1; trench 2 was situated between 5Ei and 6Ei which produced no worked flint, while trench 3 was entirely within 6Ei. The next grid square along produced four flint artefacts. The three test pits are shown in plan and section in Figure 6.5. The results are as follows:

		pottery	flakes	cores	other
Trench 1	surface	4	2	0	0
	Layer 1	24	5	0	1
Trench 2	surface	0	2	0	0
	Layer 1	5	2	1	3
	layer 2	46	11	0	1
Trench 3	surface	0	0	0	0
	Layer 1	6	5	1	0
	Layer 2	24	7	0	0
	Layer 3	10	0	0	0
% on surface		3.4	6.5	0	0

In each case therefore, a similar pattern is apparent with flint tending to concentrate both within the ploughsoil and in the underlying gravel pan. Pottery on the other hand, much of which is Romano-British, tends not to survive within the ploughsoil but instead appears to concentrate in layers 2 and 3, the gravel pan and the gravelly brown earth. The observation regarding core distribution made in chapter 4 could not be substantiated as the sample was too small to be significant.

Regarding colluviation, it is significant that Romano-British pottery appears consistently in a layer 25cm beneath the surface in trench 1 and 30cm down in trench 2, in both cases beneath the plough level. This suggests at least some accumulation even on the gentlest slopes over the last 2000 years. Smith (pers.comm.) has also made the observation that in some cases within the valley, Victorian pottery is buried beneath colluvium on slopes of $<2^{o}$. Colluvium, therefore, could be a problem if it is differentially distributed. That worked flint is occurring in all parts of the valley and across the valley profile,

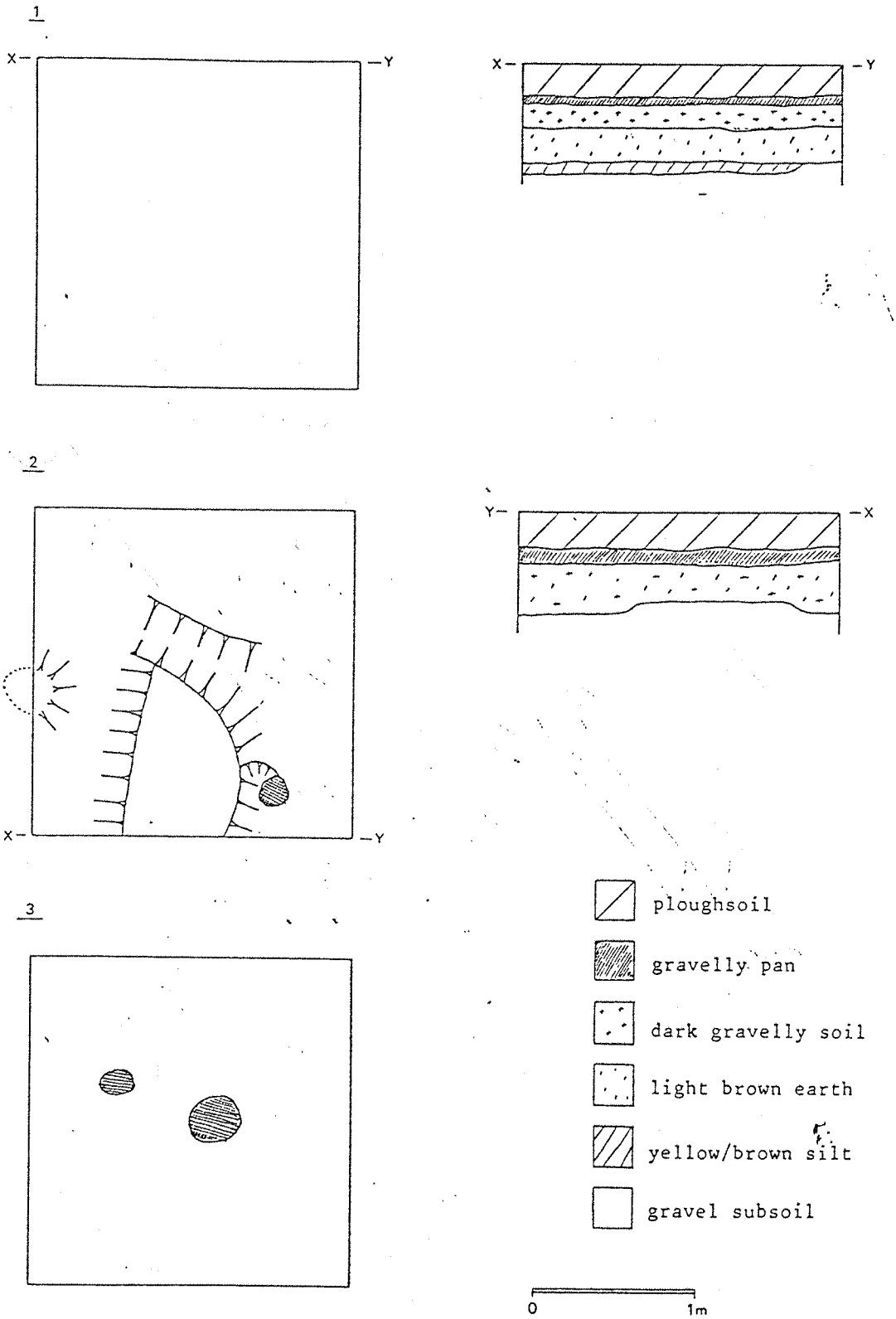


Figure 6.5 Results of test-pitting in the Avon valley, (taken from field notes drawn up by R.W.Smith).

however, suggests that the distribution may be broadly representative.

The results achieved by the Avon valley survey may now be described. The chapter is divided into four main sections. The first deals with aspects of location and distribution, looking at artefact distribution in relation to topography, soil type, geology and the availability of fresh water. The second section concerns the distribution of technological traits across the survey area, attempting to identify areas where resource stress - as defined in Chapter 4 - is either present or absent. In a third section, the home-range model will be presented, integrating results from the previous two sections into a general model of land-use and variable exploitation. This is based upon the distribution of behavioural domains or activity areas as represented by the distribution of specific artefact types and general aspects of assemblage composition. The final section is really intended for comparison with the previous three. The aim here will be to identify any chronological/cultural patterns of behaviour such as may be identified through the distribution of diagnostic artefact types. It is argued that in a case such as this where comparative collections from the region are either absent or limited, more can be said by adopting a home-range type model than on the 'dots-on-maps' approach so often favoured in the past.

6.3 Aspects of location and distribution

6.3.1 Geology

The geology of the region is dominated by the expanse of river gravels which make up 66.7% of the total surface area covered by fieldwalking. It is a factor which appears to have had a profound influence on the location and intensity of specific types of activity, although the results in this section can only be fully understood when considered in the context of other variables described above (Table 6.1). As

far as density is concerned, the Bagshot sands present the highest mean score with a mean of 22.8 per hectare while retouched artefacts are well represented at 25.4%. This combines with a low proportion of primary flakes, suggesting that in situ primary knapping was not a feature of this area. Cores, retouched items and tertiary flakes all appear in high proportion on the localised distribution of Reading Beds, part of which includes an area projected as a 'home-range' described in section 6.6. In terms of variation between groups, most aspects of assemblage composition appear in similar proportions, displaying minimal variation from the mean. According to analysis of variance, scrapers vary significantly between geological outcrops, with high mean values occurring on plateau gravels (6.3%) and upper chalk (6.1%) (Table 6.34). Retouched artefacts show a similar tendency towards the chalk but also towards Bagshot sands at the expense of plateau gravels (Table 6.31).

A further point concerns the degree of variability between artefact frequency on the river and plateau gravels (Tables 6.1, 6.13 and 6.14). The mean percentage for river gravels is 12.8% primary waste, 25.0% tertiary waste, 4.2% cores and 2.5% scrapers. For plateau gravels a very different picture is presented: 19.8% for primary waste, 22.7% for tertiary waste, 3.0% for cores and 6.3% for scrapers. This may imply that some degree of selection in determining which parts of the landscape were used for specific types of activity, was occurring on a local scale in the Avon valley. This was confirmed by means of the t-test. At a confidence level of 0.01, variation in the frequency of primary waste, tertiary waste and scrapers was significant between the two geological zones (the standard error of means used in this and later analyses are presented in Tables 6.13 and 6.14 at the end of the chapter.

The area of upper chalk provides an interesting set of results in terms of the industrial or extractive locations

discussed in chapter 5. Density is lower than that on the Reading Beds and river gravels, while the proportion of retouched material is higher, averaging 25.8% over 6 fields. Primary waste such as we may expect to see in a primary extraction zone is low in comparison to that on plateau gravels, although high in relation to other geological deposits. Tertiary waste on the other hand is higher than elsewhere in the region and significantly higher, at a confidence level of 0.01, than that on the plateau gravels further south. We may suggest therefore in terms of raw material composition within zone 3 (Table 6.6), that more flint was coming in than was going out. 42.1% of the flint artefacts recovered from the upper chalk were derived from the river gravels suggesting that the majority of primary reduction was in fact occurring elsewhere within the region. This is a point which will be discussed below, but we may suggest at this stage that upper chalk does not necessarily mean flint extraction, and high proportions of cores on the Reading Beds and primary waste on the plateau gravels may provide a clue in this direction.

A number of variables were considered further by means of the chi-square test (Table 6.51 and 6.52). In terms of fields containing a density of >15 artefacts per hectare, no statistically significant relationship was apparent with expected values broadly similar to observed values in all cases. For retouched artefacts however the result did prove significant at a 0.05 level of probability. Interestingly, the river gravels saw proportionately fewer retouched items than its expected value while the Reading Beds saw a three-fold increase.

From a technological perspective, despite a high mean value for cores on the Reading Beds, chi-square tests revealed no significant relationship (Table 6.52). In all cases fields containing high proportions of both cores and primary waste produced similar observed values to the expected with

Reading Beds the only exception providing a value slightly above the expected.

In conclusion therefore, analysis of variance, t-test and chi-square analyses all provide indications as to the strength and nature of the relationship between geology and aspects of assemblage composition. Geology certainly had an influence on the location of activities requiring high proportions of retouch, at least on the upper chalk and Bagshot sands, while mean scores indicate a high density on the river gravels and Bagshot sands.

6.3.2 Soil

Four soil types are evenly represented within the survey area. Two soil types - 571j and 841b represented only one survey unit each and were therefore excluded from statistical analyses (Table 6.2).

As a first point, density varies between soil types, the maximum appearing on 571w and 812a, variation between which is significant at a confidence level of 0.01 (Table 6.35). The former is a well-drained coarse loamy and sandy soil mainly over river and plateau terrace drift, while the latter is a shallow calcareous and non-calcareous loamy soil overlying flint gravel. The standard deviation is considerably greater on the former than the latter suggesting a degree of variability in use either in time or space (Table 6.2). Interestingly 581b provides a contrast to the higher density which appears on 571w. The soils are broadly similar and the only variable which may explain this distinction is the tendency of 581b towards slight seasonal waterlogging. Certainly there is very little else to distinguish between them.

Retouch provides a contrasting picture with 571w showing low proportions of retouch and 812a and 581b slightly higher; this proved significant at a 0.01 level of

confidence by means of the t-test (Table 6.35 for Analysis of Variance and 6.15 and 6.16 for statistics relating to t-test). The outstanding case however is 571g on which mean retouch values are 3% higher than on the other soil types. This corresponds with a density lower than the other categories and a high proportion of tertiary waste. What this represents is unclear although it does straddle the interface between river terrace and chalk downland and could be argued from chapter 5 as a possible home-range location.

Variation in the frequency of cores appears to be greatest on the well-drained coarse loam and sands of 571w, with a mean of 4.7 and a standard deviation of 3.6 (Table 6.2). Similar core frequencies appear on 571g (which is a fine stoneless coarse loam which presumably would not provide the flint inclusions necessary for core-reduction) and 812a. On the former, tertiary flakes represent a high percentage of the waste assemblage while primary flakes are also well represented. 812a provides a low proportion of both.

Chi-square tests suggested a statistically significant relationship between fields containing retouch proportions of greater than 25% and soil type, with 571g and 812a producing values greater than the expected at the expense of 571w and 581b (Table 6.53). The result was significant at a probability of .30, not as significant as the relationship between retouch and geology (above).

In conclusion therefore, soils do appear to have influenced the distribution and intensity of specific types of behaviour, although clearly the relationships are not as significant as those apparent between drift geology and assemblage composition. We must consider that the soil map is likely to have changed to a far greater extent than that of the geology and therefore the boundaries and zones which we regard as points of reference may not be as valid as the

geological zones presented in the previous section. The question of loess cover is particularly relevant here, and was discussed briefly in chapter 3.

6.3.3 Topography

The majority of fields within the survey area lie at a height of below 40m OD. All of the six height classes are however well represented with the minimum score being 3 fields for heights of between 61 and 70m OD.

Fields over 70m OD are all situated on the upper chalk to the north-west of the survey area; as was the case for geology, it is here that a lower mean density is displayed along with a low standard deviation and a relatively high proportion of retouch (Table 6.3). Cores are variable within the group while primary flakes display a mean value low in comparison to those on the terraces and valley floor. This is a relationship which proved significant, at least between primary flakes in the 31-40m category and those situated in fields above 70m. The relationship was significant at a confidence level of 0.01 (Tables 6.39 to 6.42 for Analysis of variance and 6.17 and 6.18 for descriptive statistics). Again this information combines with that provided by geology, suggesting a relationship between industrial activity on the chalk and to some extent on the valley gravels, and domestic activity marked by a high mean retouch value on the terraces between 41 and 50m OD. The high proportion of retouch in this case provides an interesting contrast with a particularly low mean density. It was suggested above that these two factors when combined, tend to imply specialist extractive activity such as may be visible through the procurement of resources within the occasional home-range. This point will be discussed further in a later section.

Primary flakes appear in particularly low proportions at heights of below 31m OD and between 41 and 50m OD. Between

51 and 60m OD the mean values are high in conjunction with higher standard deviations. This contrasts with the area of chalkland where lower mean values correspond with relatively high standard deviations. This contrast could well reflect a degree of functional autonomy within the upland zone with greater variation on the terraces indicating an overlap between industrial and domestic domains.

Chi-square tests again produced no statistically significant associations at the .05 level of probability, although with a larger sample of the upland this may not have been the case (Tables 6.54 and 6.55). Cores occur widely in this area despite low proportions of primary flakes while we have already seen that nodules derived from the gravels were probably being removed from the terraces for further reduction. We may suggest therefore that although the distinction between upland and valley is visible in some cases, it is not as clear as the associated distinction between geology in the two areas. It may therefore be true to say that geology was a more important factor than topography in terms of the location and distribution of activity within the study area.

6.3.4 Proximity to river

Proximity to the river Avon not surprisingly provides a similar set of results to those described in the previous section (Table 6.4). Density declines consistently up to a distance of 1600m, although standard deviation shows some variation within this broad zone. If we subdivide the first bar used for the analysis of variance into 100m blocks, the highest density combines with the lowest proportion of retouch between 300 and 500m, roughly the edge of the modern flood limit:

Distance	mean density	mean % retouch	prone to flood
<100	18.4	23.7	yes
101-200	22.0	26.1	yes
201-300	17.7	26.1	yes
301-400	25.2	20.6	no
401-500	24.0	19.2	no
501-600	20.5	16.0	no

The highest proportions of retouch however appear between 1601 and 2400m from the river with both mean and standard deviations showing only limited variation. This appears to correspond with the similarly high scores which appear in height class 4 between 51 and 60m OD and, as already suggested, may reflect the location of specialist activity. Tertiary waste also appears in higher proportions in this zone, not surprising perhaps considering the high correlation between tertiary waste and retouched artefacts (section 6.5). This relationship proved significant through analysis of variance (Tables 6.43 to 6.46).

Broadly speaking, the variations according to distance from the Avon are of little value. Every field included in the analysis is within the valley zone and are all within easy reach of the river. The main distinction appears to concern the foot of the first terrace which maintains a slightly higher density than elsewhere. We may expect a far more significant distinction to appear between say the Avon valley and the neighbouring non-valley context of Cranborne Chase. This will be the subject of a more detailed discussion in chapter 9.

6.3.5 Summary

Various factors can therefore be seen to have influenced

the location and distribution of human behaviour. As all the categories described here tend to be arranged in a linear fashion along the valley axis, it is difficult to establish which, if any were the most important. One indication may lie in the variation in the valley profile between the north and south of the study area. In the north the gravels of the valley floor are sandwiched between two relatively steep slopes, rising up to the chalk in the west and the New Forest plateau in the east. In this area the valley is more of a corridor, adjacent to a wide variety of niche habitats or resource patches. In the south on the other hand, the valley is 'ironed out' into a more monotonous landscape, such as is characteristic of tertiary deposits. In this region flooding would perhaps have had a more substantial influence, and this, combined with the less diverse variety of habitats would have produced a less favourable area for settlement. Activity on the terraces in the north appears at the interface between two ecological zones. It straddles the gravel/chalk divide, covers a variety of soil types and appears to concentrate at a lower point in the valley profile.

6.4 Technological patterning

We have already considered in a previous chapter, two aspects of technological visibility, namely the location of quarry or extraction sites, and the suggestion that those two patterns of procurement may be visible within the study area. We may now attempt to support these ideas through a consideration of two further variables.

1. mean flake size,

2. the range of flake sizes (ie. the difference between minimum and maximum dimensions).

These variables are based on a model which I have previously described as the 'ASDA factor' (Schofield 1986

and chapter 4), and which relates the distribution of human groups within the landscape to the location of raw material source areas. One may anticipate for example that where flint is readily available, there will be no attempt to maintain or preserve those supplies. Knapping will not be governed by technical precision but by a care-free attitude which may well result in an abundance of squat flakes, flakes with hinge fractures and a greater mean flake size. In areas where flint is in short supply we may expect to see signs of 'conscious preservation' in the archaeological record, represented for example by a higher proportion of retouched material, a smaller mean flake size and a lesser range of flake sizes. In other words the problem of distance may be overcome by increasing preparatory input into the core reduction process. This point is most clearly illustrated by those ethnographic cases where a single community treats local and non-local raw materials in two totally different ways. Among the !Kung for example, tools made of locally available raw materials have shorter use-lives, are maintained less frequently for a smaller time investment, and require a smaller time investment overall for procurement and subsequent maintenance than do tools made of non-local materials (Lee 1979). This is a point further illustrated by Munday (1984) and Bamforth (1986) and described in some detail in chapter 4.

The patterns are presented in Table 6.5. Here we can see that both the mean flake size and the range of flake sizes decrease from areas 1 and 2 southwards, with minimum dimensions appearing in areas 5 and 6. This may suggest one of two things: Either it may represent a further aspect of the home-range model with distance from the home-range determining the extent to which tools should be reworked or knapped down in order to replenish their functional value. On the other hand the variation may reflect the type or quality of raw material. Chalk forms a major part of the raw material assemblage in areas 1 and 3 to the north with gravels becoming more important with distance south (Table

	Mean flake size (mm)		range of flake size (mm)	
Area	length	breadth	length	breadth
1	37.78	28.66	53.3	76.5
2	36.36	29.02	62.5	42.8
3	32.43	27.35	51.7	38.3
4	32.08	25.60	50.9	38.1
5	29.14	27.35	35.1	33.3
6	29.85	26.06	25.6	24.1

Table 6.5 Flake size variation within the Avon valley survey area.

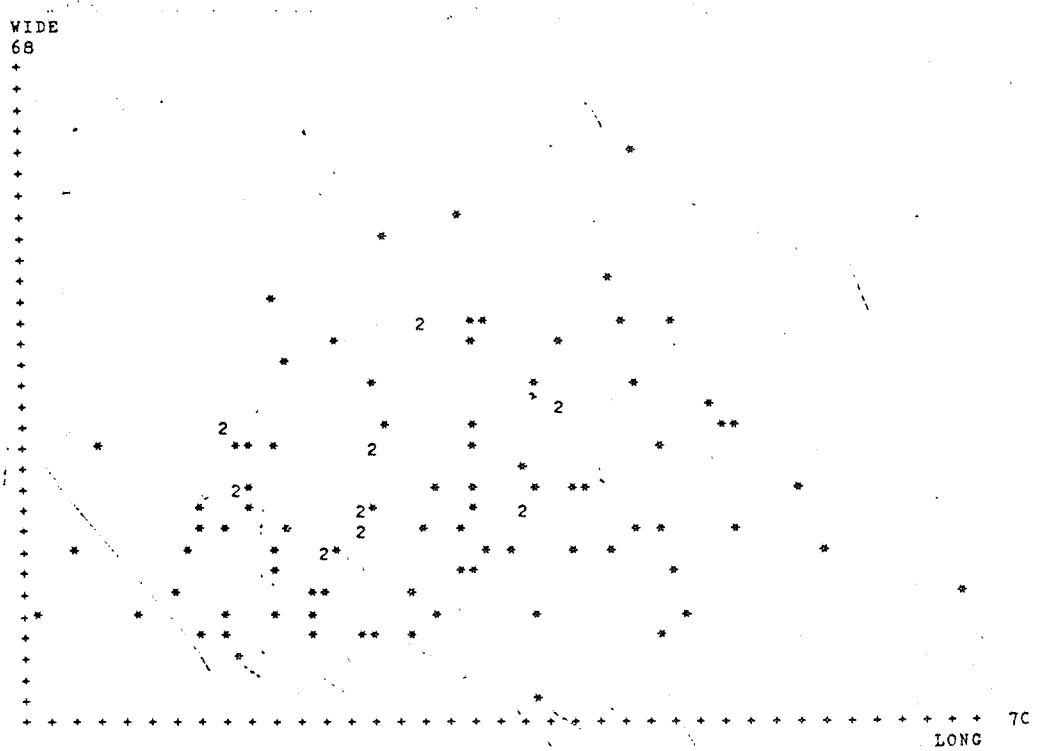
Area	Flint	%blades	mean %sandy cortex (river gravels)	mean %chalk cortex (chalk)
1	554	8.7	50.5	22.5
2	3068	8.4	68.2	5.6
3	744	7.9	42.1	30.1
4	931	9.4	62.2	4.7
5	2575	7.3	68.8	7.1
6	1276	9.1	67.4	5.7

Table 6.6 Variable quantities of gravel- and chalk-derived flint and blade frequencies from the Avon valley.

6.6). Gravels are more likely to yield smaller pebbles with the result that smaller flakes may predominate. This is also clearly apparent in the flake size diagrams from two separate fields - one from area 2 and the other from area 4. Mean flake length in the field from area 2 was 32.6mm and the standard deviation 10.4mm, mean breadth was 25.8mm and standard deviation 9.00mm (Figure 6.6). The field from area 4 however produced very different figures suggesting a flake size greater than that from area 2, despite being of apparently earlier date and yielding a higher blade frequency. In this case mean flake length was 35.2mm and the standard deviation 10.7mm, mean breadth was 27.7mm and the standard deviation 9.3mm (Figure 6.7). In other words in the case where flint was being knapped 'on-site' from local sources (Mode 1 production, after Schick 1986)), flake size was greater than if it were coming from outside (Mode 3 production). This conforms to the conclusions reached by Schick regarding the expected nature of the flake size curve (1986,114).

The tendency for the range of flake sizes to decrease with distance from area 2 does suggest that flint was being used more economically in relation to the home-range environment. This was further investigated by means of establishing the coefficient of variation; flake sizes in areas 1 and 6 were tested with the following results. In area 1 the coefficient of variation for flake length was 36.14% and for breadth 41.26%. In area 6, length was calculated as 33.27% and breadth as 33.85%. In other words, in terms of a degree of standardisation, lithics in area 6 are less variable as a group than those in area 1 despite their variation in size. The density figures, the proportion of raw material components and the concentration of occupation debris in the north all support this hypothesis.

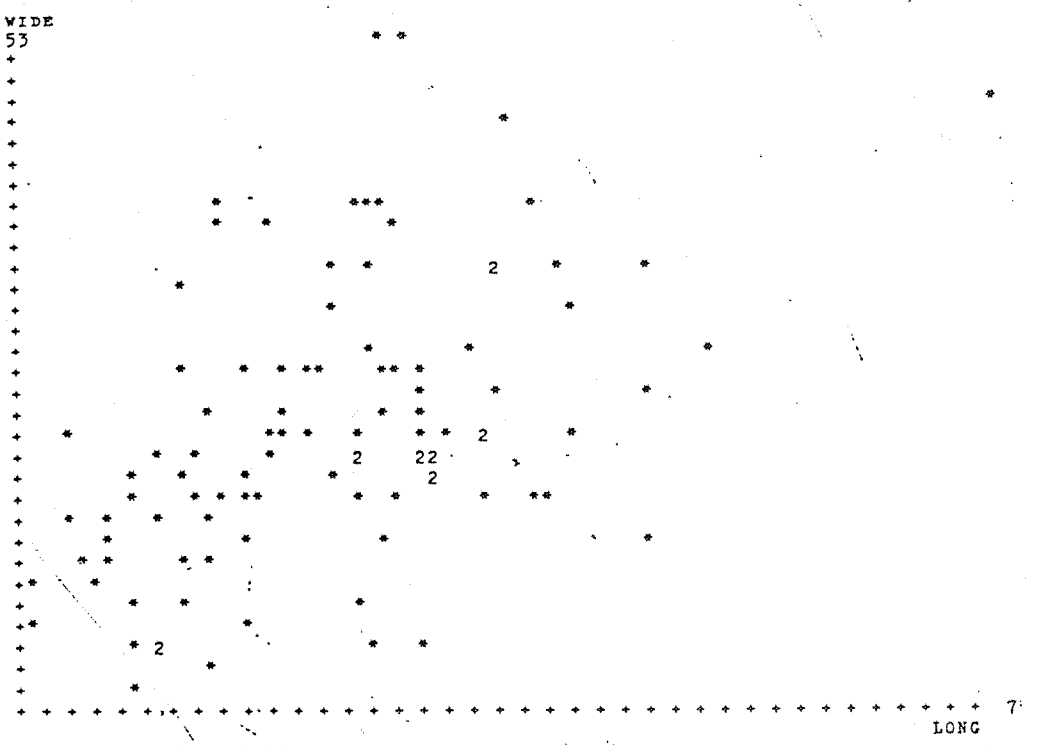
Foley (1981) suggested that a further indication of resource stress was the tendency for cortical flakes to



HORIZONTAL AXIS: LONG
LEFT ENDPOINT: 12 RIGHT ENDPOINT: 70

VERTICAL AXIS: WIDE
LOWER ENDPOINT: 10 UPPER ENDPOINT: 68
HEADER DATA FOR: B:136139 LABEL: FLINT DIMENSIONS
NUMBER OF CASES: 100 NUMBER OF VARIABLES: 2

Figure 6.6 Flake size dimensions from SU 136139 (area 4).



HORIZONTAL AXIS: LONG
LEFT ENDPOINT: 14 RIGHT ENDPOINT: 75

VERTICAL AXIS: WIDE
LOWER ENDPOINT: 9 UPPER ENDPOINT: 53
HEADER DATA FOR: B:160183 LABEL: FLINT DIMENSIONS
NUMBER OF CASES: 100 NUMBER OF VARIABLES: 2

Figure 6.7 Flake size dimensions from SU 160183 (area 2).

display retouch, and this is once again a more frequent occurrence to the south of the study area. In area 5, retouch of cortical flakes makes up 1.15% of the total collection, while in area 2 this figure is halved, totalling only 0.66%. A similar trend appears in the distribution of core-trimming flakes which are considerably more frequent in zones 2 and 5 (Table 6.8). Although analysis of variance was carried out, the result was not significant (Table 6.50).

6.5 Spatial Distribution of Behavioural Domains

Here I shall attempt to integrate results and observations from the previous two sections in terms of the home-range model described in chapter 5. It was argued in that chapter that where a coarse-grained response has occurred, repeated activity within ecological zones should result in the accumulation of distinctive assemblage characteristics; different types of activity across the landscape would produce different artefact combinations resulting in the development of a mosaic of behavioural domains. This should be discernible through surface collection. Where activity domains display a lack of continuity, these clear distinctions will not occur and the effect through surface collection will be a general blurring of assemblage characteristics.

To test this hypothesis, the most suitable framework was considered to be one which distinguished between on-site maintenance activity, off-site resource exploitation and industrial or extractive tasks. Foley's (1981) model fits these requirements and can be examined in terms of the surface artefact distributions within the survey area.

As a first stage, the unit of analysis was extended beyond the individual collection cell to one which distinguished between adjacent ecological patches. Each patch necessarily maintains its own distinct physical

characteristics through time, some being more suited to specific types of activity than others. It is therefore at this level that patterns of continuity may be expected to emerge. Figure 6.8 and Table 6.7 illustrate the distribution of zones within the study area and their various ecological characteristics. Figures relating to density and assemblage variables can be found at the end of the chapter, while results are summarised in Figures 6.9 to 6.14. Let us now consider Foley's (1981) categories in these terms.

6.5.1 Home-Range

It was suggested in Chapter 5 that factors which should emerge as predominant for this category may include high or low density variables depending upon the nature of occupation, a high proportion of maintenance items and a lower frequency of primary flakes. The results in Tables 6.8, 6.9 and 6.10 demonstrate the strength of these relationships while further descriptive statistics are presented in Tables 6.21 and 6.22. Scattergrams relating to the regression analyses in Table 6.9 and presented in Figures 6.16 to 6.43. The tests were carried out by means of the MICROSTAT regression, analysis of variance and scattergram programmes and included data from 72 of the fields from which lithics were examined. It was possible through this analysis to examine the nature and strength of various relationships which may attest to the validity of the home-range model. On the one hand there is a slight negative correlation between density and retouch of -0.2724 and a percentage level of explanation rating at only 7.02% (see chapter 2 for an explanation of what the various scores represent). Although not directly comparable (Shennan's analysis considered absolute quantity of flint per field, here calculation is for density per field), this may go against the strong positive correlation noted by Gardiner and Shennan (1985,57) for the East Hampshire Survey. In this case the percentage level of explanation

area	geology	topography	soil
1	chalky gravel and river alluvium	low spurs projecting into river valley.	shallow, calcareous and non-calcareous loam.
2	valley gravels	first river terrace	well-drained fine silty soil
3	lower chalk with areas of Reading Beds.	chalk downland rising to 100m OD	shallow, well-drained calcareous silty soil with patches of clay-with-flint.
4	complex mosaic of sands, clays and gravels with a narrow strip of alluvium	two tributary river valleys at a point entering the main valley system	a mosaic of silts and loams
5	valley gravels, plateau gravels and sands	on and below first river terrace; little topographical variation.	poorly drained soil subject to waterlogging and flooding.
6	valley gravels	below first river terrace; little topographical variation.	poorly drained soil, subject to periodic flooding.

Table 6.7 Ecological characteristics of the six ecological zones in the Avon valley (see Figure 6.18 for location).

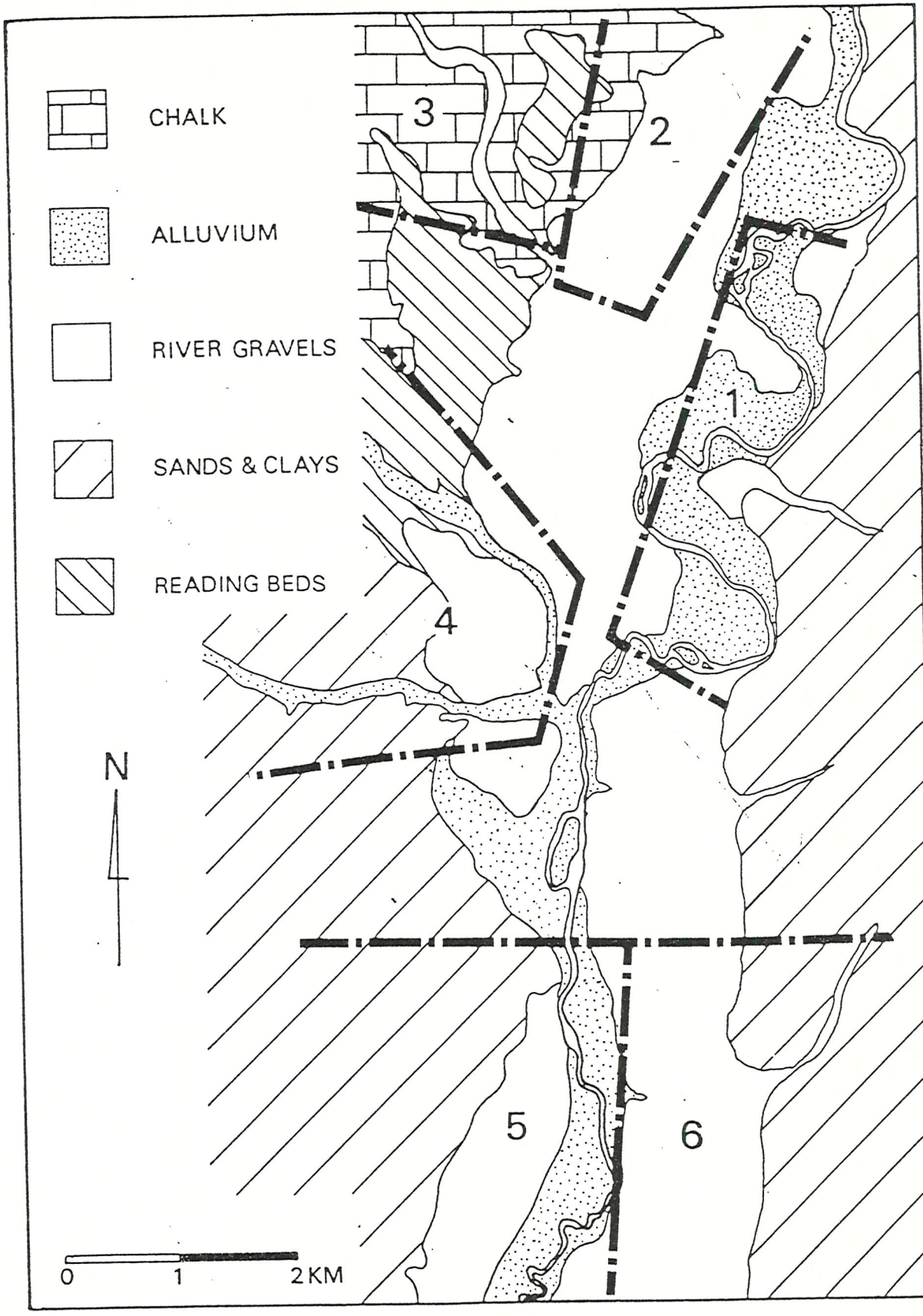


Figure 6.8: Map showing the geology of the survey area and the location of the six zones used in the analysis.

Zone		Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	n=7	10.2	4.3	22.7	8.2	11.9	5.3	26.7	6.5	7.0	4.1	6.7	3.8	4.4	4.0	2.6	1.7
2	n=14	26.5	10.7	17.3	6.4	14.7	6.5	22.8	6.1	2.7	2.3	7.9	2.4	1.9	1.0	1.1	1.1
3	n=6	14.1	6.4	28.6	8.5	15.3	10.1	34.8	6.3	5.3	2.4	8.5	5.4	6.5	4.4	0.2	0.5
4	n=13	14.1	7.5	22.9	3.9	14.1	7.5	28.4	13.2	4.5	3.2	9.7	4.1	2.2	2.5	1.4	2.3
5	n=20	21.8	10.2	23.3	9.8	15.8	9.4	22.6	7.7	3.9	2.5	8.6	3.0	4.5	3.9	1.7	1.6
6	n=12	26.4	17.3	11.8	7.5	9.6	3.1	24.5	5.7	4.2	3.2	9.0	6.4	1.4	1.5	1.2	1.4

Note: sd = standard deviation
n = number of cases

Table 6.8 Assemblage composition per field for the six zones described in section 6.5.

Dependent variable	Independent variable	r	r^2
Density	%retouch	-0.27	0.07
	%primary	-0.13	0.02
	%tertiary	-0.30	0.09
	%cores	-0.14	0.02
	%blades	0.03	0.00
	%scrapers	-0.13	0.02
	%core-trimmers	0.07	0.00
%retouch	%primary	0.21	0.04
	%tertiary	0.36	0.13
	%cores	0.03	0.00
	%blades	0.05	0.00
	%scrapers	0.66	0.44
	%core-trimmers	-0.08	0.01
%primary	%tertiary	0.09	0.01
	%cores	-0.15	0.02
	%blades	0.15	0.02
	%scrapers	0.16	0.03
	%core trimmers	-0.12	0.01
%tertiary	%cores	0.13	0.02
	%blades	0.31	0.09
	%scrapers	0.20	0.04
	%core trimmers	-0.34	0.12
%cores	%blades	-0.02	0.00
	%scrapers	0.01	0.00
	%core trimmers	0.16	0.02
%blades	%scrapers	0.04	0.00
	%core trimmers	-0.20	0.04
%scrapers	%core trimmers	-0.23	0.05

Table 6.9: Regression values for the Avon valley survey

	flint	%retouch	%primary	%tertiary	%cores	%blades	%scrapers	%coretrimmer
flint	1.000							
%retouch	-0.272	1.000						
%primary	-0.133	0.210	1.000					
%tertiary	-0.302	0.358	0.088	1.000				
%cores	-0.137	0.034	-0.152	0.135	1.000			
%blades	0.034	0.047	0.154	0.307	-0.019	1.000		
%scrapers	-0.132	0.662	0.162	0.202	0,006	0.041	1.000	
%coretrimmer	0.070	-0.077	-0.117	-0.341	0.156	-0.201	-0.234	1.000

Table 6.10 Correlation matrix for the Avon valley survey.

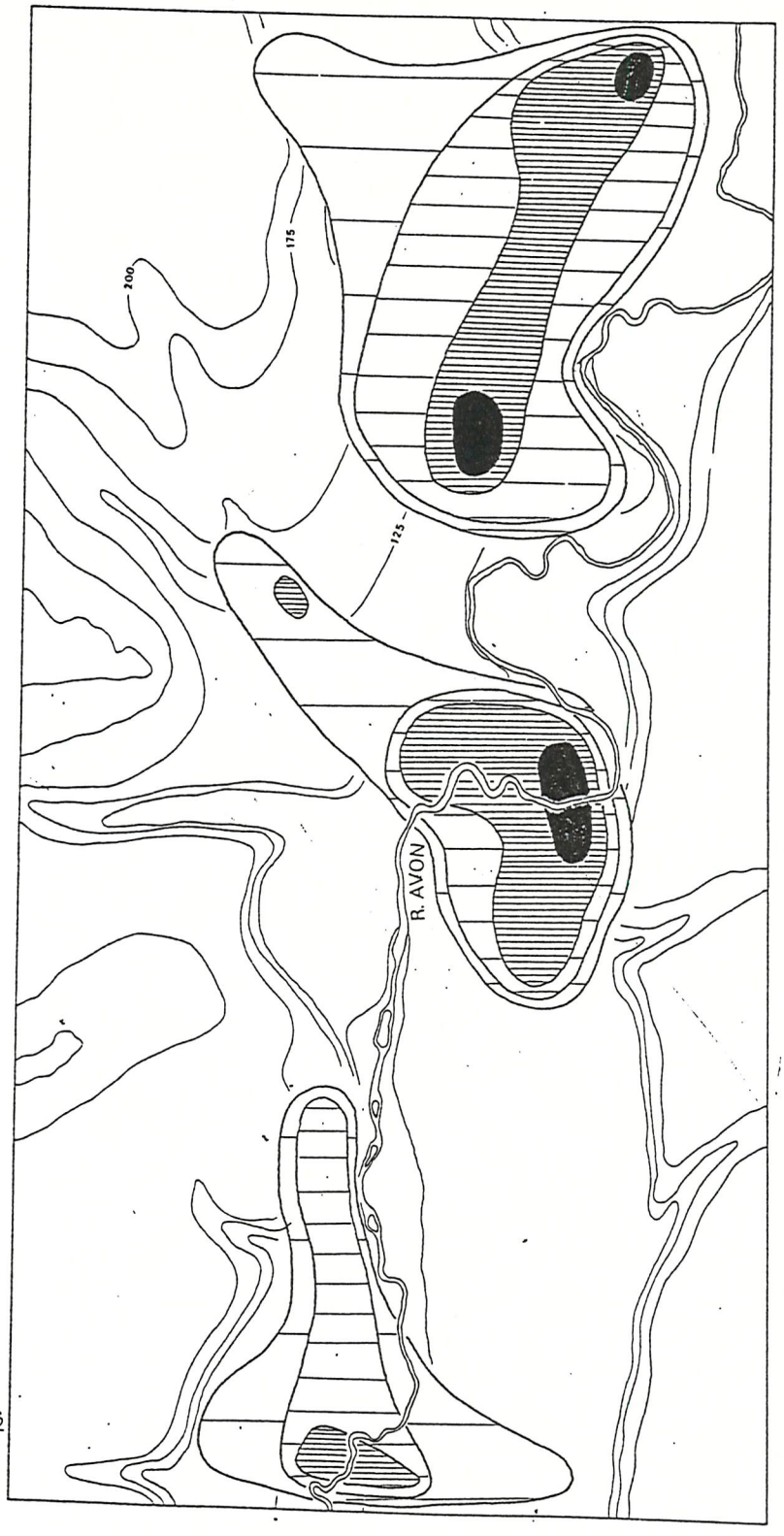


FIGURE 6.9: Density variation in the Avon valley survey area. Contour intervals range from 2 sd above mean to 2 sd below mean.

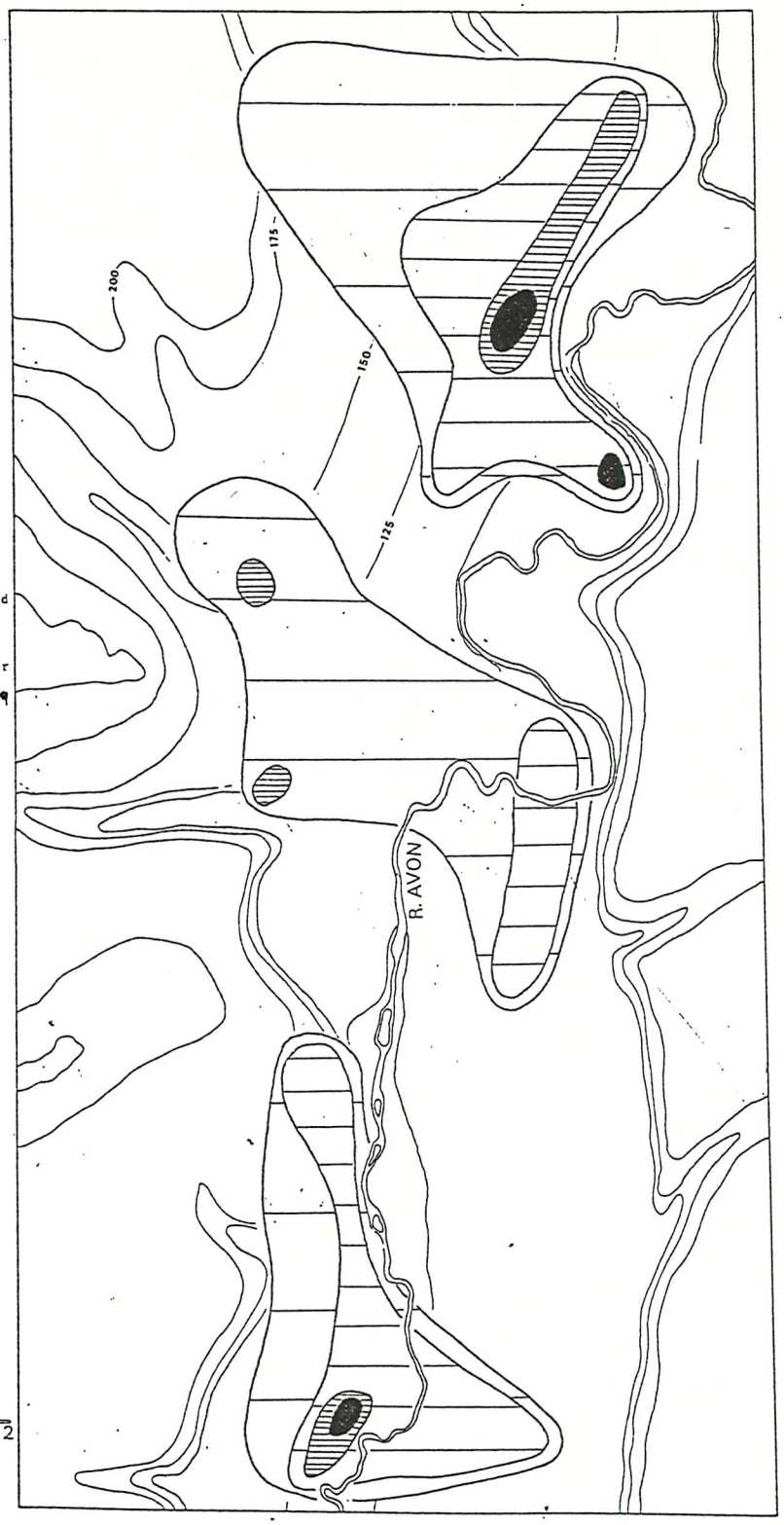


Figure 6.10: Variation in the percentage of retouched artefacts in the Avon valley survey area. Contour intervals as for Figure 6.9

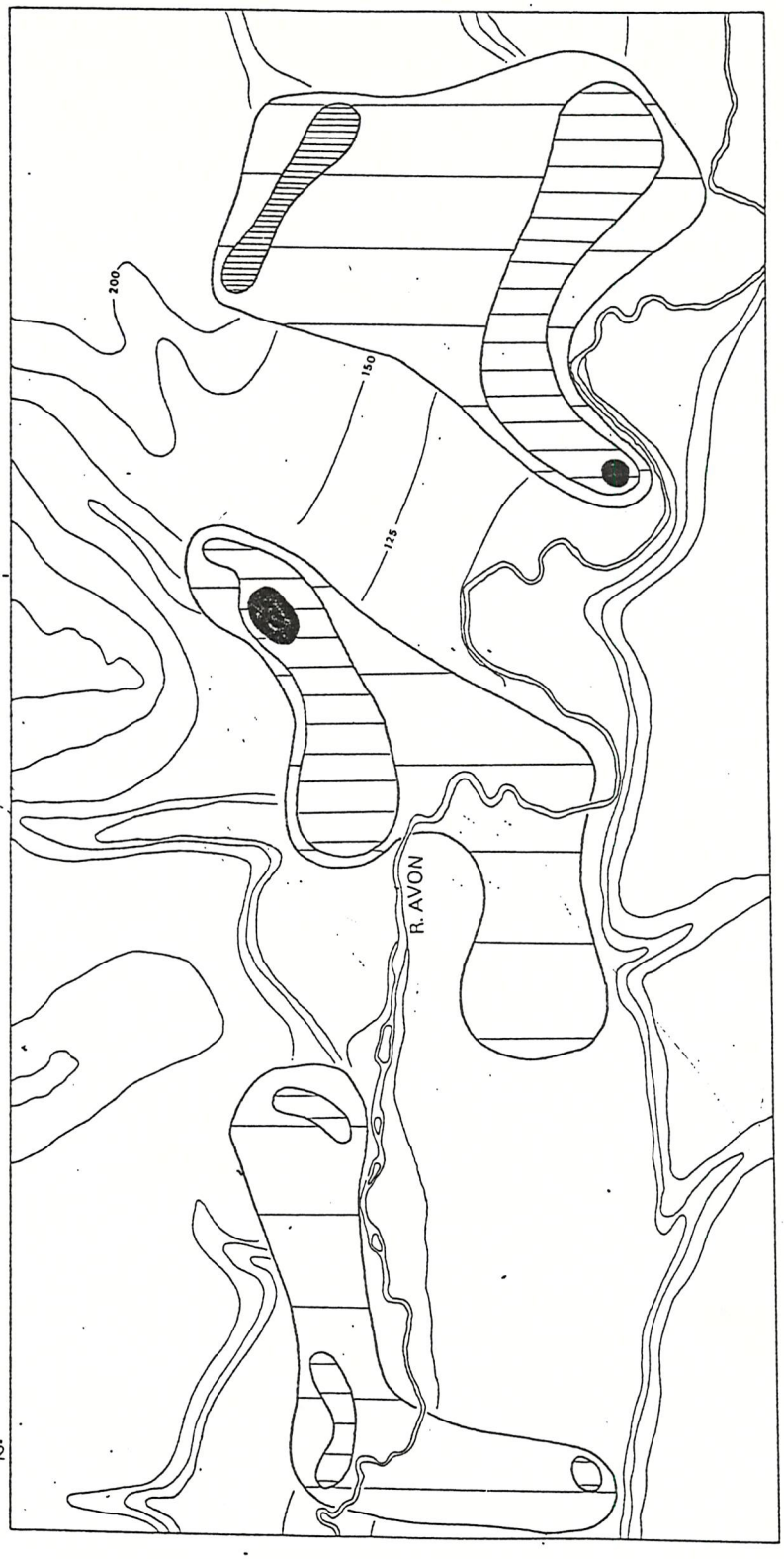


FIGURE 6.11: Variation in the percentage of primary waste in the Avon valley survey area. Contour intervals as for Figure 6.9.

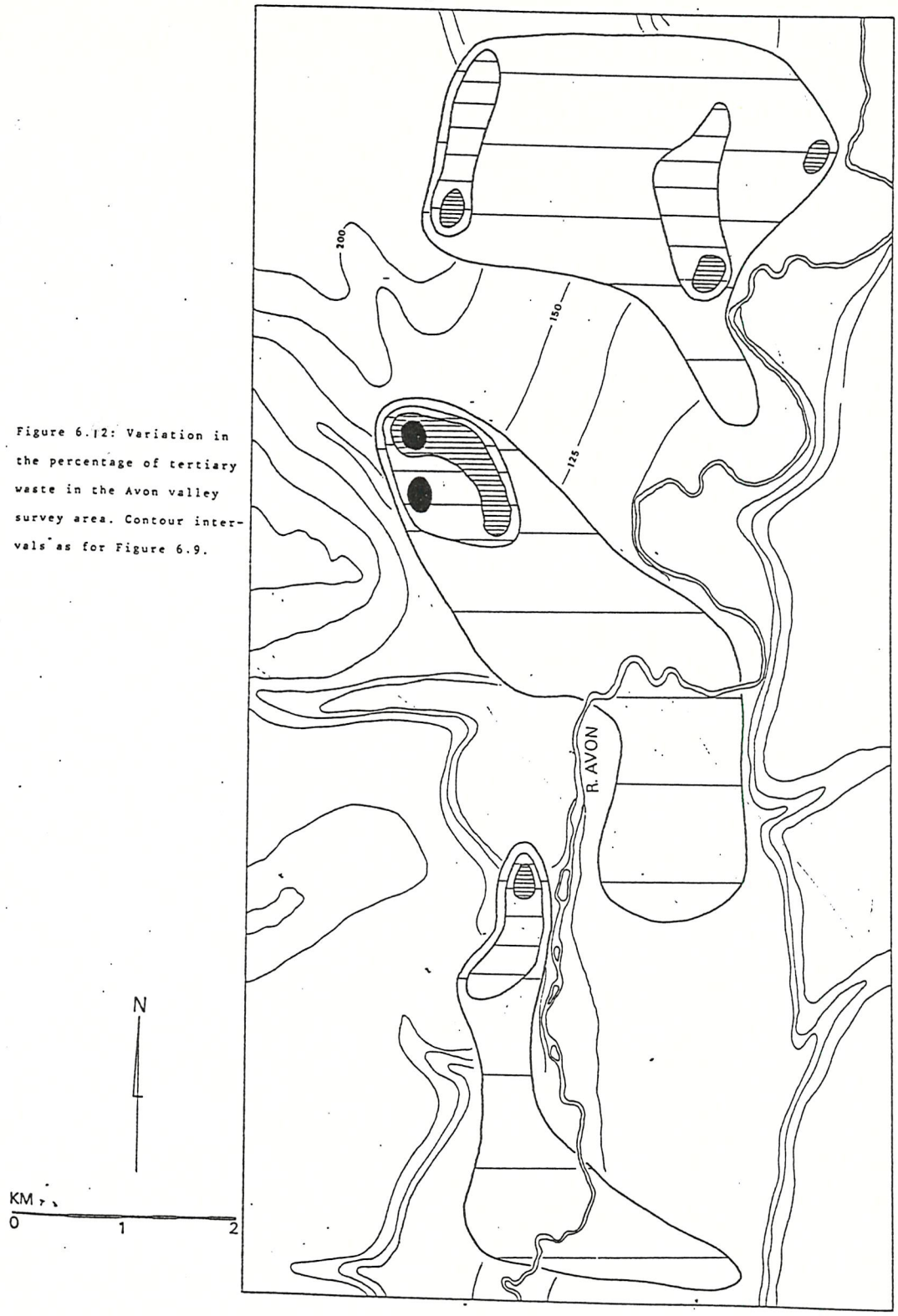


Figure 6.12: Variation in the percentage of tertiary waste in the Avon valley survey area. Contour intervals as for Figure 6.9.

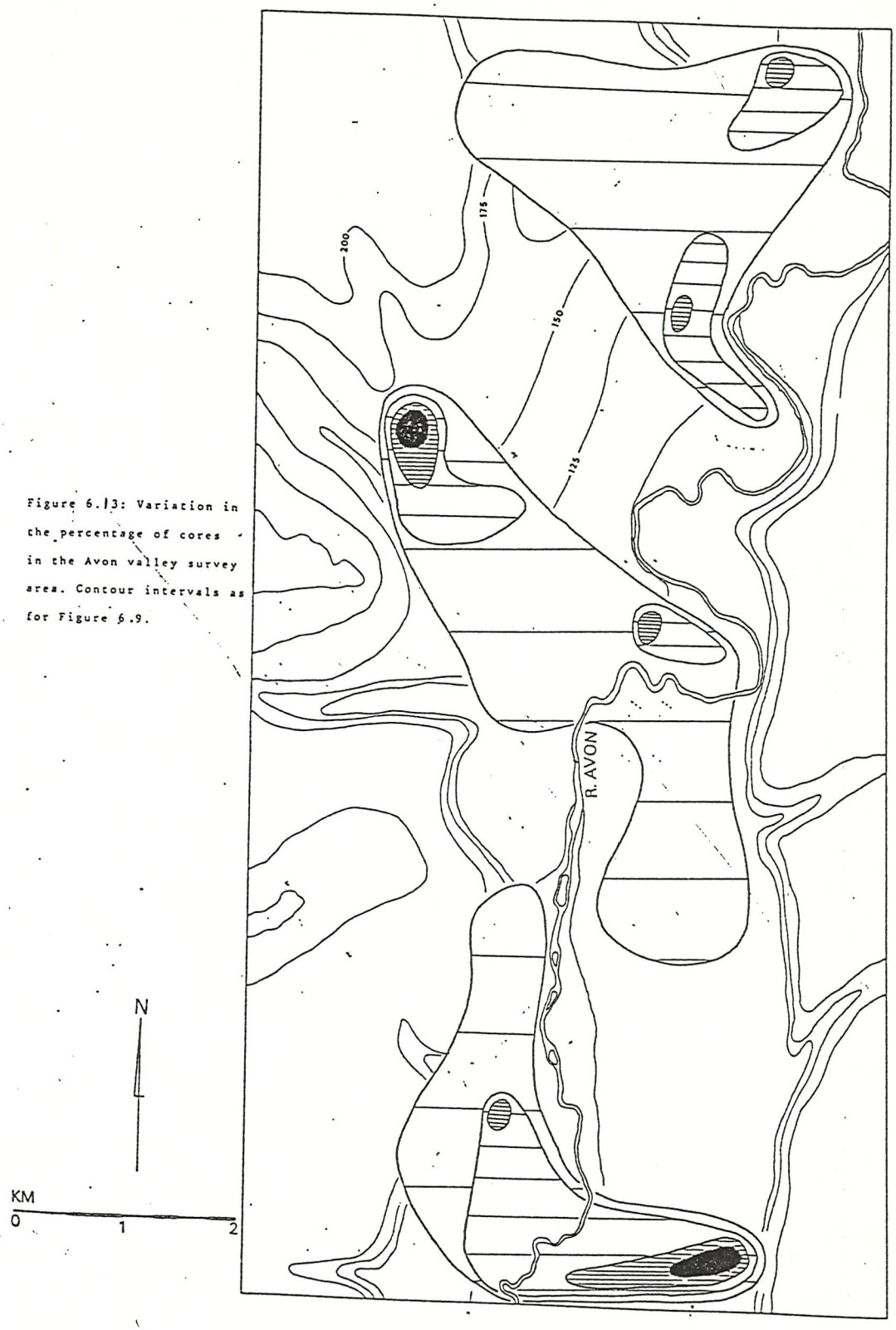


Figure 6.13: Variation in the percentage of cores in the Avon valley survey area. Contour intervals as for Figure 6.9.

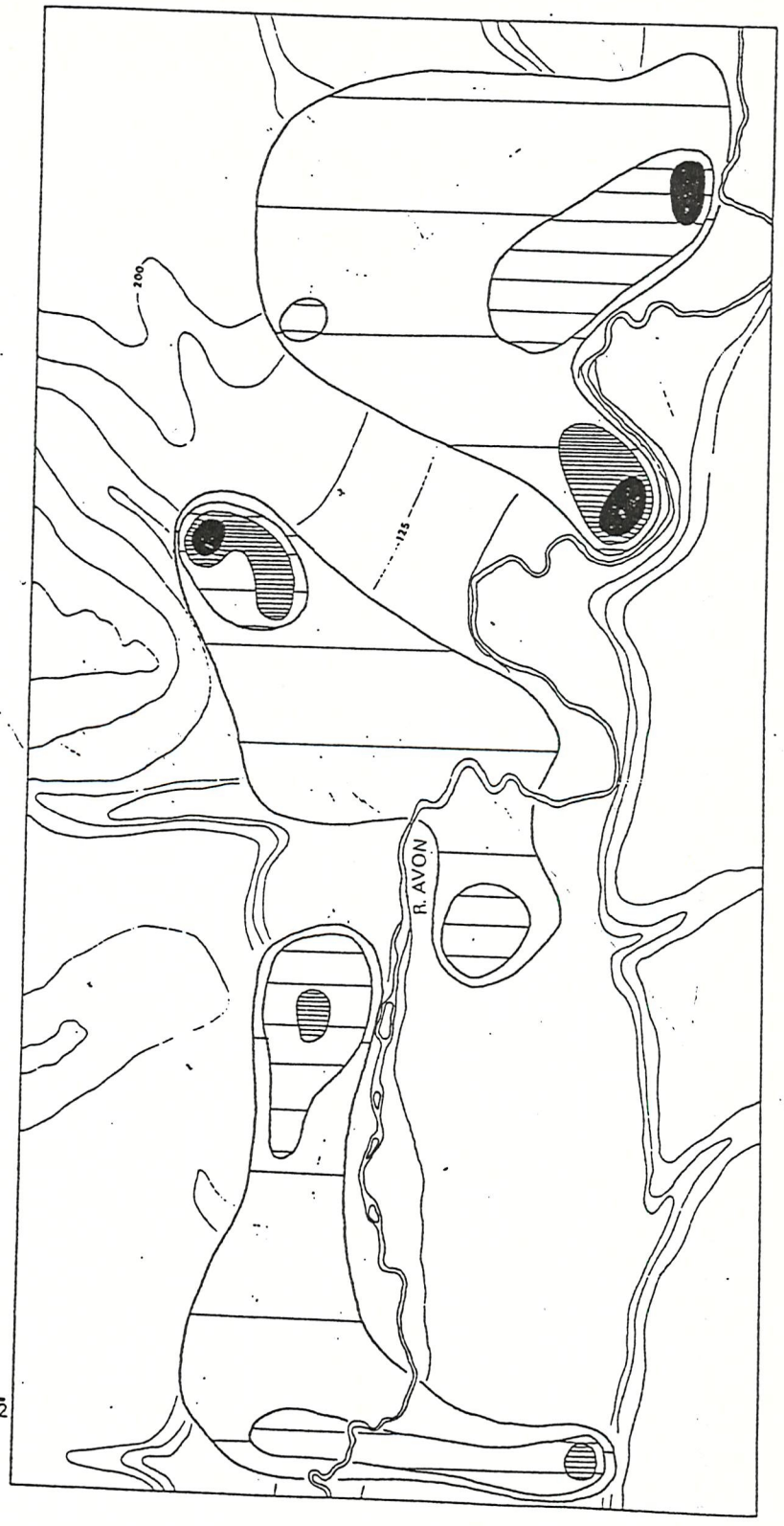


Figure 6.14: variation in the percentage of scrapers in the Avon valley survey area. Contour intervals as for Figure 6.9.

was 36.3%; in other words, the total number of lithic pieces accounts for 36.3% of variation in the number of retouched pieces from East Hampshire, and only 7.02% for the Avon valley. However as can be seen in the distribution maps, survey units with high proportions of retouch do appear to cluster around those with high density and may suggest some form of spatial arrangement linked to the idea of a home-range environment. Another interesting point to note is the strength of correlation between retouched items on the one hand and primary, secondary and tertiary waste on the other. The scores do vary, although not significantly; for primary waste r^2=.04410, for secondary waste r^2=.10757 while for tertiary waste r^2=.12816. In other words tertiary waste is the most frequently retouched although this is not significant. That tertiary flakes may, by this argument, be an indication of home-range location (being the final stage of the core-reduction sequence) is confirmed by the correlation and associated scatterplot relating tertiary waste and scrapers (Figure 6.36). The relationship appears to represent a linear pattern; beyond a certain threshold (5% scrapers, 20% tertiary waste) correlation between the two may act as an indication of home-range activity (scatterplots relating to these and other variables are to be found in section 6B at the end of this chapter). One outlier in the scatterplot, maintaining 17.9% scrapers, is of particular interest in the context of the home-range argument. It is situated within zone 1 close to the river and in an area projected as immediately surrounding the home-range. Combined with the high scraper value is an exceptionally high overall retouch value (44.5%), suggesting a possible focus of activity connected with the home-range and situated on the gravel spurs which now project into the river Avon. The variation in retouch and scraper frequencies between the six zones proved significant through analysis of variance (Table 6.47 and 6.50).

It may be suggested therefore, that areas 1 and 2 conform

to the home-range category (Table 6.11). In terms of overall density, area 2, situated on the river terrace to the west of the river is clearly a focus of activity, a point confirmed by analysis of variance (Table 6.47). Area 1 on the other hand has a slightly lower density but a significantly higher proportion of maintenance items, a result confirmed by t-test and significant at a confidence level of 0.01. We can perhaps envisage the two areas representing the focus of intermittent settlement concentrating on the river terrace, overlooking an area of floodplain on which the majority of activities would have taken place.

For the projected home-range, the proportion of retouched items is lower than it is on the floodplain, where the proportion of tertiary waste and cores is also high. The gravels certainly supplied the majority of flint in this area even though chalk was being exploited further to the west (Table 6.6). It is interesting that chalk derived flint makes up such a high proportion in an area so clearly divorced from the chalklands. It may be that nodules were being washed down from the upper reaches of the valley - although primary flakes show little sign of being rolled - or that the nodules were being deliberately carried from known source areas across to the home-range. This will be considered further in the following section.

A number of further points can be made regarding the distribution and relationship between proposed settlement and other 'special task locations' (Tables 6.11 and 6.12). For the Avon valley, the high proportion of retouched items is considered a feature of special task locations and high density of settlement areas.

Although there is a degree of overlap (for example field 142097), the two classes do appear mutually exclusive; indeed the locational 'catchment' characteristics provide a further indication of this apparent dichotomy. Settlement

Table 6.11 Characteristics of Proposed Settlement Locations.

Field no. (grid ref)	flint per ha.	% ret.	% prim.	catchment geology	catchment height	catchment distance to river(m)
140094	39.1	21.9	19.1	gravel	1	200
142097	35.2	35.7	19.5	gravel	1	320
159149	44.5	11.2	10.8	gravel	1	320
149092	32.4	23.5	13.7	gravel	1	200
166200	45.9	23.3	4.9	gravel/ chalk	3	600
163193	31.9	30.8	18.2	gravel	2	650
152176	48.6	15.5	11.8	gravel	2	800
136139	32.8	25.0	16.3	gravel/ London clay	2	925
142159	43.0	5.7	5.3	gravel	2	1000
151171	61.8	5.5	8.2	gravel	2	800
155198	34.6	5.8	12.3	chalk	6	1480
158138	51.8	4.6	8.0	gravel	2	250

Table 6.12: Characteristics of Proposed Special Task Locations.

Field no. (grid ref)	flint per ha.	% ret.	% prim.	% tert.	catchment geol.	catchment height	catchment dist. to river(m)
137115	9.0	33.3	8.5	29.6	gravel	4	2000
144119	7.9	31.6	10.8	37.8	gravel	2	280
142097	35.2	35.7	19.5	20.5	gravel	1	320
166169	31.5	44.7	18.6	20.3	gravel	2	40
165167	12.3	44.1	14.3	32.1	gravel	2	300
155125	7.6	29.7	5.0	26.5	gravel	1	1000
169194	7.8	37.5	13.3	36.7	gravel	2	220
163193	32.0	30.8	18.2	30.3	gravel	2	650
139182	17.3	33.1	15.8	38.6	Reading beds	6	2100
134165	7.5	38.1	0.0	36.8	London clay/Reading beds	4	1800
134167	4.7	29.4	20.0	60.0	London clay/Reading beds	4	1850
138162	24.8	35.1	18.5	44.4	gravel	4	1500

locations on the one hand appear to concentrate, with only one exception towards the rear of the valley gravels, fairly close to the river (mean distance of 550m and a standard deviation of 280m when the single exception is excluded) and tending towards height categories 1 and 2 (<40m OD). The so-called 'special task locations' on the other hand display a more variable set of locational requirements. Although the majority of locations are again on the gravels, there is also a tendency towards the Bagshot Sands, Reading Beds and upper chalk, where the highest proportion of retouched artefacts occur. The height category is variable while proximity to the river provides a mean score of 1005m and a standard deviation of 760m. We may suggest therefore, that for settlements, locational characteristics were fairly standard - as was suggested by Trigger (1965) and discussed in an earlier section - while the situation of special task locations was more flexible, depending presumably on the nature and distribution of certain ecological 'patches'. This observation was confirmed by means of analysis of variance (Tables 6.47 to 6.50). Indeed variation between zones proved significant by means of analysis of variance for the following variables: density, percentage of retouched artefacts, percentage of tertiary waste, percentage of cores and the percentage of scrapers.

It is interesting to note that the proposed settlement locations appear to cluster in three areas, one to the north in area 2 suggested below as representing a possible focus of Neolithic activity, one to the west in area 4 possibly representing a smaller scale Mesolithic activity area, and one to the south in area 5. The latter corresponds closely with the distribution of evidence for Bronze Age activity (below) and it is tempting to suggest that this may represent a third home-range existing within the survey area. The preference for gravel locations has already been discussed both for the Kennet (Bradley et.al. 1980) and upper Avon valleys (Smith 1985), and this may

represent a further example of valley adaptation in the post-Neolithic period. All three possible home-range locations appear to be surrounded by a more general and apparently peripheral distribution of special task locations.

6.5.2 Secondary Home-Range

This is represented in the study area by zones 3 and 4, both of which demonstrate an emphasis on industrial/extractive behaviour combined with certain aspects of home-range activity. Density in both areas is low in comparison to area 2 although there does appear to be some distinction in the way raw material was being exploited. In area 3 for example, there is a higher proportion of primary flakes and high proportions of cores, scrapers and of retouched items, suggesting occupation perhaps in the capacity of temporary settlement in an extra or secondary home-range context. Only variations in scraper, core and retouch frequency were, however, significant. The results of analysis of variance are presented in Tables 6.47 to 6.50). Analogy may be drawn between this and the pattern observed by Gould (1980) in which groups of Aborigines went from the settlement to the quarry, extracted the raw material and then proceeded to remove primary flakes, reducing nodules to 'manageable lumps', easier for transportation on the return journey. The frequency of gravel flint flakes in this area would suggest interrelationship between this area and the river valley, where it was argued that chalk-derived flint was being knapped. In other words, areas 1 and 2 on the one hand and area 3 on the other, appear to complement each other in terms of the core-reduction process (Table 6.6).

To support the working hypothesis that all stages of a core-reduction sequence may be observed through surface collection, a number of relationships between relevant variables were noted (Table 6.9). On the one hand there is

a negative correlation between primary waste and density (-0.133), although this is not at all strong and could well have been blurred by long-term regional activity. Perhaps more convincing however is the higher correlation between tertiary waste and cores (0.135) than that between primary waste and cores (-0.152). The real reason for their inclusion, however, is for comparison with the corresponding statistics in chapter 7.

Area 4 displays a different pattern, although not significantly so. In this case flint was being extracted from a very narrow strip of gravel which dissects the chalk from north-west to south-east. Primary flakes in this case are supplemented by a higher proportion of tertiary waste, cores and retouched material than occurs in other adjacent zones. This does not suggest the movement of flint so much as its exploitation within a much more compact home-range, occupied perhaps for only a single episode. Such a feature may only be characteristic of highly mobile forager groups, and the high frequency of blades in addition to other Mesolithic type-fossils within this zone may reinforce this argument (see below).

6.5.3 Extra Home-Range

This is represented by areas 5 and 6 and surrounding areas of chalk upland, and may be defined as that area which contains 'back-up' resources. These areas were probably exploited on a more casual basis than was the case in the home-range environment, possibly functioning largely as an extended hunting/foraging territory. The distribution of artefacts supports this interpretation with a general low density scatter occurring over much of the area and few relationships standing out between artefact groups. Few significant relationships were apparent, for example, through analysis of variance. (Tables 6.47 to 6.50). Occasional peaks in the distribution are characterised by primary waste and cores, especially at the back of the

floodplain where the flat ground rises to the first river terrace. In such locations fresh nodules are eroded following heavy storms and were clearly being exploited in the prehistoric period.

A further point concerns the distribution of Neolithic arrowheads in the area, several kilometres south of the projected home-range. The tendency for arrowheads to be concentrated on areas of chalk downland was used in the past to confirm the hypothesis that such locations represented areas of settlement. This distribution however, in an area separated from the primary settlement zone contradicts these observations and puts areas 5 and 6 on a par with the extra home-range of Cranborne Chase. Both areas display little evidence for occupation debris while both maintain high concentrations of arrowheads. I suggest that both areas represent the extent of the extra home-range, exploited by groups living within the middle Avon valley region.

It is possible therefore that behavioural domains may be defined through surface collection when appropriate units of analysis are employed. Within the broader sphere of the occasional home-range (areas 1-4), two home-range's were broadly defined, one of which is probably Mesolithic in date (area 4) and one of which is Neolithic (area 2) with a possible focus of Bronze Age activity appearing in area 5 and characterised by a high proportion of scrapers. As would be expected for a more settled economy, the 'Neolithic' home-range maintains a higher density than that of area 4, while another distinction lies in the relationship between settlement and the acquisition of raw material. This may also reflect the intrinsic difference between highly mobile 'forager' groups who 'encounter' resources (Binford 1980) and would find the resource inventory provided by area 4 highly favourable, and early farming communities who could 'map-on' to resource patches as and when required. The use of chalk-flint when gravel-

flint was more accessible may be a reflection of such a policy. It should be stressed that these temporal observations are made in the light of expectations raised in chapter 5 and bear no relation to any patterns which may emerge in the following section.

6.6 The evidence of chronology

In this section, results known prior to the survey will be considered in relation to the ubiquity of diagnostic artefacts recovered by surface collection. The latter will be expressed as a ubiquity score, the number representing the percentage of fields in which a diagnostic artefact was recovered. The quality of information will then be compared with that from the previous sections and the value of the two approaches considered. For convenience, the traditional chronological divisions will be maintained.

6.6.1 Mesolithic

Evidence for Mesolithic activity prior to the survey comprises largely chipped and worked stone artefacts collected at random over the past few decades (Figure 6.15). At Godshill to the east of the river Avon for example, a pebble macehead with hour-glass perforation was recovered (Rankine 1951), while at Fordingbridge a tranchet axe and microlith were found. There are records of two occupation or settlement sites in the region, one being at Downton to the north of the survey area (Higgs 1959), while another was located during excavation of Whitsbury Castle Ditches. With these exceptions evidence for hunter-gatherers in the region is sparse, a situation which is not made any easier by the problems of defining 'Mesolithic flints' through surface collection.

The distribution of Mesolithic artefacts recovered by fieldwalking is limited and appears to concentrate on the river gravels; a ubiquity score of 4.8% is recorded (ie

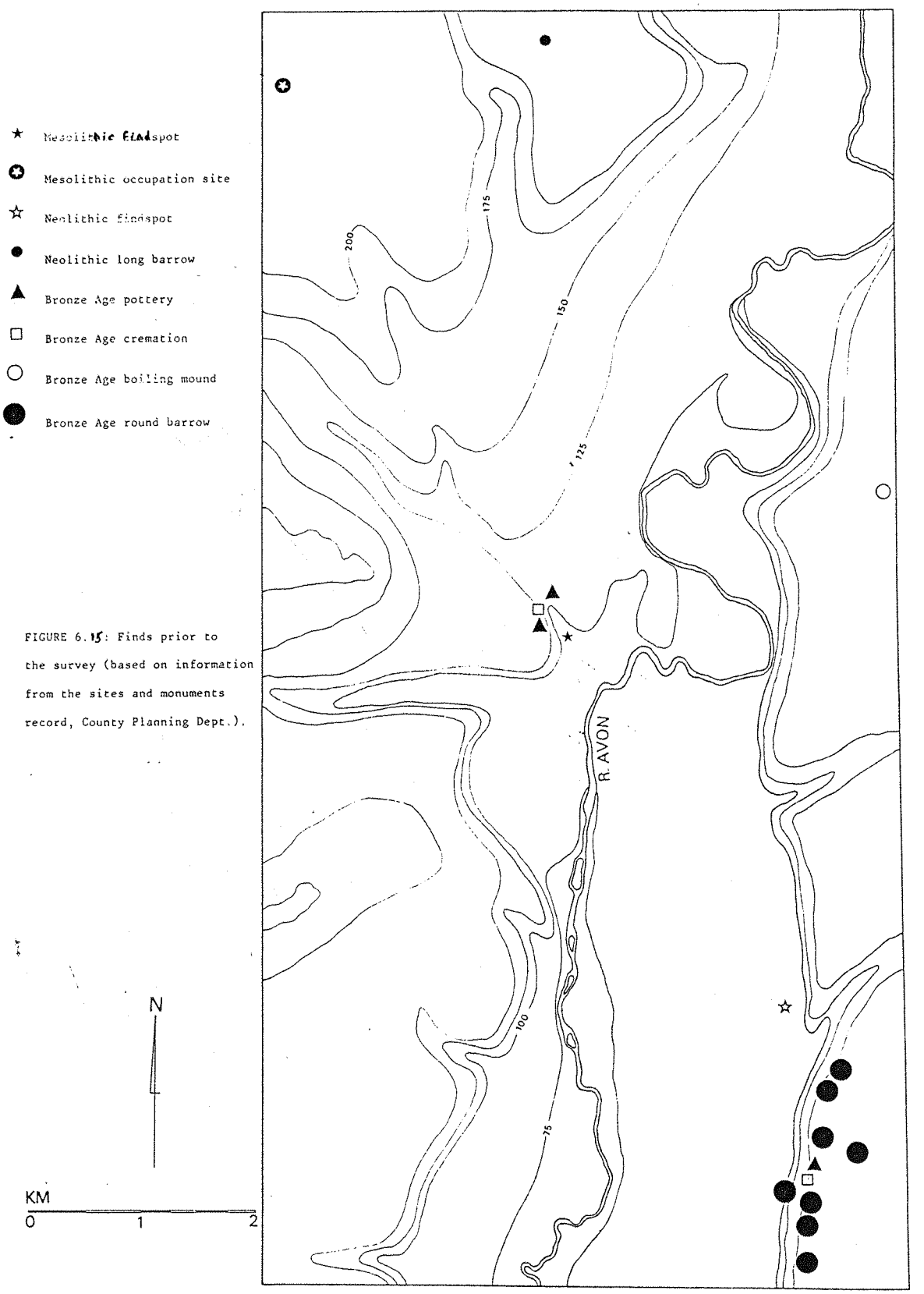


FIGURE 6.15: Finds prior to the survey (based on information from the sites and monuments record, County Planning Dept.).

that Mesolithic artefacts were recovered from 4.8% of the fields walked). This distribution is not surprising when we consider the observations made by Mellars and Reinhardt (1978) who stress the spatial relationship between microliths and tertiary deposits. Microliths almost certainly represent only one part of a composite tool which seems to have been characteristic of the early postglacial period. If we assume this to be the case, we can suggest that any evidence for the manufacture of such composite tools may represent a very specific type of activity, while their use patterns may be a reflection of more general off-site activity domains. All the findspots except one represent microliths with the one exception yielding an exceptionally high frequency of microburins and blade cores. It may be significant that the same field also maintained a high proportion of tertiary waste, considered above to represent home-range maintenance activities. If this distinction can be made, then a clear pattern begins to emerge with the distribution providing evidence for both hunting and maintenance activity.

By combining the very limited chronological evidence with that from the previous sections, what general statements can we make about the distribution of hunter-gatherers in the middle Avon valley?

1. The distribution of activity appears to represent a structured, coherent adaptation to the natural distribution of resources. Microliths and blade frequency are the two most visible characteristics and if blade frequency is taken to represent hunter-gatherer activity, their distribution does suggest some kind of a functional division of activities. A similar trend was noted by Smith (1985,115) in the Kennet valley with microliths and maintenance items again appearing as distinct categories in a valley environment (Chapter 9). What this suggests is that home-range and non-home-range activities were distinct in terms of behavioural control and that this is clearly

manifested in the distribution of diagnostic cultural items. That this distinction is clear in both cases suggests that where settlement was a repeated process, the same ecological zones were maintained and that relocation was not random but a closely controlled adaptation.

2. That Mesolithic artefacts are few in number suggests that the valley was not intensively occupied in the early postglacial period and certainly not on a long-term basis. Instead we may suggest that this constitutes only one component of a behavioural cycle, whether seasonal or otherwise, which was based on the rivers and coastline of southern England. We are aware of the constantly changing environmental mosaic characteristic of boreal and atlantic woodlands and with such a lack of stability, settlement would have concentrated on the predictable patches of resources which occurred in such coarse-grained environments.

3. It would also have been necessary to maintain home-range locations at the junctions of ecological zones. In dealing with settlement patterns within a heterogenous environment, an optimization strategy is one which maximises net energy return by feeding in dense resource patches; thus optimal behaviour is ultimately affected by the distribution of resources in time and space. If optimization is a factor which should determine settlement location, then such a position would be one which minimises travel time and energy and one which lies at the centre of gravity of the weighted resource distribution (Moore 1981, 200). Such a situation could not be better illustrated than in the case of the Avon valley. To the north and west lie the chalklands of Cranborne Chase while immediately to the east lies the New Forest. Both areas are clearly defined habitats which each maintain a distinctly rich and varied flora and fauna. Only a few miles to the south lies Christchurch Harbour, the availability of marine resources and the location of sites such as Mother Sillers Channel

(Palmer 1977). It is no surprise that settlement in the Avon valley area is at a point central to such a selection of resource patches, a trend mirrored elsewhere and highlighted by the density of settlement in some areas (Froom 1972).

The picture that emerges therefore is one of small foraging communities traversing the landscape and returning to the same areas from year to year, concentrating on those regions which maintain resource clusters and which are central to the most diverse mosaics (Orians and Pearson 1979). In the Avon valley, fish may have been as important in the past as they are today, while the diverse hazel and oak/elm woodlands would have maintained a rich selection of plants and animals. Hazelnuts were clearly important to Mesolithic communities in this area, as indicated by their frequency at sites such as Oakhanger, Thatcham and Broomhill. What this may suggest is that these sites were occupied in autumn and winter. Could the absence of such resources on coastal sites and the emphasis on shellfish suggest their use as summer camps or are we dealing with a more complex seasonal dichotomy?

Until recently, hazel has tended to be regarded as an understorey shrub, but as Waton suggests it is now seen more as a woodland forming species, often reaching heights of up to 12m (1982). If it were an understorey shrub in the early postglacial, sealed beneath a woodland canopy, it would not flower and as a result would be absent from pollen diagrams. The very fact that it is not only present but abundant in diagrams from Poole Harbour (Haskins 1978) and the New Forest (Seagrief 1960) suggests that it existed in sufficient quantity to provide for a winter occupation within the region. On Woodman's estimates (1985,163), based on a similar availability ratio to that projected for the Avon valley, it would have been possible to collect sufficient nuts along the valley terraces without having to go more than a few kilometres from the home-range. In other

words the survey area could easily have provided sufficient resources to support a winter occupation.

The distribution map for the Avon valley therefore would support the idea of a forager population paying repeated visits to a particularly favourable area within the landscape. According to Binford (1980), foragers tend to have a high residential mobility with regular daily food/resource procurement strategies. Evidence from the Avon valley as well as from other valley systems in the Wessex region (Froom 1972) tends to support this hypothesis. We might further suggest that the larger valley systems were winter rather than summer domains. It may be no coincidence that larger sites in the region such as Thatcham and Oakhanger contain quantities of hazelnuts, suggestive of autumn/winter occupation and fall into Price's (1978) category of aggregation centres. Mellars (1976) proposed a summer/winter model in which summer settlements tended to be small units, suited to the single family group, such as have been suggested for the coastal sites in Dorset and Hampshire (Palmer 1977). During the summer months the lack of climatic/environmental constraints and the wider availability of plant foods permitted a greater freedom of choice in selecting settlement locations. The associated pattern would thus be wide and dispersed, concentrating on the chalk Downlands to the east and north-west, and on the coast to the south. In winter there would be less freedom of choice and the need for shelter and resource predictability would have to be met. Winter settlements would thus be larger and with structures having to last for several months at a time. Oakhanger, Thatcham, Wawcott and Downton may all fit this category, with inland summer sites leaving traces not conducive to substantive recovery.

In terms of a hunting strategy, valley locations would have been ideal for the hunting of red deer during the winter months. That red deer was a dominant species appears in

little doubt (Coy 1982) and it was clearly the major species at Thatcham. At Cherhill, Wiltshire on the other hand, wild pig appears to have been predominant, representing 56% of the faunal assemblage. Grigson (1983,70) suggests this may represent a seasonal hunting site where groups pursued animals to damp ground in the summer months. Again this may reflect the seasonal dichotomy between central valley locations and the remainder of the landscape. As de Nahlik (1974) and Taylor Page (1971) both point out, red deer form herds throughout the year but in winter divide into smaller groups and tend to concentrate in lowland, sheltered areas. Smaller herds implies greater herd frequency and the concentration in river valleys during the winter months would both make them a more accessible resource during that time of the year. In summer, settlements would be more widely dispersed with human groups taking full advantage of the wide variety of resource patches available on the coast and the chalk uplands.

We have already described the extent to which settlement tends to concentrate on ecological boundaries, and this is a theme further maintained by Mellars and Reinhardt (1978) in the area of southern England. Within the Wessex region the only major ecotones are those provided by river valleys. We have already noted the tendency for river valleys to contain narrow, compact ecological zones, and it seems reasonable to suggest that such locations would be ideal for the siting of larger base camps. As Winterhalder (1981,68) suggests, patch selectivity assumes that the foragers effective resource habitat is discontinuous and that the different patches each maintain a different quality. Patches tend to be ranked by foragers on that basis and as a result, the patches with highest rank - such as river valleys - will form the basis for exploitation strategies. It is the result of such a selection pattern that we are seeing in the Avon valley.

6.6.2 Neolithic

Much of the evidence for Neolithic activity in the area is once again comprised mainly of stone artefacts, with findspots appearing at random over much of the region (Figure 6.15); the only real exception being the jadeite axe found at Breamore, and described in detail by Smith (1963). In addition seven earthen long barrows are known, five of which are now destroyed and two of which lie within the survey area itself. To the west on Cranborne Chase there exists a rich variety of field monuments, while to the north in the upper reaches of the Avon valley there exists one of the most important Neolithic landscapes in northern Europe. The northernmost site in the valley is the henge monument at Marden which displays evidence for activity through from the Mesolithic to the middle Neolithic. The sequence at Durrington Walls, a comparable henge 16km further south is better documented, with environmental evidence showing a progressive clearance of the valley during the middle Neolithic at a time when cultivation was also taking place.

Evidence for settlement in the region is minimal, the only exceptions being the sites of Downton (Rahtz 1962) and Pamphill (Field et.al. 1964) which both lie close to the survey area. At Downton settlement continued from the Mesolithic through to the late Neolithic, shifting gradually further up the valley profile. Occupation debris is scattered extensively over an area of 2000m^2, with discrete clusters of Ebbsfleet and Mortlake pottery contained within pits and hollows. ApSimon (1962) studied the pottery from the excavations and suggested that the nature of the settlement supported the evidence provided by ceramics, implying a semi-permanent and small-scale occupation. Despite this, activity in the valley was apparently intense with alluviation involving the redeposition of a clay/gravel deposit such as might occur through the erosion and reworking of river terraces (Smith

1985,174). Intensive clearance and agricultural activity is further suggested through pollen and mollusc sequences - discussed in chapter 3 - from Poole Harbour (Haskins 1978) and on the chalklands of east Hampshire (Allen 1986).

Pamphill, like Downton occupies a gravel spur projecting into the valley floodplain, the type of location also favoured by early farming communities in northern France (Howell 1983). Excavations revealed a large subrectangular pit containing 180 potsherds and a small but diagnostic lithic assemblage which included leaf arrowheads and a greenstone axe. Though only the one feature was investigated, other test pits made in the area suggested occupation over an area in excess of $1000m^2$.

Of the four Neolithic artefacts recovered by surface collection, two are leaf shaped arrowheads and belong to the earlier period, one is transverse and is later in date while the fourth appears to be the fragment of a sickle blade. The ubiquity index therefore provides a score of 1.8% for the early Neolithic and 4.8% for the later Neolithic. Although the scores are too low to produce any significant indications of preference, the two earlier findspots do suggest an emphasis on the river gravels at a level slightly above that of the floodplain, while the later artefact type is located higher up, on the 50m contour. While this is little to go on, the pattern of settlement shift from the valley floor upwards does appear to be suggested and is comparable to the pattern of change seen upstream at Downton. In this example Smith (1985,174) suggests a rising water level to be responsible. He suggests that the formerly stable pattern of braids and seasonally active storm channels separated by gravel dunes appears to have been replaced by a marshy unstable meander belt. Flood levels rose by as much as 5m, enough to explain the gradual shift in surface artefact distributions, and a substantial part of the area previously available for settlement was lost.

If we consider the nature of blade frequency distributions and consider the assumption that blades are generally regarded as a feature of earlier assemblages, a similar trend emerges with the higher blade frequencies maintaining a distribution closer to the river - especially to the south where the valley profile would be more conducive to seasonal flooding - than those with lower blade frequencies. It is also possible to identify a much more diverse spread of material than was the case in the Mesolithic. This may well be a reflection of a more extensive exploitation strategy in which river terraces were cleared for agriculture while the areas left wooded and undisturbed continued to function as hunting/foraging territories well into the Neolithic. We may also suggest that this is a trend brought about by the greater degree of permanency which agriculture allows, with the regular spacing of settlement units dispersed along valley systems being characteristic.

The suggestion that settlement units would focus on the valley is supported both by the home-range interpretation (above), and by the evidence from palaeoecology. A suggested home-range, possibly belonging to the Neolithic, was located at a major ecological boundary separating the chalk from the valley gravels. The soil which forms upon chalk is relatively infertile, largely because it lacks many of the crucial mineral elements for healthy plant growth. Moffat and Cope (1984) however suggest that today's chalk soils display a more complex pattern than that which existed in the past, and hence that to early farmers, lithological uniformity would have been even more extreme. It was valley sides that were apparently cleared for farming at an early stage and therefore we must assume that it was the gravel and alluvial soils which were considered most suitable for cultivation. Indeed the chalk in many areas remained wooded often until the Bronze Age (Allen 1986, Thorley 1981) although such areas clearly

remained of considerable importance both for lithic extraction, hunting, foraging and the supply of timber. The location of settlement areas at a boundary between such critical resource patches would have been ideal and appears to have been the case, at least in the middle Avon valley.

Arrowheads were the only distinctive artefacts recovered in any number by surface collection, and their distribution along with the general spread of arrowheads on the chalk uplands of Cranborne Chase may well serve to delimit the extent of an extended territory, beyond what Foley (1981) describes as the occasional home-range. Arrowheads always appear to concentrate in upland zones and in areas unfavourable to long-term or permanent occupation; areas such as the Brecklands of East Anglia, the Cotswolds and the Yorkshire Wolds are frequently quoted. Bradley and Ellison (1975,190) point out that leaf arrowheads are common on the Berkshire Downs and not in the Lambourne valley while the same contrast can be seen between arrowhead frequency on the Sussex chalklands and those from the Weald (Curwen 1936). Both Bradley and Ellison (1975,191) and Green (1984,32) suggest these high density arrowhead scatters indicate areas which maintained higher population densities in the Neolithic; a more logical argument however may be that their distribution actually represents negative settlement areas, or in Foley's terms, an extra-home range. Certainly if we were to believe Bradley and Green, we would expect arrowheads to occur also in the river valleys. That they do not may rather invalidate the argument.

The Avon valley is a particularly important area for understanding the pattern of settlement and exploitation in the Neolithic. It lies at the centre of a complex mosaic of resource patches and with areas rich in monuments to the north around Avebury, and to the west on Cranborne Chase. We do know something of land-use strategies in these regions (Richards 1984, Bradley et.al. 1984, Smith 1985);

our knowledge of what was happening outside this 'monument zone' is however, limited.

Our knowledge of the settlement units themselves is minimal, with only a few structures recorded for the British Isles. Although small in number however, they do display a remarkable uniformity in size and form (chapter 5). The suggestion is that small family-sized units occupied these structures but never for very long, perhaps only 15-20 years, moving on to other similar sites as part of a system of shifting agriculture (Renfrew 1973). We may also suggest that units remained independent, maintaining a degree of autonomy and self-sufficiency. We know from excavations at Fengate (Pryor 1974) and Ballynagilly in Northern Ireland (ApSimon 1976) that this was the case and that it was a widespread phenomenon.

The general scatter of chipped stone artefacts within the river valleys of central-southern England support this picture. The pattern of shifting location and repeated cycles of occupation will tend to generate a pattern of differential density structure across the landscape, supported by distinct aspects of scatter composition, scrapers for example indicating areas of home-range/maintenance activities. If, as is suggested the middle Avon valley formed one such area where groups returned intermittently, then within one such zone we should expect to see a general scatter of home-range activities, defined by high density characteristics and a high incidence of maintenance items. As is described above, areas 1 and 2 to the north of the survey area appear to fit these requirements.

It would appear both from the evidence here, as well as that from neighbouring upland zones (Bradley et.al.1984 and Chapter 9), that in the Avon valley we are dealing with what has been described as a 'linear stream pattern' (Flannery 1976,173), whereby communities are dispersed

along the length of valley systems. By drawing on the principles of equidistant spacing as applied in central place theory, it is possible to construct a model for the expected arrangement of settlements. Social, environmental and economic reasons can be proposed accounting for the regular linear arrangement of valley settlements. If, as may be the case with farming communities, farming land is a primary factor, then we may expect to see a relationship between the spacing of villages and the width of valley alluvium. In other words, units may be closer together where alluvium is wide and further apart when the alluvium is narrow (Flannery 1976,177). It may be no surprise therefore to note the relationship between the proposed 'home-range' described above and the widest belt of valley gravels within the survey area.

In summary therefore a number of points can be made:

1. Settlement in the survey area forms one part of a system which maintained a degree of lesser mobility, whether the result of shifting agriculture (Renfrew 1973) or transhumance (Bradley 1978).

2. The area of settlement concentrated on the northern half of the survey area, with extra-home-range activities extending south along the river valley and west onto Cranborne Chase (Bradley et.al.1984).

3. It would seem likely that valley bases such as this were maintained as zones of occupation while the upper reaches of river valleys and areas of chalk downland performed a very different role, whether ceremonial or extractive.

4. With time, settlement shifted gradually up the valley profile in response to changes in the hydrological regime. This is a pattern observed both in the excavations at Downton (Rahtz 1962) and to a lesser extent through the survey results.

6.6.3 Bronze Age

The most substantial evidence for Bronze Age activity comprises the many burial monuments which are distributed widely across the survey area (Figure 6.15). The excavation of a ring ditch at Hucklesbrook for example, interpreted as the remains of a ploughed-out round barrow (Davies and Graham 1984), yielded several sherds of later Bronze Age pottery, although other features in the immediate vicinity do tend to suggest the presence of small scale occupation.

The evidence as a whole provides a picture of Bronze Age activity far more extensive than that from earlier periods. The distribution of barrows for example tends to concentrate on the upper scarp slope to the east of the valley as well as on the higher ground to the west. Barrows also exist - though are more widely dispersed - on the valley floor, while less substantial evidence appears in the form of occasional flint scatters, pottery and metalwork, often the result, as at Hucklesbrook of gravel extraction.

As was the case for the Neolithic, the survey area appears the poor relation in comparison to the evidence in the upper reaches of the Avon valley. Here, aerial photographs under drought conditions in 1975 revealed large numbers of ring-ditches on the valley floor (Smith 1985,226), a pattern which does not occur in the survey area. Instead it may be possible to trace the distribution of settlement through the location of flint scatters and boiling mounds, some of which are present in the survey area.

Chronology unfortunately provides little evidence for Bronze Age settlement, with a ubiquity score of only 0.6%; it is only technological indices, specifically those considered characteristic of declining ability (Ford et.al. 1984) upon which any observations of Bronze Age activity

might depend.

The distribution of collection units maintaining low blade frequencies tend to concentrate in the south of the region with an emphasis on the area around Harbridge. This pattern corresponds with one of the three findspots of Bronze Age pottery recovered during the survey, and a series of boiling mounds, all of which were identified initially through surface collection and one of which has subsequently been excavated. Areas with a high incidence of hinge fractures are widespread although one of the highest concentrations does correspond with this area, while the greatest frequency of core-rejuvenation flakes also appears to concentrate in the south of the survey area (Table 6.10). We should not ignore the fact however, that such cases may well be a reflection not of technological ineptitude but of the poor quality of local flint.

Another clue to the nature of settlement in the study area stems from a knowledge of what has been termed the 'Deverel-Rimbury complex' which appeared in the region from around 3100bp. In the Harbridge area at least two sherds of heavily tempered bucket urn were recovered by surface collection, a type defined by Ellison (1980) as representing heavy duty wares used for general domestic tasks. In Cranborne Chase immediately to the west, Barrett et.al. (1978) suggest that such pottery was being locally produced and possibly transported, either as a raw material or finished product, between settlements.

This would therefore conform with the lithic evidence to suggest small scale and essentially localised activity in this area of southern England. As Bradley (1984,106) has observed, in contrast to other areas of the country and having dominated the settlement pattern for most of the second millennium, Wessex in the middle Bronze Age becomes a rather marginal area with occupation sites showing less variety than, for example in the Thames valley. Ellison

(1981) suggests that a standard domestic unit should be found within Deverel-Rimbury settlements consisting of a major dwelling house plus one or more subsidiary huts and storage buildings. These features contrast strongly with the pattern at Aldermaston Wharf and may reflect the fact that Aldermaston is situated in a rather more productive area than Deverel-Rimbury settlements (Bradley et.al.1980,255).

The structure and arrangement of Bronze Age societies in southern England has been the subject of some attention in recent years, studies concentrating either on specific sites or site complexes or at a more general level of analysis. In the light of these investigations it should be possible to consider what the survey results actually represent. That we are dealing with a valley adaptation appears fairly convincing, and it may be useful to consider the evidence in those terms, looking for example to excavations on the Kennet gravels (Bradley et.al.1980) by way of analogy.

In the Salisbury region the distinction between valley and downland is one maintained by Smith (1985,293) who sees it in terms of transhumant exploitation of the upper portion of valley systems from settlement areas which occur in the broader middle reaches. Outlying territories do occasionally contain permanent occupation sites but for the most part are only seasonally visited. This distinction is further maintained by Bradley (1981) who sees a contrast in the pattern of burial between the two zones. In the extended downland territories, the range of barrow types is wider, the size of mounds is larger, mounds contain individual burials, the burial population comprises selected individuals while metalwork and specialised urn types are common. In the coastal region on the other hand, which includes the lower to middle reaches of most river valleys including the Avon, the situation is one of communal burial in smaller burial mounds, the inclusion of

grave goods being an exception to the rule. The evidence from burial would therefore appear to support that of settlement, with a clear distinction being maintained between the two types of environment.

Initially, subsistence strategies would have been geared largely to the clearance of scrub woodland. In Poole Harbour this represents the first significant reduction in tree pollen, while charcoal in a number of sequences within the region suggest controlled clearance phases (Haskins 1978,166), at least within the lowland zone. The appearance of field systems in areas of Wessex at this time and their relationship to the distribution of burial monuments combines to make the situation remarkably similar to that which occurs on Dartmoor. It is interesting to note that in this case Fleming (1983,224) also infers seasonal occupation of upland 'community territories' from settlement bases in the valley zone.

That some valley settlements were both extensive and relatively wealthy (Bradley et.al. 1980,289) is fairly certain. What is unclear however is the extent to which those sites are typical of the overall valley system. At Westbury in the Meon valley for example (Lewis and Walker 1977), a later Bronze Age settlement was excavated and found to consist of a series of pits, similar to those identified for the same period at Winnall Down in the Itchen valley (Fasham 1985). If this situation is typical then the signatures of Bronze Age activity that we might expect to see would be precisely those recorded in the Avon valley survey. If, on the other hand, sites like that at Aldermaston Wharf were typical of valley adaptations in this area of southern England, then we should expect to see a manifestation of the wealth of such sites in terms of the surface distribution and density of artefacts. This apparently does not occur in the case of the Avon valley and we may suggest therefore that it is a pattern of small scale activity, focused on the family group that we are

seeing in the survey results described above.

6.7 Summary

Two main points emerge from this discussion: First that the survey results demonstrate that chalkland river valleys were occupied throughout the prehistoric period. The results confirm the observation made through palaeoecology that it was in the valleys that early prehistoric communities made the most significant impact.

Second, that interpretation based solely on the distribution of chronological markers, as is often the case, would provide only a partial view of settlement and land-use in the survey area. Indeed where chronological arguments are based upon technological indices, 'patterns' may well relate to a different set of conditions altogether. I suggest that by adopting the home-range model, a full range of activity domains may be identified as well as evidence for lithic extraction and tool production on a local scale. That temporal shift, both in settlement and industrial activity occurred within the area may be established by calibrating the results of the survey with the expectations raised in chapter 5; the necessity for arguments such as 'blades = Mesolithic' and 'core trimming = Bronze Age' need never arise. It is suggested instead that specific types of location would have been favoured by hunter-gatherers and by farmers and that these may be identified by the results of surface collection. It is argued that in this case the home-range model and the emphasis on activity areas and technology provided a more detailed and unbiased picture of land-use within the survey area, than a more traditional chronology-based interpretation would have allowed.

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Geology																								
River gravels n=48	5.6	61.8	2.0	0.0	37.5	1.2	3.9	33.9	0.9	7.2	47.1	1.1	0.0	13.5	0.5	0.0	25.9	0.6	0.0	12.5	0.3	0.0	6.7	0.2
Plateau gravels n=6	9.8	31.5	3.1	11.3	44.7	5.1	5.0	51.7	6.8	13.0	31.3	2.8	1.3	6.9	0.9	4.1	11.6	1.1	1.9	17.9	2.4	0.0	2.9	0.5
Reading beds n=7	4.7	32.8	3.7	12.5	29.4	2.4	6.7	20.0	1.8	16.2	60.0	5.7	2.7	11.8	1.3	0.0	17.6	2.2	0.0	5.5	0.9	0.0	5.4	0.8
Bagshot sands n=4	12.3	32.4	4.1	15.7	44.1	6.4	10.9	17.0	1.3	15.1	32.1	3.6	0.8	9.9	2.0	3.7	11.9	1.8	1.2	11.9	2.5	0.0	4.1	0.9
upper chalk n=6	7.5	34.6	3.9	5.8	34.6	5.0	0.0	32.3	4.4	8.8	44.4	5.5	0.0	9.5	1.4	4.8	16.7	1.7	1.2	14.3	2.0	0.0	0.0	0.0

Note: se = standard error of the mean

Table 6.13: Statistics relating assemblage composition per field to geology.

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Geology																
River gravels n=48	30820.4	9017.7	20195.1	3199.8	9668.0	1854.8	32957.7	2887.7	1294.4	464.4	4192.6	917.4	565.5	271.9	266.5	140.1
Plateau gravels n=6	2488.4	291.9	3654.5	772.5	3733.9	1373.8	3339.9	243.6	77.0	23.0	556.0	38.9	414.8	174.2	10.4	6.7
Reading beds n=7	2381.5	576.7	3792.7	235.4	1595.0	137.8	6499.8	1375.2	320.7	75.9	772.9	200.5	67.4	36.9	40.7	26.7
Bagshot sands n=4	2286.8	202.9	3085.8	495.0	800.0	18.8	2284.4	159.2	129.5	48.5	314.6	37.4	155.3	76.9	23.4	10.5
upper chalk n=6	2676.9	445.8	4729.8	751.4	2261.7	571.6	6546.2	903.5	147.0	62.7	574.6	88.6	340.6	121.0	0.0	0.0

Note: a = sum of squares
b = deviation of sum of squares

Table 6.14: Statistics relating assemblage composition per field to geological divisions in the middle Avon valley (alluvium is excluded).

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Soil																								
571g n=14	4.7	34.6	2.7	5.8	38.1	2.3	0.0	32.3	2.0	8.8	60.0	3.5	0.0	11.8	0.9	4.4	17.6	1.1	0.0	14.3	1.1	0.0	6.7	0.6
571w n=18	5.6	45.9	2.9	5.7	37.5	1.9	4.2	26.5	1.3	11.1	36.7	1.6	0.0	12.2	0.9	0.0	25.9	1.3	0.0	12.5	0.7	0.0	4.9	0.4
581b n=15	8.3	48.6	2.7	11.3	44.7	2.7	5.0	51.7	2.8	13.0	47.1	2.2	0.0	6.9	0.5	3.1	13.9	0.9	0.0	17.9	1.2	0.0	4.1	0.4
812a n=23	6.8	61.8	3.0	0.0	35.7	1.9	3.9	33.9	1.5	7.2	39.0	1.6	1.0	13.5	0.6	2,9	18.2	0.8	0.0	7.5	0.4	0.0	4.6	0.3

Note: se = standard error of the mean

Table 6.15: Statistics relating assemblage composition per field to soil divisions.

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Soil																
571g n=14	5664.6	1289.2	9389.2	975.9	4209.1	723.6	14678.4	2281.5	490.8	156.6	1420.9	228.6	418.1	221.9	102.4	71.8
571w n=18	10654.7	2518.1	6169.3	1058.7	3009.8	543.4	12385.2	792.6	635.9	230.7	1708.9	513.3	223.2	133.0	76.8	46.9
581b n=15	6500.2	1542.5	8733.5	1495.4	5659.7	1697.2	10574.8	1018.9	154.0	61.8	1333.3	176.9	624.9	327.5	45.3	27.1
812a n=23	16333.1	4698.3	11412.1	1885.2	4795.4	1068.0	13636.9	1303.8	656.6	195.3	1983.7	296.4	281.0	90.1	116.8	49.0

Note: a = sum of squares
b = deviation of sum of squares

Table 6.16: Statistics relating assemblage composition per field to soil divisions in the middle Avon valley (excluding 571j and 841b).

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Topography																								
<30m n=29	5.6	61.8	2.8	0.0	37.5	1.9	3.9	33.9	1.2	7.2	39.0	1.5	0.0	12.2	0.5	2.7	25.9	0.9	0.0	12.5	0.5	0.0	4.6	0.3
31-40m n=17	7.7	48.6	2.6	8.0	25.7	1.2	5.6	26.5	1.5	13.6	32.2	1.2	0.0	13.5	0.9	0.0	13.8	0.9	0.0	7.5	0.4	0.0	4.9	0.3
41-50m n=10	4.7	45.9	3.8	11.3	44.1	3.1	4.9	20.5	1.9	13.0	60.0	4.5	0.0	11.8	1.1	4.4	17.6	1.2	0.0	11.9	1.3	0.0	6.7	0.7
51-60m n=9	6.5	32.8	2.9	13.3	44.7	3.1	10.7	51.7	4.3	16.2	32.1	2.1	0.8	9.7	1.0	4.1	12.5	1.1	0.0	17.9	1.9	0.0	5.4	0.7
61-70m n=3	13.2	34.6	6.6	5.8	33.1	8.0	12.3	32.3	6.2	8.8	38.6	9.4	1.2	5.0	1.2	6.6	16.7	3.1	1.2	6.1	1.4	0.0	0.0	0.0
>70m n=4	5.5	18.3	3.2	12.5	38.1	5.7	0.0	21.8	5.1	20.0	36.8	3.5	0.0	9.5	2.0	0.0	12.2	2.5	0.0	14.3	3.2	0.0	1.4	0.4

Note: se = standard error of the mean

Table 6.17: Statistics relating assemblage composition per field to topographic divisions

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Topography																
<30m OD n=29	21332.1	6220.2	13338.2	2854.0	5481.0	1140.2	19569.3	1886.5	830.6	238.0	2843.6	655.6	430.0	185.5	146.9	75.5
31-40m OD n=17	8990.0	1780.0	6264.9	391.0	4147.3	604.9	9202.6	420.0	446.1	208.9	1080.7	200.8	118.8	41.7	79.7	33.3
41-50m OD n=10	3874.7	1272.9	6855.5	857.9	1877.5	339.9	12435.7	1801.6	316.3	112.0	1191.3	124.2	306.4	162.0	49.1	39.1
51-60m OD n=9	4154.0	609.8	5421.0	710.2	4278.6	1341.0	5116.9	305.1	231.6	73.6	800.8	80.7	418.1	251.7	64.0	37.3
61-70m OD n=3	1670.7	258.0	1714.9	387.7	1444.2	228.2	2820.6	535.3	28.7	8.9	388.1	59.4	55.5	12.1	0.0	0.0
>70m OD n=4	690.4	121.5	2745.7	383.7	855.0	307.5	3185.4	143.8	146.8	47.7	225.2	77.5	236.9	121.3	2.0	1.5

Note: a = sum of squares
b = deviation of sum of squares

Table 6.18: Statistics relating assemblage composition per field to topographic divisions in the middle Avon valley.

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Distance from river																								
<400m n=22	6.8	61.8	3.2	0.0	35.7	2.0	5.0	21.1	1.0	7.2	33.3	1.3	1.0	13.5	0.7	0.0	18.2	0.9	0.0	7.5	0.4	0.0	4.9	0.3
401-800m n=19	5.6	48.6	3.1	5.7	37.5	1.7	3.9	33.9	1.8	13.0	39.0	1.8	0.0	12.2	0.8	4.5	25.9	1.1	0.0	12.5	0.7	0.0	4.6	0.4
801-1200m n=12	6.9	31.5	2.2	8.0	44.7	3.3	4.2	22.5	1.6	13.6	32.2	1.8	0.0	8.3	0.7	3.8	12.5	1.0	0.0	17.9	1.5	0.0	4.2	0.4
1201-1600m n=9	6.5	34.6	2.9	5.8	27.8	2.2	5.0	32.3	2.8	8.8	47.1	3.5	0.0	6.7	0.8	2.7	16.7	1.5	0.0	6.1	0.7	0.0	6.7	0.7
1601-2000m n=6	4.7	32.8	3.7	17.2	29.4	2.0	10.7	51.7	6.0	16.2	60.0	6.7	1.7	11.8	1.7	5.4	17.6	1.9	0.0	6.8	1.2	0.0	5.4	0.9
>2000m n=4	5.5	24.8	4.5	12.5	38.1	5.8	0.0	18.5	4.2	26.7	44.4	3.7	5.0	9.5	1.0	0.0	10.5	2.1	0.0	14.3	3.1	0.0	0.0	0.0

Note: se = standard error of the mean

Table 6.19: Statistics relating assemblage composition per field with distance from river

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Distance from river																
<400m n=22	17900.8	4841.9	8923.3	1856.3	3662.2	460.5	11012.0	833.9	701.3	198.3	1621.5	346.2	231.2	78.8	130.6	39.0
401-800m n=19	12105.0	3266.3	8847.0	1029.4	5139.0	1126.8	13936.5	1082.1	512.7	220.6	2192.7	381.7	310.2	150.4	85.5	50.8
801-1200m n=12	4928.0	652.8	7827.7	1470.5	2229.7	322.1	7176.0	435.7	227.7	72.9	837.4	130.5	554.4	306.8	38.2	26.2
1201-1600m n=9	2633.8	587.8	3096.1	353.8	2332.2	568.2	8547.2	908.5	98.6	44.4	918.3	154.7	64.3	34.0	46.6	39.5
1601-2000m n=6	2143.3	419.4	3710.3	123.5	4083.8	1082.2	6130.2	1353.1	276.7	82.8	782.9	104.5	106.9	48.0	40.7	24.4
>2000m n=4	1000.8	241.8	3935.5	407.1	636.8	216.5	5528.5	162.9	183.0	12.7	176.9	56.9	298.7	113.8	0.0	0.0

Note: a = sum of squares
b = deviation of sum of squares

Table 6.20: Statistics relating assemblage composition per field to distance from the river Avon.

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Zone																								
1 n=7	7.5	20.0	1.8	10.6	37.5	3.3	5.0	21.1	2.2	18.4	36.7	2.7	1.9	13.5	1.7	0.0	11.3	1.6	0.0	12.5	1.6	0.0	4.9	0.7
2 n=14	13.3	48.6	3.0	5.8	30.8	1.8	4.9	26.5	1.8	8.8	32.2	1.7	0.0	8.3	0.6	3.8	12.5	0.7	0.0	4.1	0.3	0.0	4.1	0.3
3 n=6	5.5	24.8	2.9	12.5	38.1	3.8	0.0	32.3	4.5	26.7	44.4	2.8	1.5	9.5	1.1	0.0	16.7	2.4	0.0	14.3	2.0	0.0	1.4	0.2
4 n=13	4.7	32.8	2.2	17.2	29.4	1.1	3.9	33.9	2.2	13.6	60.0	3.8	0.0	11.8	0.9	4.4	17.6	1.2	0.0	6.9	0.7	0.0	6.7	0.7
5 n=20	7.9	44.5	2.3	11.2	44.7	2.3	5.0	51.7	2.2	7.2	37.8	1.8	0.8	9.9	0.6	3.1	14.3	0.7	1.2	17.9	0.9	0.0	4.6	0.4
6 n=12	5.6	61.8	5.2	0.0	23.7	2.3	4.2	14.8	0.9	11.1	32.8	1.7	0.0	11.1	1.0	2.7	25.9	1.9	0.0	4.5	0.4	0.0	4.2	0.4

Note: se refers to the standard error of the mean.

Table 6.21: Statistics relating assemblage composition per field to the six ecological zones

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Zone																
1 n=7	856.9	128.7	4063.6	465.7	1182.5	196.0	5295.6	300.0	465.3	118.1	418.1	101.2	248.0	110.7	65.8	19.5
2 n=14	11479.1	1615.7	4765.6	568.6	3604.9	588.4	7812.3	516.3	174.7	74.3	949.1	81.7	66.8	15.1	33.6	17.5
3 n=6	1444.0	248.3	5327.7	431.4	2015.0	616.5	7499.9	240.6	202.1	34.6	604.6	174.5	365.1	115.5	2.0	1.6
4 n=13	3306.6	724.9	7029.0	198.0	3298.6	722.5	12728.2	2271.3	398.3	135.9	1431.3	215.8	139.2	78.4	94.5	68.2
5 n=20	11633.2	2097.8	12798.7	1296.9	6753.4	1785.9	11391.1	1194.0	420.0	123.6	1660.7	181.5	698.6	302.5	106.6	50.1
6 n=12	11992.0	3607.3	2355.3	682.0	1229.4	115.7	7603.3	390.4	339.5	121.1	1465.8	495.6	48.1	26.0	39.2	22.9

Notes: a = sum of squares
b = deviation of the sum of squares

Table 6.22: Statistics relating assemblage composition per field to the six ecological zones

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 1 . DENS

LABEL: FREQUENCY DISTRIBUTION: DENSITY PER HECTARE

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	5.00	1	1.39	1	1.39
5.00	<	10.00	17	23.61	18	25.00
10.00	<	15.00	11	15.28	29	40.28
15.00	<	20.00	13	18.06	42	58.33
20.00	<	25.00	9	12.50	51	70.83
25.00	<	30.00	7	9.72	58	80.56
30.00	<	35.00	6	8.33	64	88.89
35.00	<	40.00	2	2.78	66	91.67
40.00	<	45.00	2	2.78	68	94.44
45.00	<	50.00	2	2.78	70	97.22
50.00	<	55.00	1	1.39	71	98.61
55.00	<	60.00	0	0.00	71	98.61
60.00	<	65.00	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 1 . DENS

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	5.00	1	=
5.00	<	10.00	17	=================================
10.00	<	15.00	11	=====================
15.00	<	20.00	13	=========================
20.00	<	25.00	9	================
25.00	<	30.00	7	============
30.00	<	35.00	6	==========
35.00	<	40.00	2	===
40.00	<	45.00	2	===
45.00	<	50.00	2	===
50.00	<	55.00	1	=
55.00	<	60.00	0	
60.00	<	65.00	1	=

Table 6.23

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 2 . %RET

LABEL: FREQUENCY DISTRIBUTION: % RETOUCH PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	2.50	1	1.39	1	1.39
2.50	<	5.00	1	1.39	2	2.78
5.00	<	7.50	3	4.17	5	6.94
7.50	<	10.00	3	4.17	8	11.11
10.00	<	12.50	5	6.94	13	18.06
12.50	<	15.00	4	5.56	17	23.61
15.00	<	17.50	10	13.89	27	37.50
17.50	<	20.00	9	12.50	36	50.00
20.00	<	22.50	7	9.72	43	59.72
22.50	<	25.00	8	11.11	51	70.83
25.00	<	27.50	7	9.72	58	80.56
27.50	<	30.00	4	5.56	62	86.11
30.00	<	32.50	2	2.78	64	88.89
32.50	<	35.00	2	2.78	66	91.67
35.00	<	37.50	2	2.78	68	94.44
37.50	<	40.00	2	2.78	70	97.22
40.00	<	42.50	0	0.00	70	97.22
42.50	<	45.00	2	2.78	72	100.00
		TOTAL	72	100.00		

VARIABLE: 2 . %RET

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	2.50	1	==
2.50	<	5.00	1	==
5.00	<	7.50	3	========
7.50	<	10.00	3	========
10.00	<	12.50	5	==============
12.50	<	15.00	4	===========
15.00	<	17.50	10	==============================
17.50	<	20.00	9	==========================
20.00	<	22.50	7	====================
22.50	<	25.00	8	=======================
25.00	<	27.50	7	====================
27.50	<	30.00	4	===========
30.00	<	32.50	2	=====
32.50	<	35.00	2	=====
35.00	<	37.50	2	=====
37.50	<	40.00	2	=====
40.00	<	42.50	0	
42.50	<	45.00	2	=====

Table 6.24

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 3 .%PRIM

LABEL: FREQUENCY DISTRIBUTION: % PRIMARY WASTE PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	3.50	1	1.39	1	1.39
3.50	<	7.00	9	12.50	10	13.89
7.00	<	10.50	14	19.44	24	33.33
10.50	<	14.00	19	26.39	43	59.72
14.00	<	17.50	11	15.28	54	75.00
17.50	<	21.00	9	12.50	63	87.50
21.00	<	24.50	5	6.94	68	94.44
24.50	<	28.00	1	1.39	69	95.83
28.00	<	31.50	0	0.00	69	95.83
31.50	<	35.00	2	2.78	71	98.61
35.00	<	38.50	0	0.00	71	98.61
38.50	<	42.00	0	0.00	71	98.61
42.00	<	45.50	0	0.00	71	98.61
45.50	<	49.00	0	0.00	71	98.61
49.00	<	52.50	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 3 . %PRIM

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	3.50	1	=
3.50	<	7.00	9	==========
7.00	<	10.50	14	==========
10.50	<	14.00	19	==========
14.00	<	17.50	11	==========
17.50	<	21.00	9	==========
21.00	<	24.50	5	=======
24.50	<	28.00	1	=
28.00	<	31.50	0	
31.50	<	35.00	2	===
35.00	<	38.50	0	
38.50	<	42.00	0	
42.00	<	45.50	0	
45.50	<	49.00	0	
49.00	<	52.50	1	=

Table 6.25

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 4 .%TERT

LABEL: FREQUENCY DISTRIBUTION: % TERTIARY WASTE PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	3.50	0	0.00	0	0.00
3.50	<	7.00	0	0.00	0	0.00
7.00	<	10.50	2	2.78	2	2.78
10.50	<	14.00	3	4.17	5	6.94
14.00	<	17.50	7	9.72	12	16.67
17.50	<	21.00	14	19.44	26	36.11
21.00	<	24.50	9	12.50	35	48.61
24.50	<	28.00	11	15.28	46	63.89
28.00	<	31.50	11	15.28	57	79.17
31.50	<	35.00	6	8.33	63	87.50
35.00	<	38.50	4	5.56	67	93.06
38.50	<	42.00	2	2.78	69	95.83
42.00	<	45.50	1	1.39	70	97.22
45.50	<	49.00	1	1.39	71	98.61
49.00	<	52.50	0	0.00	71	98.61
52.50	<	56.00	0	0.00	71	98.61
56.00	<	59.50	0	0.00	71	98.61
59.50	<	63.00	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 4 . %TERT

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	3.50	0	
3.50	<	7.00	0	
7.00	<	10.50	2	====
10.50	<	14.00	3	======
14.00	<	17.50	7	==========
17.50	<	21.00	14	==========
21.00	<	24.50	9	==========
24.50	<	28.00	11	==========
28.00	<	31.50	11	==========
31.50	<	35.00	6	==========
35.00	<	38.50	4	========
38.50	<	42.00	2	====
42.00	<	45.50	1	==
45.50	<	49.00	1	==
49.00	<	52.50	0	
52.50	<	56.00	0	
56.00	<	59.50	0	
59.50	<	63.00	1	==

Table 6.26

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 5 .%CORE

LABEL: FREQUENCY DISTRIBUTION: % CORES PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	1.00	7	9.72	7	9.72
1.00	<	2.00	13	18.06	20	27.78
2.00	<	3.00	11	15.28	31	43.06
3.00	<	4.00	7	9.72	38	52.78
4.00	<	5.00	7	9.72	45	62.50
5.00	<	6.00	10	13.89	55	76.39
6.00	<	7.00	6	8.33	61	84.72
7.00	<	8.00	2	2.78	63	87.50
8.00	<	9.00	2	2.78	65	90.28
9.00	<	10.00	3	4.17	68	94.44
10.00	<	11.00	0	0.00	68	94.44
11.00	<	12.00	2	2.78	70	97.22
12.00	<	13.00	1	1.39	71	98.61
13.00	<	14.00	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 5 . %CORE

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	1.00	7	==========
1.00	<	2.00	13	==========
2.00	<	3.00	11	==========
3.00	<	4.00	7	==========
4.00	<	5.00	7	==========
5.00	<	6.00	10	==========
6.00	<	7.00	6	==========
7.00	<	8.00	2	====
8.00	<	9.00	2	====
9.00	<	10.00	3	======
10.00	<	11.00	0	
11.00	<	12.00	2	====
12.00	<	13.00	1	==
13.00	<	14.00	1	==

Table 6.27

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 6 .%BLAD

LABEL: FREQUENCY DISTRIBUTION: % BLADES PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	1.50	2	2.78	2	2.78
1.50	<	3.00	2	2.78	4	5.56
3.00	<	4.50	8	11.11	12	16.67
4.50	<	6.00	8	11.11	20	27.78
6.00	<	7.50	9	12.50	29	40.28
7.50	<	9.00	14	19.44	43	59.72
9.00	<	10.50	8	11.11	51	70.83
10.50	<	12.00	9	12.50	60	83.33
12.00	<	13.50	5	6.94	65	90.28
13.50	<	15.00	3	4.17	68	94.44
15.00	<	16.50	0	0.0Q	68	94.44
16.50	<	18.00	2	2.78	70	97.22
18.00	<	19.50	1	1.39	71	98.61
19.50	<	21.00	0	0.00	71	98.61
21.00	<	22.50	0	0.00	71	98.61
22.50	<	24.00	0	0.00	71	98.61
24.00	<	25.50	0	0.00	71	98.61
25.50	<	27.00	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 6 . %BLAD

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	1.50	2	====
1.50	<	3.00	2	====
3.00	<	4.50	8	==========
4.50	<	6.00	8	==========
6.00	<	7.50	9	==========
7.50	<	9.00	14	==========
9.00	<	10.50	8	==========
10.50	<	12.00	9	==========
12.00	<	13.50	5	==========
13.50	<	15.00	3	======
15.00	<	16.50	0	
16.50	<	18.00	2	====
18.00	<	19.50	1	==
19.50	<	21.00	0	
21.00	<	22.50	0	
22.50	<	24.00	0	
24.00	<	25.50	0	
25.50	<	27.00	1	==

Table 6.28

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 7 .%SCRA

LABEL: FREQUENCY DISTRIBUTION: % SCRAPERS PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	1.00	15	20.83	15	20.83
1.00	<	2.00	15	20.83	30	41.67
2.00	<	3.00	15	20.83	45	62.50
3.00	<	4.00	6	8.33	51	70.83
4.00	<	5.00	7	9.72	58	80.56
5.00	<	6.00	4	5.56	62	86.11
6.00	<	7.00	4	5.56	66	91.67
7.00	<	8.00	1	1.39	67	93.06
8.00	<	9.00	1	1.39	68	94.44
9.00	<	10.00	0	0.00	68	94.44
10.00	<	11.00	0	0.00	68	94.44
11.00	<	12.00	1	1.39	69	95.83
12.00	<	13.00	1	1.39	70	97.22
13.00	<	14.00	0	0.00	70	97.22
14.00	<	15.00	1	1.39	71	98.61
15.00	<	16.00	0	0.00	71	98.61
16.00	<	17.00	0	0.00	71	98.61
17.00	<	18.00	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 7 . %SCRA

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	1.00	15	==========
1.00	<	2.00	15	==========
2.00	<	3.00	15	==========
3.00	<	4.00	6	======
4.00	<	5.00	7	=======
5.00	<	6.00	4	====
6.00	<	7.00	4	====
7.00	<	8.00	1	=
8.00	<	9.00	1	=
9.00	<	10.00	0	
10.00	<	11.00	0	
11.00	<	12.00	1	=
12.00	<	13.00	1	=
13.00	<	14.00	0	
14.00	<	15.00	1	=
15.00	<	16.00	0	
16.00	<	17.00	0	
17.00	<	18.00	1	=

Table 6.29

HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

VARIABLE: 8 . %CT

LABEL: FREQUENCY DISTRIBUTION: % CORE TRIMMING FLAKES PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	0.50	32	44.44	32	44.44
0.50	<	1.00	8	11.11	40	55.56
1.00	<	1.50	5	6.94	45	62.50
1.50	<	2.00	5	6.94	50	69.44
2.00	<	2.50	2	2.78	52	72.22
2.50	<	3.00	5	6.94	57	79.17
3.00	<	3.50	4	5.56	61	84.72
3.50	<	4.00	2	2.78	63	87.50
4.00	<	4.50	5	6.94	68	94.44
4.50	<	5.00	2	2.78	70	97.22
5.00	<	5.50	1	1.39	71	98.61
5.50	<	6.00	0	0.00	71	98.61
6.00	<	6.50	0	0.00	71	98.61
6.50	<	7.00	1	1.39	72	100.00
		TOTAL	72	100.00		

VARIABLE: 8 . %CT

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	0.50	32	==========
0.50	<	1.00	8	=======
1.00	<	1.50	5	====
1.50	<	2.00	5	====
2.00	<	2.50	2	=
2.50	<	3.00	5	====
3.00	<	3.50	4	===
3.50	<	4.00	2	=
4.00	<	4.50	5	====
4.50	<	5.00	2	=
5.00	<	5.50	1	
5.50	<	6.00	0	
6.00	<	6.50	0	
6.50	<	7.00	1	

Table 6.30

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	21.313	48
2	19.133	6
3	16.057	7
4	22.825	4
5	19.283	6

GRAND MEAN 20.524

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: DENSITY vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	211.530	4	52.883	0.331
WITHIN	10534.980	66	159.621	
TOTAL	10746.510	70		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	18.817	48
2	21.917	6
3	22.543	7
4	25.450	4
5	25.750	6

GRAND MEAN 20.406

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % RETOUCH vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	440.021	4	110.005	1.331
WITHIN	5454.097	66	82.638	
TOTAL	5894.117	70		

Table 6.31: 1: river gravels; 2: plateau gravels 3: Reading beds; 4: Bagshot sands; 5: upper chalk

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	12.758	48
2	19.833	6
3	14.429	7
4	13.975	4
5	16.783	6

GRAND MEAN 13.930

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	325.588	4	81.397	1.358
WITHIN	3956.740	66	59.951	
TOTAL	4282.328	70		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	25.029	48
2	22.717	6
3	27.057	7
4	23.050	4
5	30.667	6

GRAND MEAN 25.399

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	257.542	4	64.385	0.763
WITHIN	5569.289	66	84.383	
TOTAL	5826.831	70		

Table 6.32: Key as for Table 6.31

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	4.158	48
2	3.000	6
3	5.914	7
4	4.500	4
5	3.750	6

GRAND MEAN 4.218

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORES vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	30.846	4	7.711	0.755
WITHIN	674.400	66	10.218	
TOTAL	705.246	70		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.260	48
2	9.283	6
3	9.043	7
4	8.325	4
5	9.000	6

GRAND MEAN 8.490

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % BLADES vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	10.115	4	2.529	0.130
WITHIN	1282.808	66	19.436	
TOTAL	1292.923	70		

Table 6.33: Key as for Table 6.31

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	2.473	48
2	6.333	6
3	2.086	7
4	4.425	4
5	6.050	6

GRAND MEAN 3.173

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % SCRAPERS vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	147.660	4	36.915	3.578
WITHIN	680.959	66	10.318	
TOTAL	828.619	70		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.623	48
2	0.783	6
3	1.414	7
4	1.800	4
5	0.000	6

GRAND MEAN 1.404

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs GEOLOGY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	17.067	4	4.267	1.531
WITHIN	183.962	66	2.787	
TOTAL	201.029	70		

Table 6.34: Key as for Table 6.31

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	17.679	14
2	21.261	18
3	18.180	15
4	22.491	23

GRAND MEAN 20.289

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: DENSITY vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	290.682	3	96.894	0.636
WITHIN	10048.190	66	152.245	
TOTAL	10338.870	69		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	24.514	14
2	16.850	18
3	21.967	15
4	20.352	23

GRAND MEAN 20.630

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % RETOUCH vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	496.994	3	165.665	2.019
WITHIN	5415.253	66	82.049	
TOTAL	5912.247	69		

Table 6.35: 1: 571g; 2: 571w; 3: 581b; 4: 812a

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	15.779	14
2	11.706	18
3	16.253	15
4	12.730	23

GRAND MEAN 13.831

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	250.292	3	83.431	1.366
WITHIN	4032.098	66	61.092	
TOTAL	4282.390	69		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	29.757	14
2	25.378	18
3	25.240	15
4	23.157	23

GRAND MEAN 25.494

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	381.320	3	127.107	1.554
WITHIN	5396.797	66	81.770	
TOTAL	5778.116	69		

Table 6.36: Key as for Table 6.35

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	4.886	14
2	4.744	18
3	2.480	15
4	4.478	23

GRAND MEAN 4.200

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORES vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	58.075	3	19.358	1.983
WITHIN	644.385	66	9.763	
TOTAL	702.460	69		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	9.229	14
2	8.150	18
3	8.780	15
4	8.565	23

GRAND MEAN 8.637

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % BLADES vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	9.594	3	3.198	0.174
WITHIN	1215.169	66	18.412	
TOTAL	1224.763	69		

Table 6.37: Key as for Table 6.35

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	3.743	14
2	2.239	18
3	4.453	15
4	2.878	23

GRAND MEAN 3.224

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % SCRAPERS vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	46.655	3	15.552	1.328
WITHIN	772.773	66	11.709	
TOTAL	819.429	69		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.479	14
2	1.289	18
3	1.100	15
4	1.717	23

GRAND MEAN 1.427

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	3.924	3	1.308	0.443
WITHIN	194.814	66	2.952	
TOTAL	198.738	69		

Table 6.38: Key as for Table 6.35

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	22.828	29
2	20.594	17
3	16.130	10
4	19.844	9
5	21.700	3
6	11.925	4

GRAND MEAN 20.344

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: DENSITY vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	648.800	5	129.760	0.835
WITHIN	10262.420	66	155.491	
TOTAL	10911.220	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	19.014	29
2	18.588	17
3	24.490	10
4	22.878	9
5	21.033	3
6	24.300	4

GRAND MEAN 20.535

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % RETOUCH vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	394.800	5	78.960	0.933
WITHIN	5584.505	66	84.614	
TOTAL	5979.304	71		

Table 6.39: 1: less than 30m; 2: 31-40m; 3: 41-50m; 4: 51-60m; 5: 61-70m; 6: greater than 70m.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	12.234	29
2	14.435	17
3	12.400	10
4	18.067	9
5	20.133	3
6	11.700	4

GRAND MEAN 13.806

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	399.347	5	79.869	1.331
WITHIN	3961.611	66	60.024	
TOTAL	4360.958	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	24.693	29
2	22.729	17
3	32.610	10
4	23.122	9
5	27.600	3
6	27.575	4

GRAND MEAN 25.414

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	735.700	5	147.140	1.907
WITHIN	5092.327	66	77.156	
TOTAL	5828.027	71		

Table 6.40. Key as for Table 6.39.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	4.521	29
2	3.735	17
3	4.520	10
4	4.189	9
5	2.567	3
6	4.975	4

GRAND MEAN 4.238

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORES vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	17.983	5	3.597	0.344
WITHIN	689.146	66	10.442	
TOTAL	707.129	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.686	29
2	7.194	17
3	10.330	10
4	8.944	9
5	10.467	3
6	6.075	4

GRAND MEAN 8.524

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % BLADES vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	100.349	5	20.070	1.105
WITHIN	1198.302	66	18.156	
TOTAL	1298.650	71		

Table 6.41. Key as for Table 6.39.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	2.903	29
2	2.129	17
3	3.800	10
4	4.300	9
5	3.800	3
6	5.375	4

GRAND MEAN 3.194

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % SCRAPERS vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	56.525	5	11.305	0.964
WITHIN	774.392	66	11.733	
TOTAL	830.918	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.569	29
2	1.653	17
3	1.000	10
4	1.722	9
5	0.000	3
6	0.350	4

GRAND MEAN 1.396

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	14.739	5	2.948	1.042
WITHIN	186.650	66	2.828	
TOTAL	201.389	71		

Table 6.42. Key as for Table 6.39.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	24.364	22
2	21.568	19
3	18.875	12
4	15.078	9
5	16.950	6
6	13.775	4

GRAND MEAN 20.344

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: DENSITY vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	901.165	5	180.233	1.188
WITHIN	10010.050	66	151.667	
TOTAL	10911.220	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	17.923	22
2	20.284	19
3	23.017	12
4	17.456	9
5	24.450	6
6	29.700	4

GRAND MEAN 20.535

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % RETOUCH vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	738.525	5	147.705	1.860
WITHIN	5240.778	66	79.406	
TOTAL	5979.303	71		

Table 6.43: 1: less than 400m from river; 2: 401-800m; 3: 801-1200m; 4: 1201-1600m; 5: 1601- 2000m; 6: greater than 2000m.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	12.064	22
2	14.532	19
3	12.608	12
4	14.000	9
5	22.367	6
6	10.250	4

GRAND MEAN 13.806

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	584.633	5	116.927	2.044
WITHIN	3776.324	66	57.217	
TOTAL	4360.958	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	21.509	22
2	26.011	19
3	23.700	12
4	29.133	9
5	28.217	6
6	36.625	4

GRAND MEAN 25.414

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	1051.854	5	210.371	2.907
WITHIN	4776.174	66	72.366	
TOTAL	5828.028	71		

Table 6.44. Key as for Table 6.43.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	4.782	22
2	3.921	19
3	3.592	12
4	2.456	9
5	5.683	6
6	6.525	4

GRAND MEAN 4.237

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORES vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	75.477	5	15.095	1.577
WITHIN	631.651	66	9.570	
TOTAL	707.129	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	7.614	22
2	9.763	19
3	7.675	12
4	9.211	9
5	10.633	6
6	5.475	4

GRAND MEAN 8.524

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % BLADES vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	124.188	5	24.838	1.396
WITHIN	1174.462	66	17.795	
TOTAL	1298.650	71		

Table 6.45. Key as for Table 6.43.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	2.632	22
2	2.900	19
3	4.542	12
4	1.833	9
5	3.133	6
6	6.800	4

GRAND MEAN 3.194

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % SCRAPERS vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	99.088	5	19.818	1.787
WITHIN	731.830	66	11.088	
TOTAL	830.918	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	2.041	22
2	1.353	19
3	1.000	12
4	0.889	9
5	1.650	6
6	0.000	4

GRAND MEAN 1.396

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	21.564	5	4.313	1.583
WITHIN	179.824	66	2.725	
TOTAL	201.389	71		

Table 6.46. Key as for Table 6.43.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	10.200	7
2	26.543	14
3	14.117	6
4	14.092	13
5	21.835	20
6	26.433	12

GRAND MEAN 20.344

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: DENSITY VARIATION BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	2488.454	5	497.691	3.900
WITHIN	8422.764	66	127.618	
TOTAL	10911.220	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	22.671	7
2	17.314	14
3	28.567	6
4	22.923	13
5	23.315	20
6	11.808	12

GRAND MEAN 20.535

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % RETOUCH BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	1706.781	5	341.356	5.273
WITHIN	4272.523	66	64.735	
TOTAL	5979.303	71		

Table 6.47. Numbers refer to the six zones in Figure 6.8.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	11.871	7
2	14.679	14
3	15.267	6
4	14.077	13
5	15.760	20
6	9.633	12

GRAND MEAN 13.806

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	335.909	5	67.182	1.102
WITHIN	4025.050	66	60.986	
TOTAL	4360.959	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	26.714	7
2	22.829	14
3	34.783	6
4	28.362	13
5	22.580	20
6	24.517	12

GRAND MEAN 25.414

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	915.361	5	183.072	2.460
WITHIN	4912.665	66	74.434	
TOTAL	5828.027	71		

Table 6.48. Key as for Table 6.47.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	7.043	7
2	2.679	14
3	5.283	6
4	4.492	13
5	3.850	20
6	4.267	12

GRAND MEAN 4.238

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORES BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	99.534	5	19.907	2.162
WITHIN	607.595	66	9.206	
TOTAL	707.129	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	6.729	7
2	7.871	14
3	8.467	6
4	9.669	13
5	8.600	20
6	8.992	12

GRAND MEAN 8.524

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % BLADES BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	48.337	5	9.667	0.510
WITHIN	1250.313	66	18.944	
TOTAL	1298.650	71		

Table 6.49. Key as for Table 6.47.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	4.429	7
2	1.921	14
3	6.450	6
4	2.162	13
5	4.450	20
6	1.358	12

GRAND MEAN 3.194

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % SCRAPERS BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	182.795	5	36.559	3.723
WITHIN	648.123	66	9.820	
TOTAL	830.918	71		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	2.571	7
2	1.071	14
3	0.233	6
4	1.423	13
5	1.680	20
6	1.167	12

GRAND MEAN 1.396

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	21.511	5	4.302	1.579
WITHIN	179.878	66	2.725	
TOTAL	201.389	71		

Table 6.50. Key as for Table 6.47.

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: DENSITY (>15 per ha) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	29	28.70	0.6905	0.6833
2	2	4.10	0.0476	0.0976
3	3	3.60	0.0714	0.0857
4	1	1.60	0.0238	0.0381
5	7	4.10	0.1667	0.0976
TOTALS	42	42.10	1.0000	1.0024

CHI-SQUARE= 3.455 D.F.= 4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 4

D MAX = 0.0693

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % RETOUCH (>25%) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	14	15.70	0.6087	0.6826
2	1	2.30	0.0435	0.1000
3	6	2.00	0.2609	0.0870
4	2	0.90	0.0870	0.0391
5	0	2.30	0.0000	0.1000
TOTALS	23	23.20	1.0000	1.0087

CHI-SQUARE= 12.563 D.F.= 4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 2

D MAX = 0.1237

Table 6.51. Key as for Table 6.31 (p280).

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % CORES (>6%) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	12	12.30	0.6667	0.6833
2	2	1.80	0.1111	0.1000
3	3	1.50	0.1667	0.0833
4	0	0.70	0.0000	0.0389
5	1	1.80	0.0556	0.1000
TOTALS	18	18.10	1.0000	1.0056

CHI-SQUARE= 2.585 D.F.= 4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 3

D MAX = 0.0826

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % PRIMARY WASTE (>17.5%) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	13	13.00	0.6842	0.6842
2	1	1.90	0.0526	0.1000
3	3	1.60	0.1579	0.0842
4	0	0.70	0.0000	0.0368
5	2	1.90	0.1053	0.1000
TOTALS	19	19.10	1.0000	1.0053

CHI-SQUARE= 2.357 D.F.= 4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 2

D MAX = 0.0433

Table 6.52. Key as for Table 6.31 (p280).

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % RETOUCH (>25%) vs SOIL TYPE

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	6	3.90	0.2727	0.1773
2	5	5.80	0.2273	0.2636
3	2	5.60	0.0909	0.2545
4	9	6.50	0.4091	0.2955
TOTALS	22	21.80	1.0000	0.9909

CHI-SQUARE= 4.517 D.F.= 3

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 3

D MAX = 0.1109

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: DENSITY (>15 per ha) vs SOIL TYPE

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	8	6.70	0.2105	0.1763
2	11	10.10	0.2895	0.2658
3	5	9.60	0.1316	0.2526
4	14	11.50	0.3684	0.3026
TOTALS	38	37.90	1.0000	0.9974

CHI-SQUARE= 3.080 D.F.= 3

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 3

D MAX = 0.0650

Table 6.53. Key as for Table 6.35 (p284).

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: DENSITY (>15 per ha) vs TOPOGRAPHY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	17	16.80	0.4048	0.4000
2	12	11.60	0.2857	0.2762
3	4	5.30	0.0952	0.1262
4	3	4.70	0.0714	0.1119
5	2	1.60	0.0476	0.0381
6	4	2.10	0.0952	0.0500
TOTALS	42	42.10	1.0000	1.0024

CHI-SQUARE= 2.769 D.F.=5

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 4

D MAX = 0.0550

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % RETOUCH (>25%) vs TOPOGRAPHY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	6	8.80	0.2727	0.4000
2	9	6.10	0.4091	0.2773
3	1	2.80	0.0455	0.1273
4	4	2.50	0.1818	0.1136
5	1	0.80	0.0455	0.0364
6	1	1.10	0.0455	0.0500
TOTALS	22	22.10	1.0000	1.0045

CHI-SQUARE= 4.386 D.F.=5

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 1

D MAX = 0.1255

Table 6.54. Key as for Table 6.39 (p288).

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % CORES (>6%) vs TOPOGRAPHY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	8	6.80	0.4706	0.4000
2	3	4.70	0.1765	0.2765
3	3	2.10	0.1765	0.1235
4	3	1.90	0.1765	0.1118
5	0	0.60	0.0000	0.0353
6	0	0.90	0.0000	0.0529
TOTALS	17	17.00	1.0000	1.0000

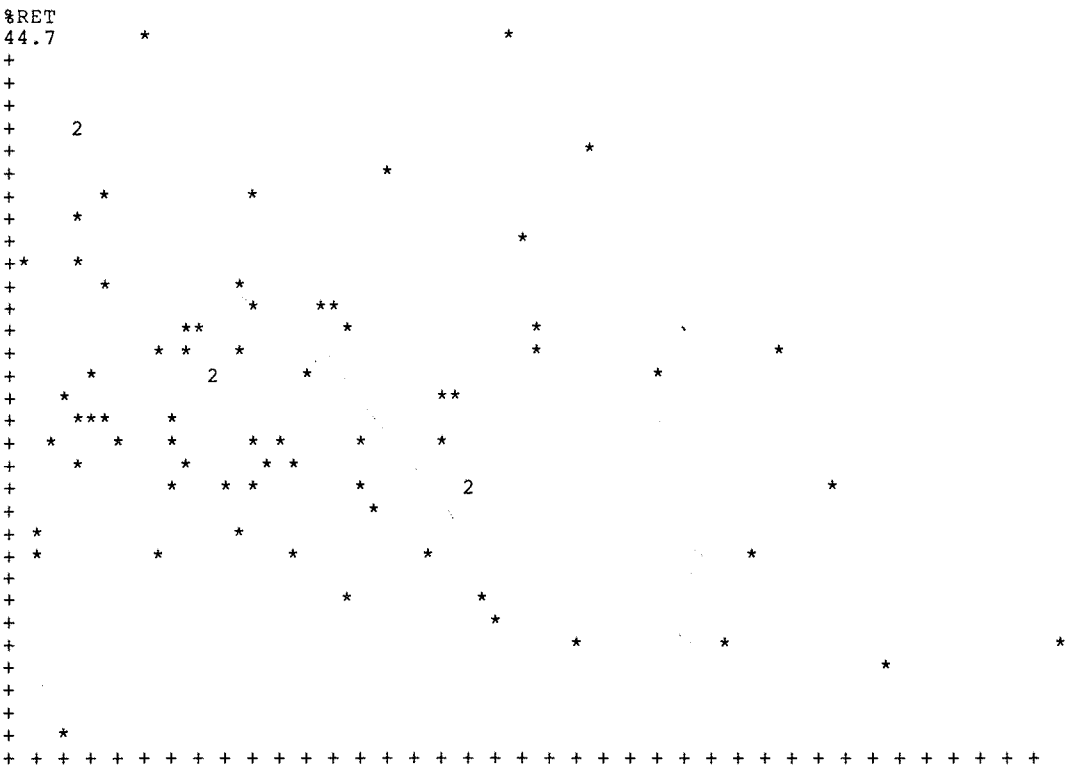
CHI-SQUARE= 3.349 D.F.= 5

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 4

D MAX = 0.0882

Table 6.55. Key as for Table 6.39 (p288).

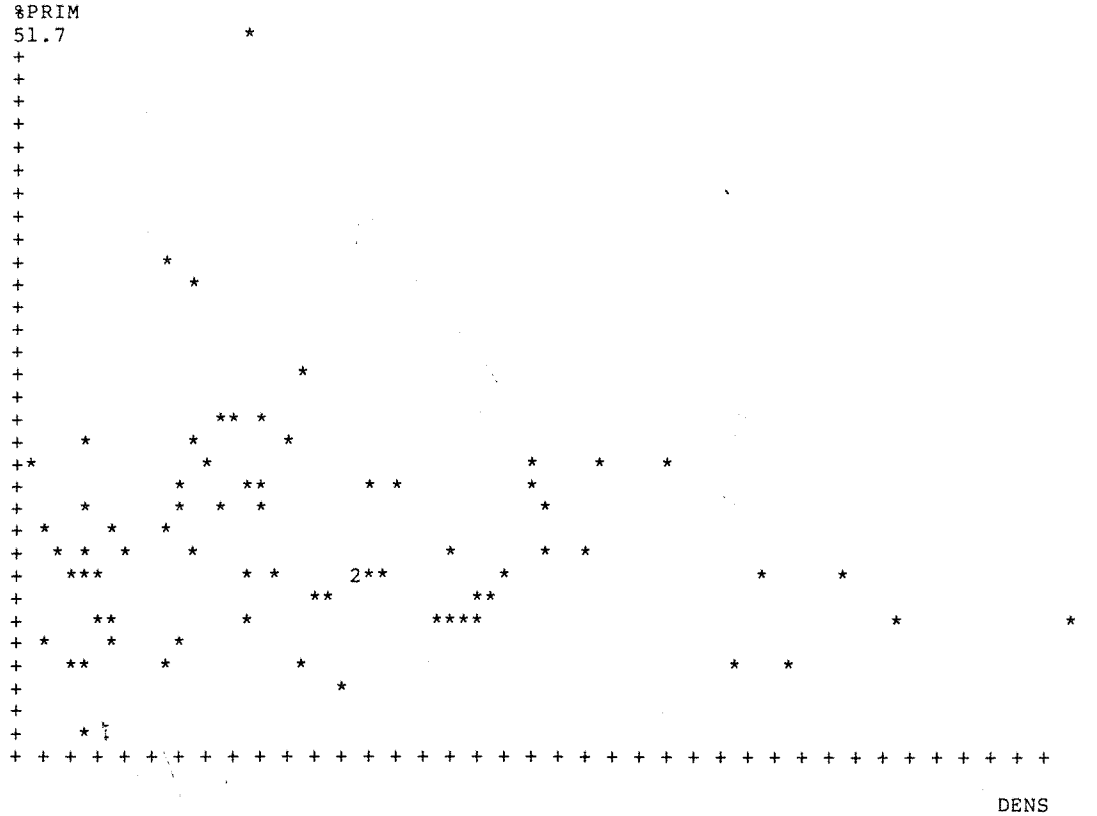


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %RET
LOWER ENDPOINT: 0 UPPER ENDPOINT: 44.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.16

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS DENS AND %PRIM ON THE Y

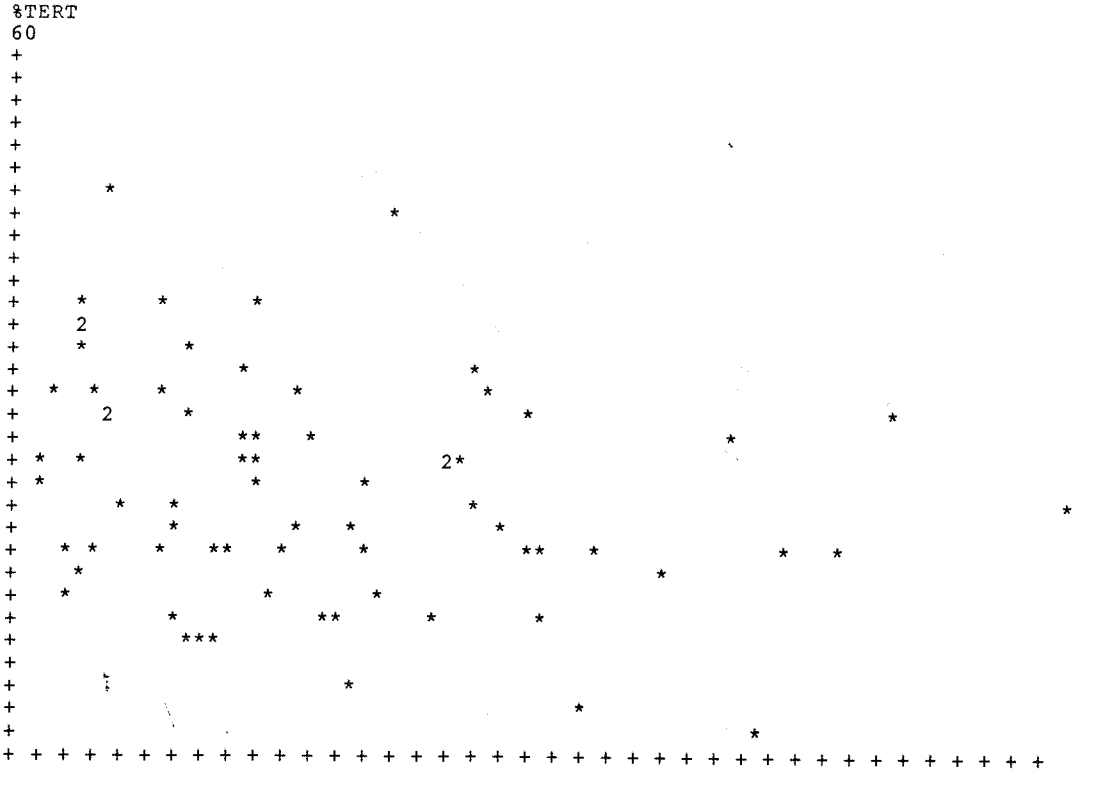


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %PRIM
LOWER ENDPOINT: 0 UPPER ENDPOINT: 51.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.17

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS DENS AND %TERT ON THE Y

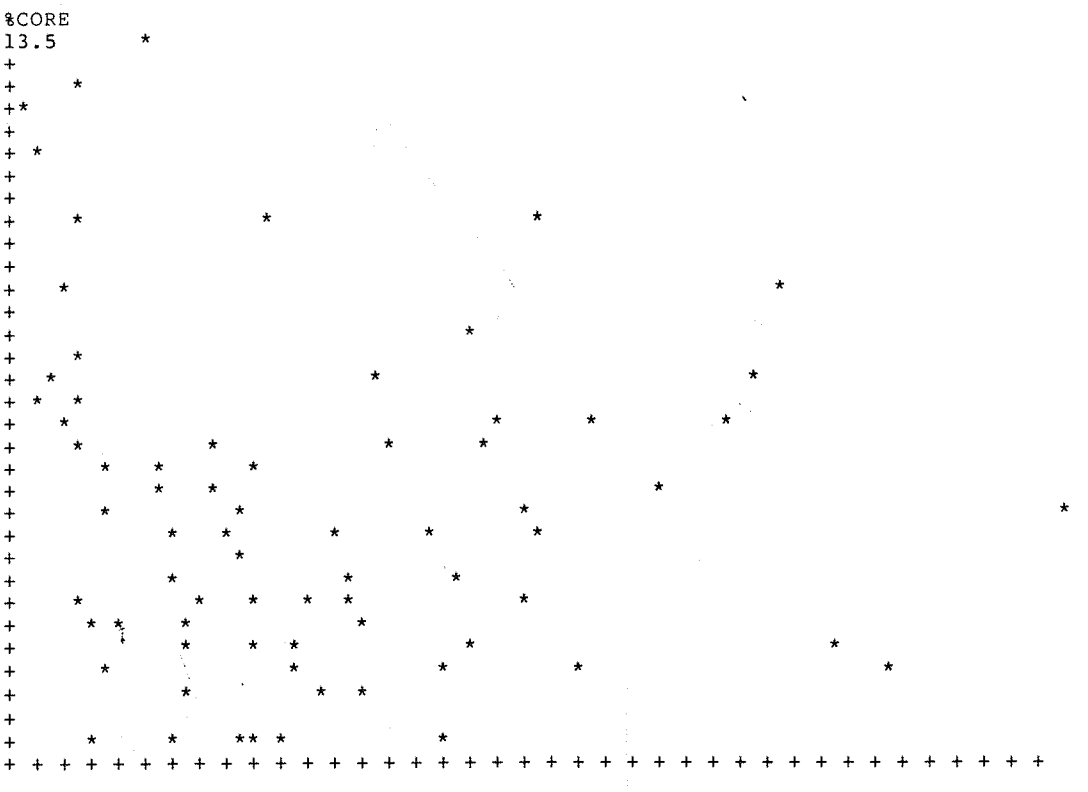


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %TERT
LOWER ENDPOINT: 7.2 UPPER ENDPOINT: 60
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.18

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS DENS AND %CORE ON THE Y

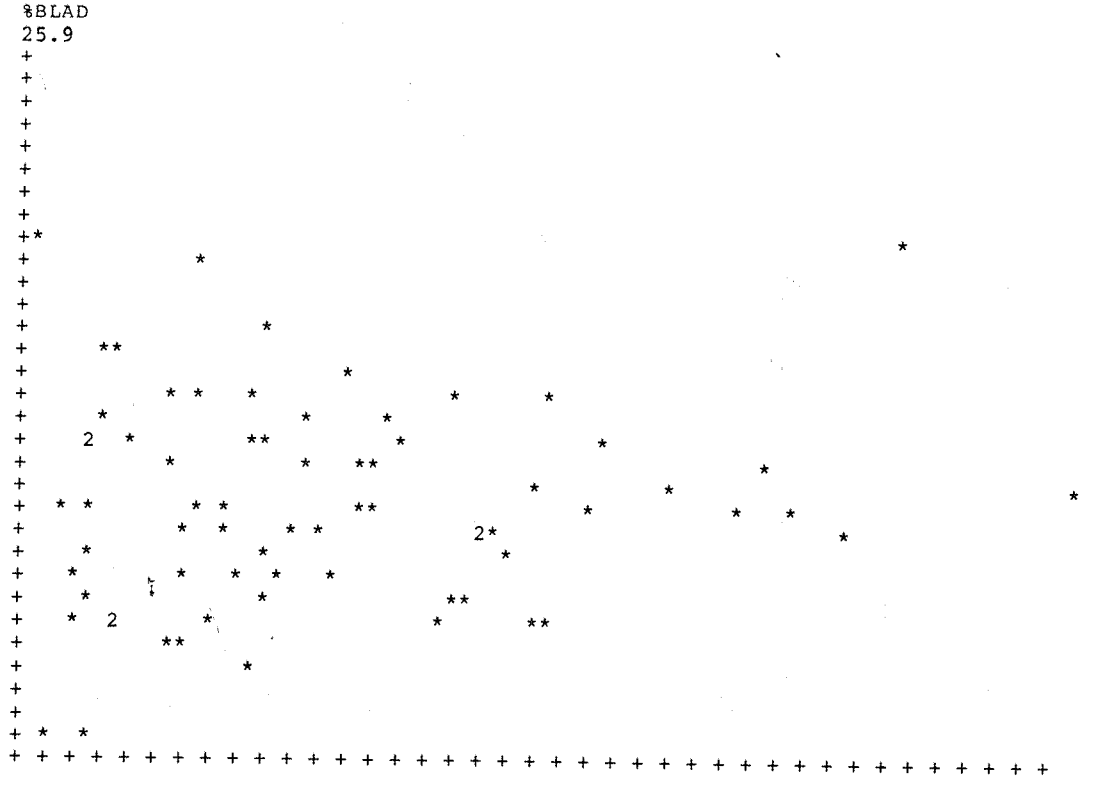


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 13.5
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.19

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS DENS AND %BLAD ON THE Y

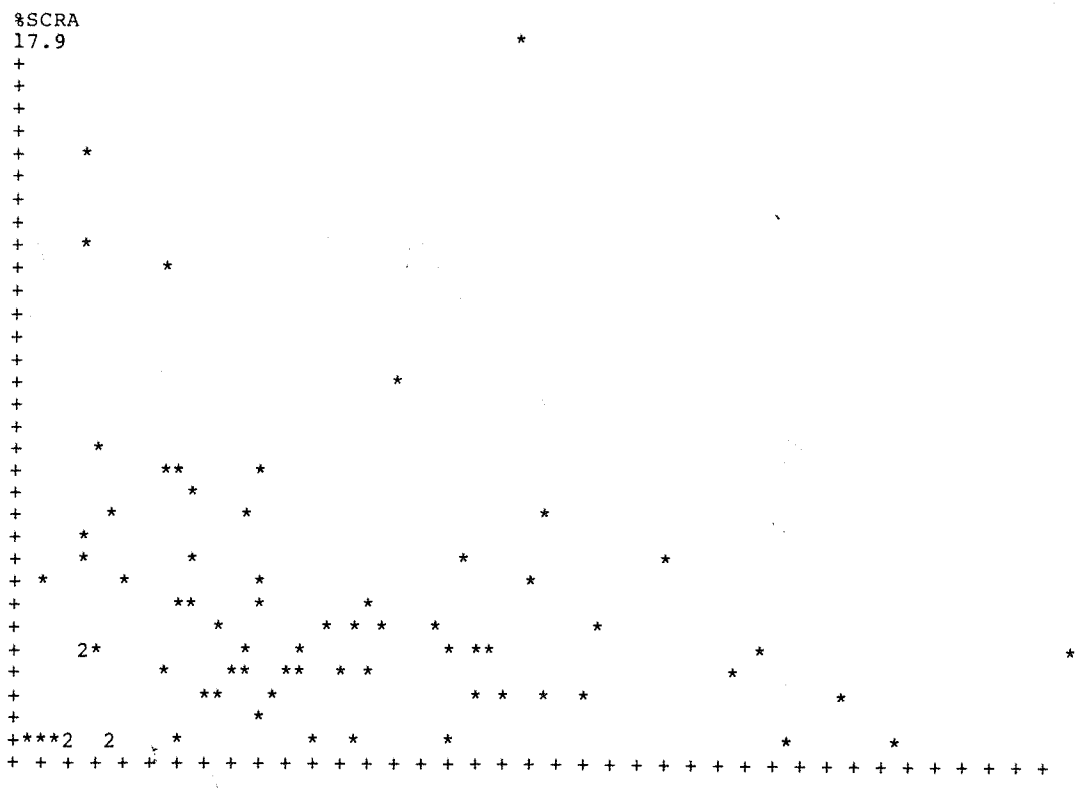


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 25.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.20

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS DENS AND %SCRA ON THE Y

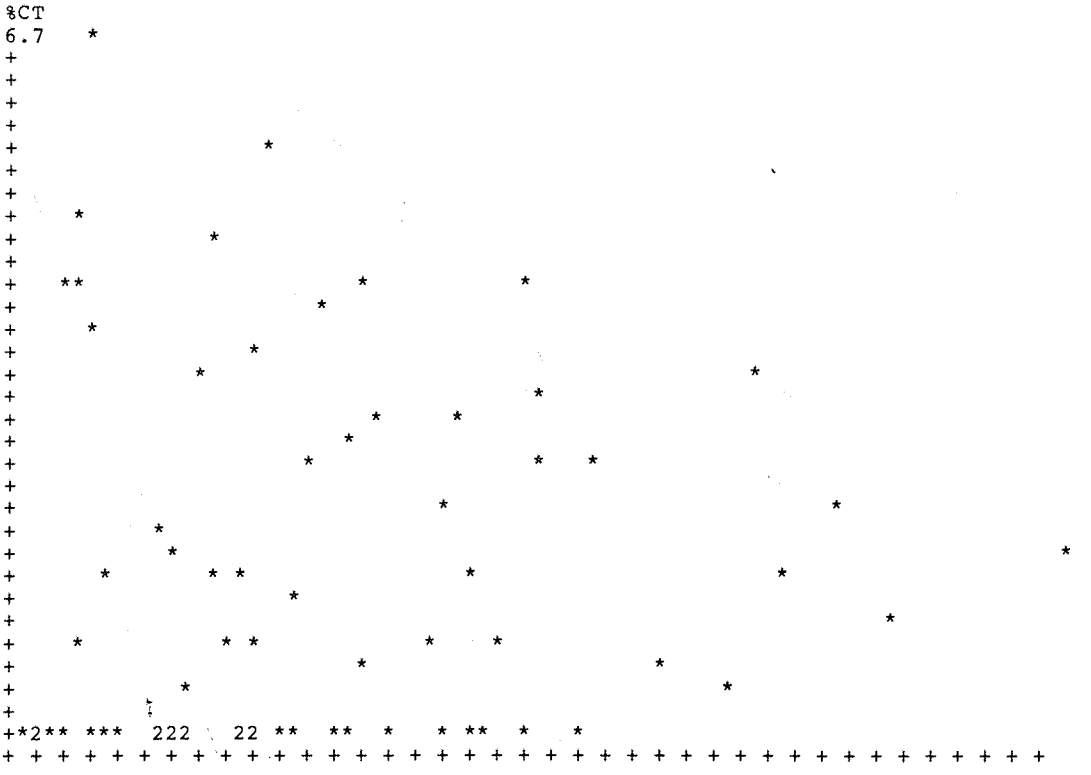


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 17.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.21

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS DENS AND %CT ON THE Y

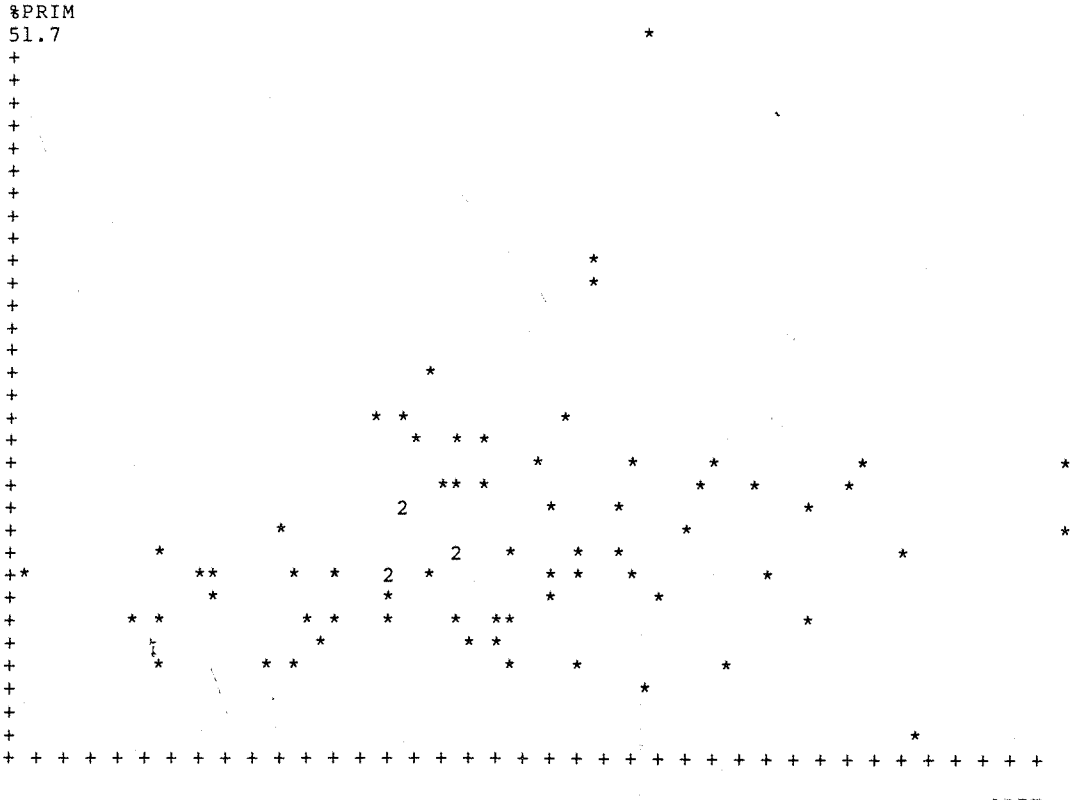


HORIZONTAL AXIS: DENS
LEFT ENDPOINT: 4.7 RIGHT ENDPOINT: 61.8

VERTICAL AXIS: %CT
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.22

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %RET AND %PRIM
ON THE Y



HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 44.7

VERTICAL AXIS: %PRIM
LOWER ENDPOINT: 0 UPPER ENDPOINT: 51.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.23

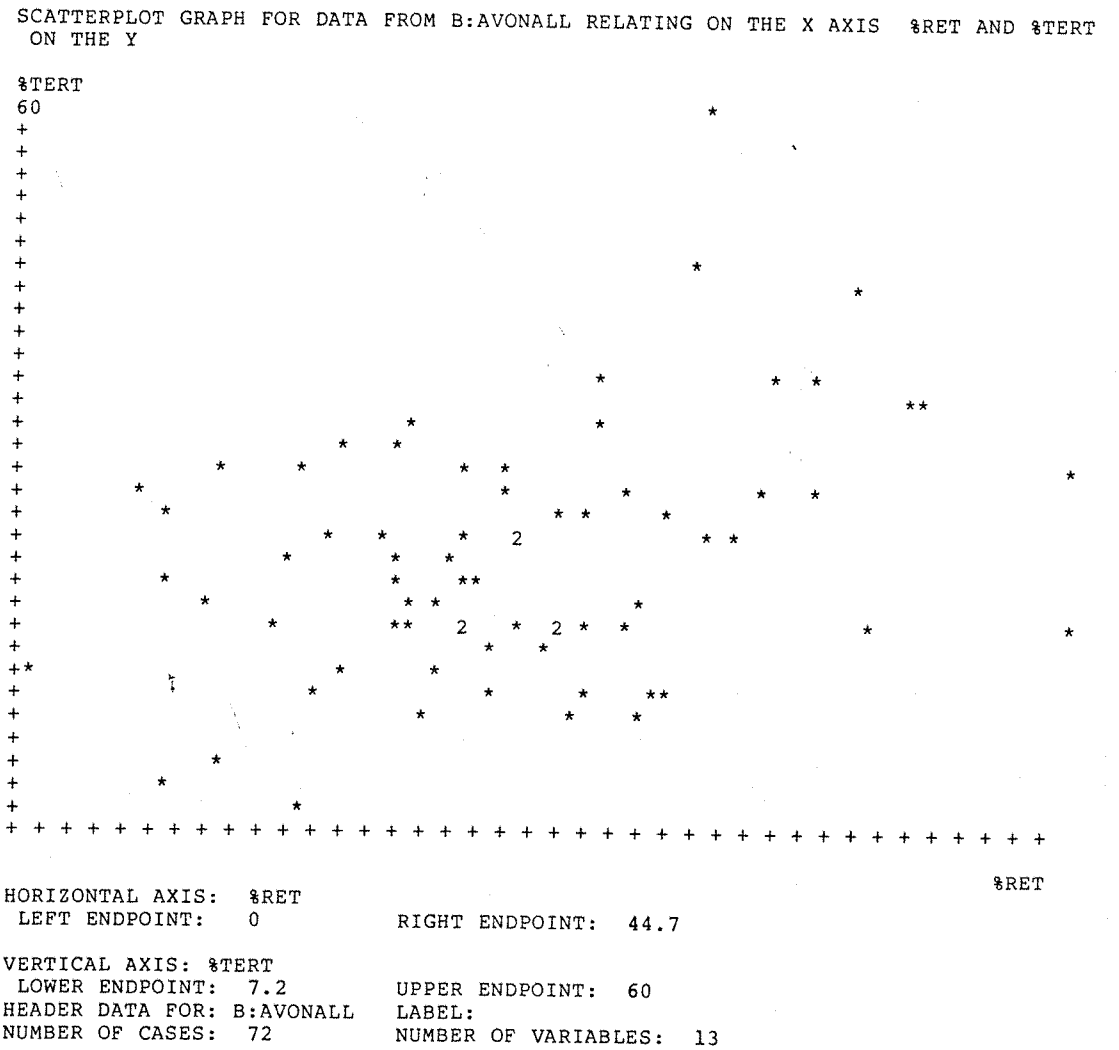
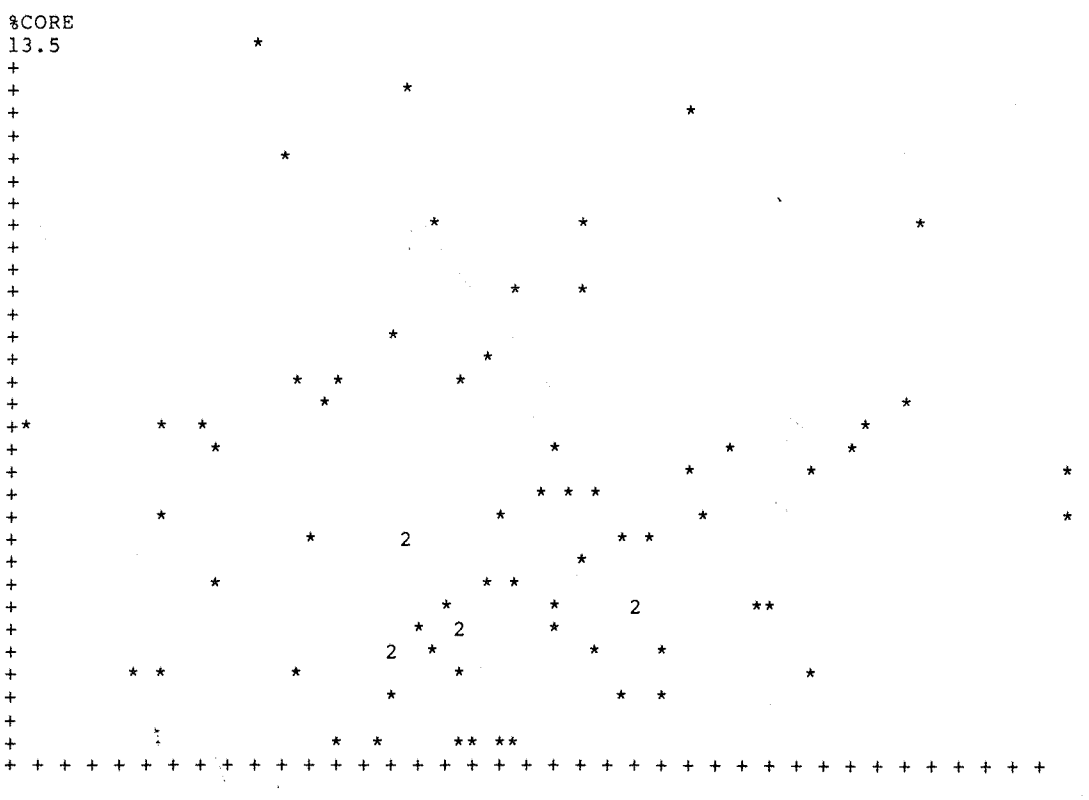

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %RET AND %TERT
ON THE Y
%TERT
60
%RET
HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 44.7
VERTICAL AXIS: %TERT
LOWER ENDPOINT: 7.2
UPPER ENDPOINT: 60
HEADER DATA FOR: B:AVONALL
LABEL:
NUMBER OF CASES: 72
NUMBER OF VARIABLES: 13

Figure 6.24

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %RET AND %CORE ON THE Y

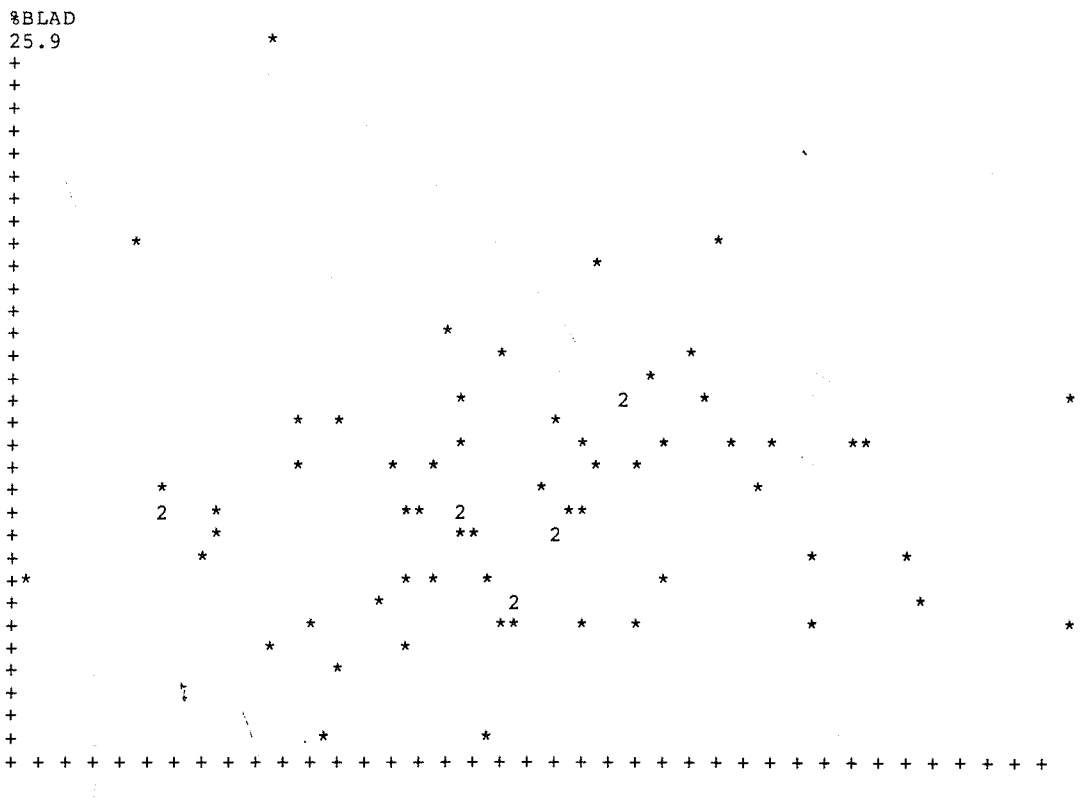


HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 44.7

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 13.5
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.25

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %RET AND %BLAD
ON THE Y

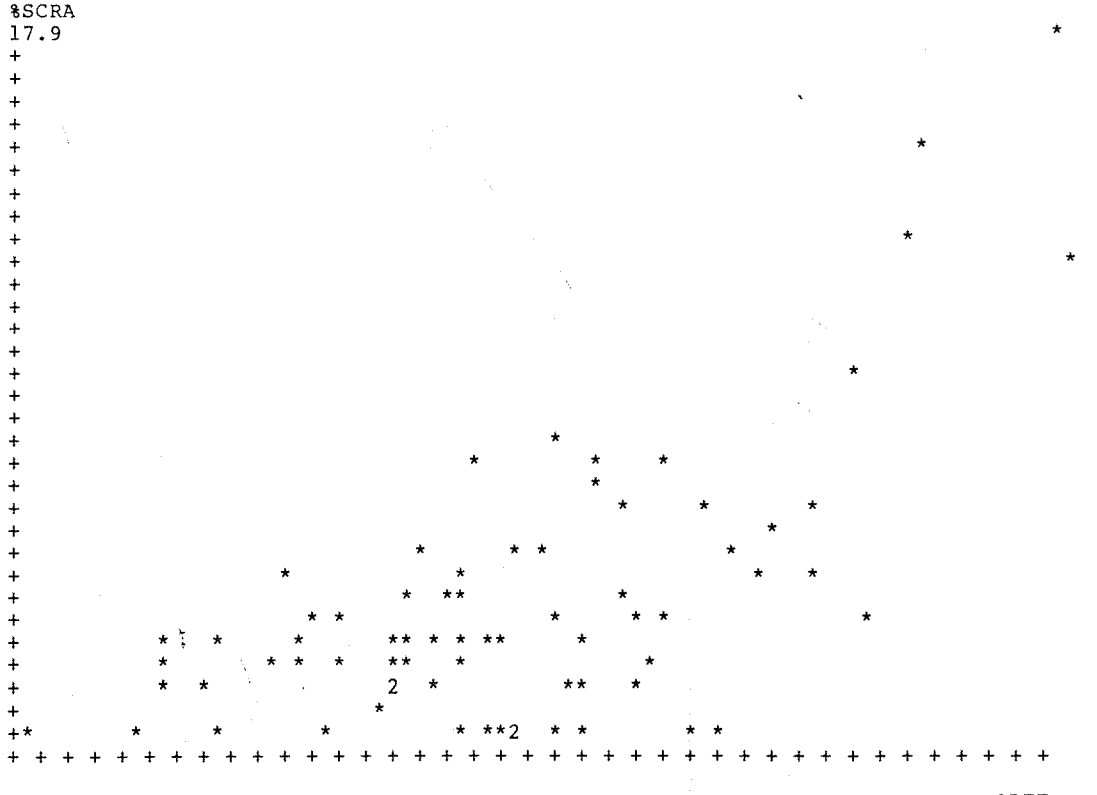


HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 44.7

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 25.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.26

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %RET AND %SCRA
ON THE Y

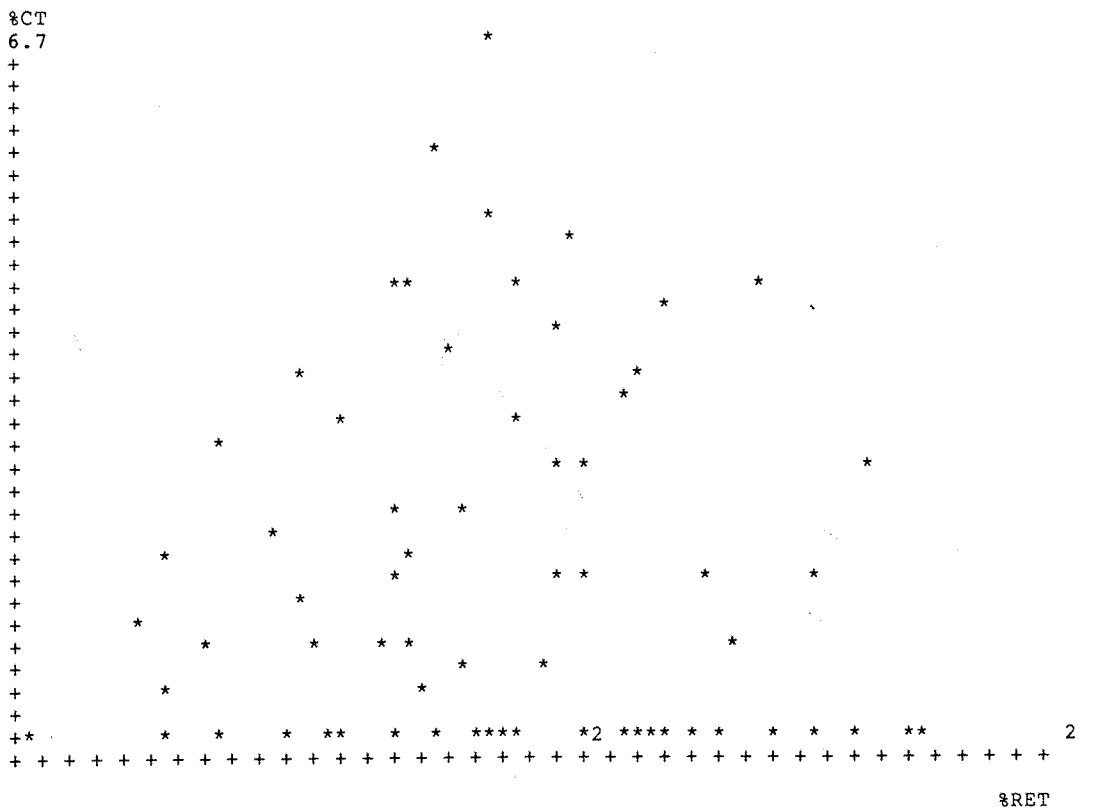


HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 44.7

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 17.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.27

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %RET AND %CT ON THE Y



HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 44.7

VERTICAL AX: %CT
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.28

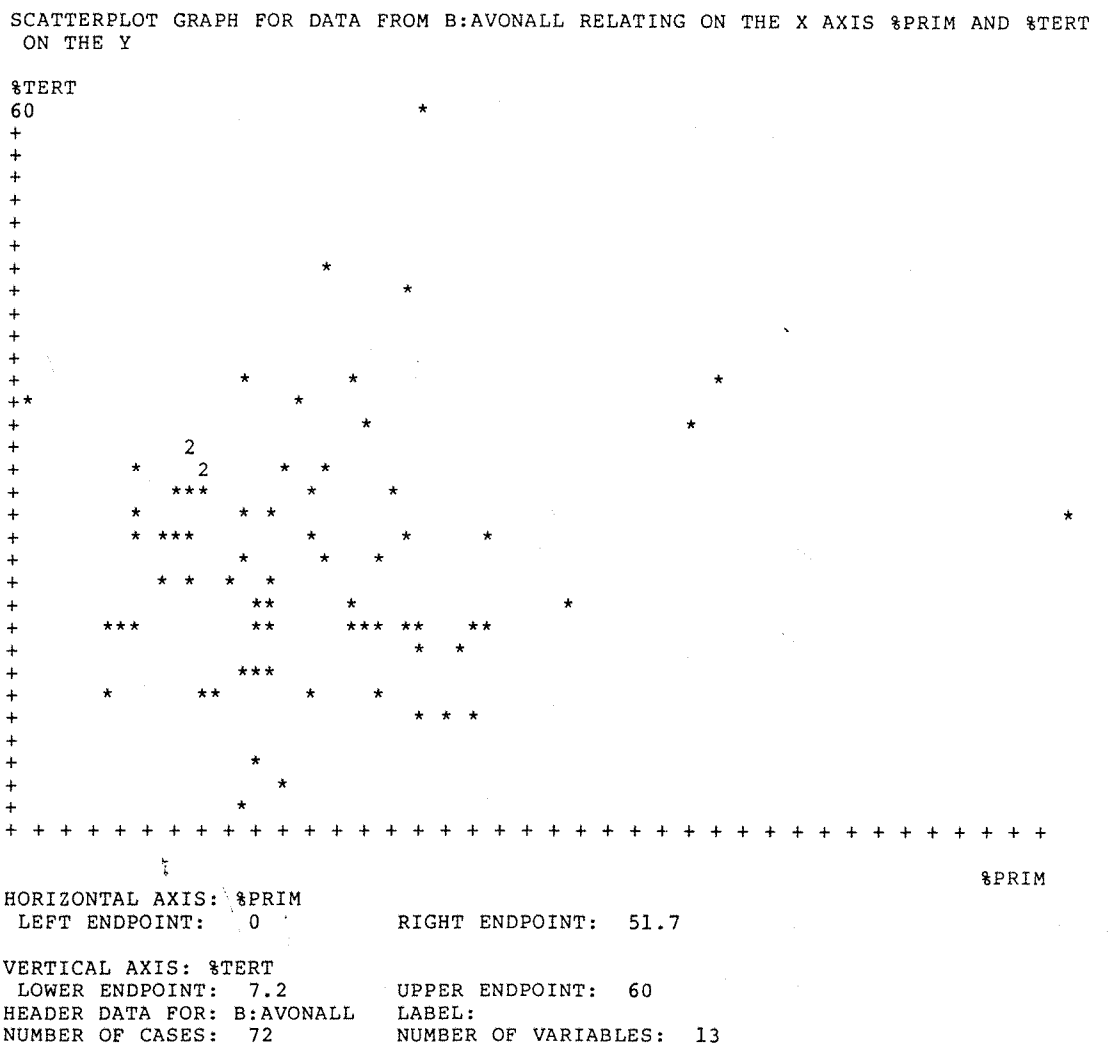
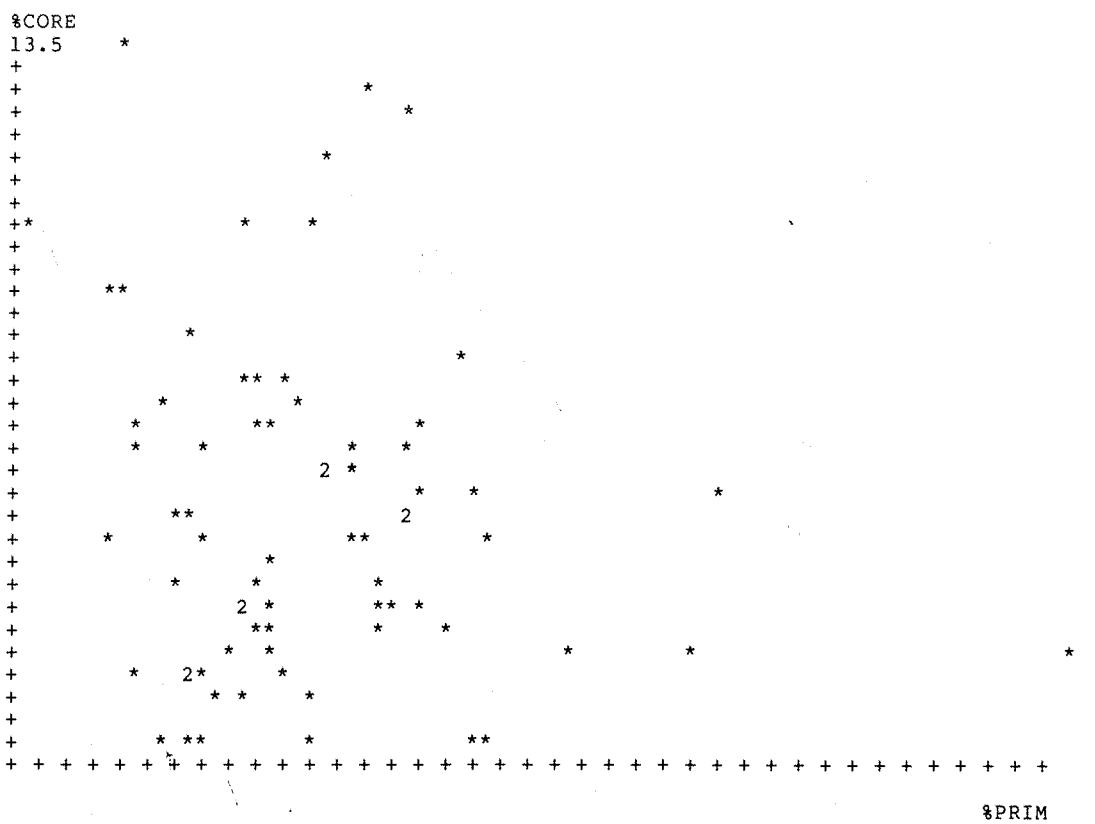

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %PRIM AND %TERT
ON THE Y
%TERT
60
%PRIM
HORIZONTAL AXIS: %PRIM
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 51.7
VERTICAL AXIS: %TERT
LOWER ENDPOINT: 7.2
UPPER ENDPOINT: 60
HEADER DATA FOR: B:AVONALL
LABEL:
NUMBER OF CASES: 72
NUMBER OF VARIABLES: 13

Figure 6.29

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %PRIM AND %CORE
ON THE Y

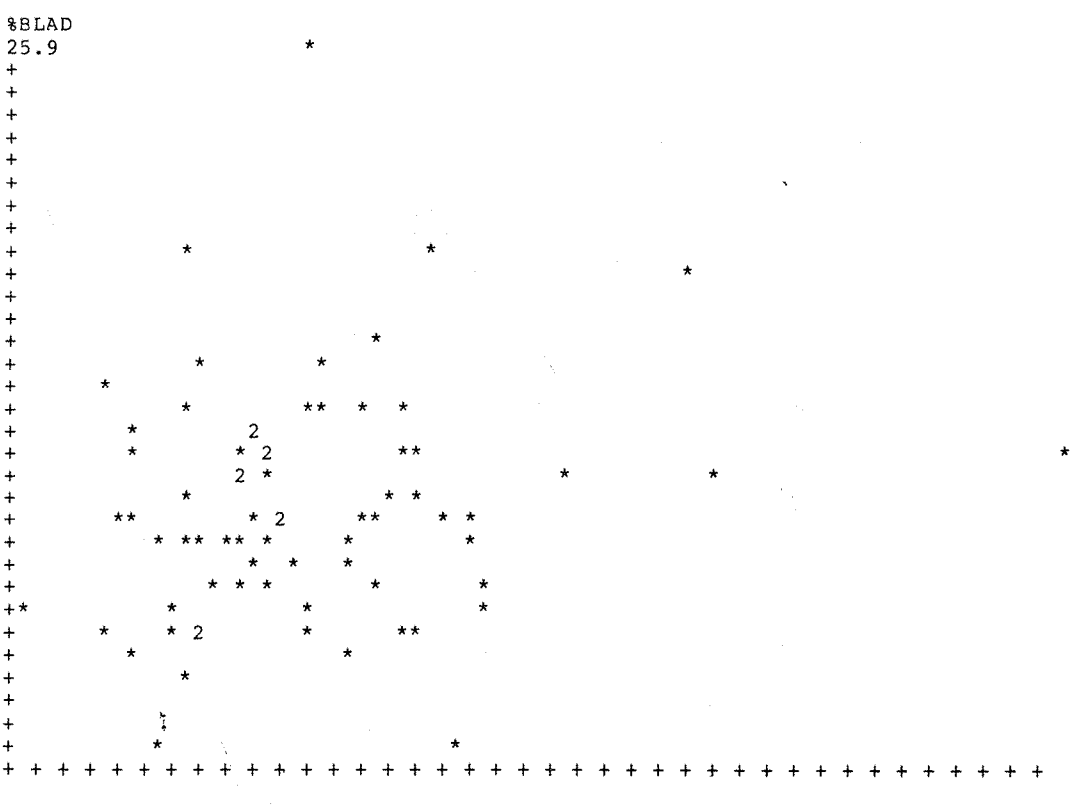


HORIZONTAL AXIS: %PRIM
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 51.7

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 13.5
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.30

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %PRIM AND %BLAD
ON THE Y

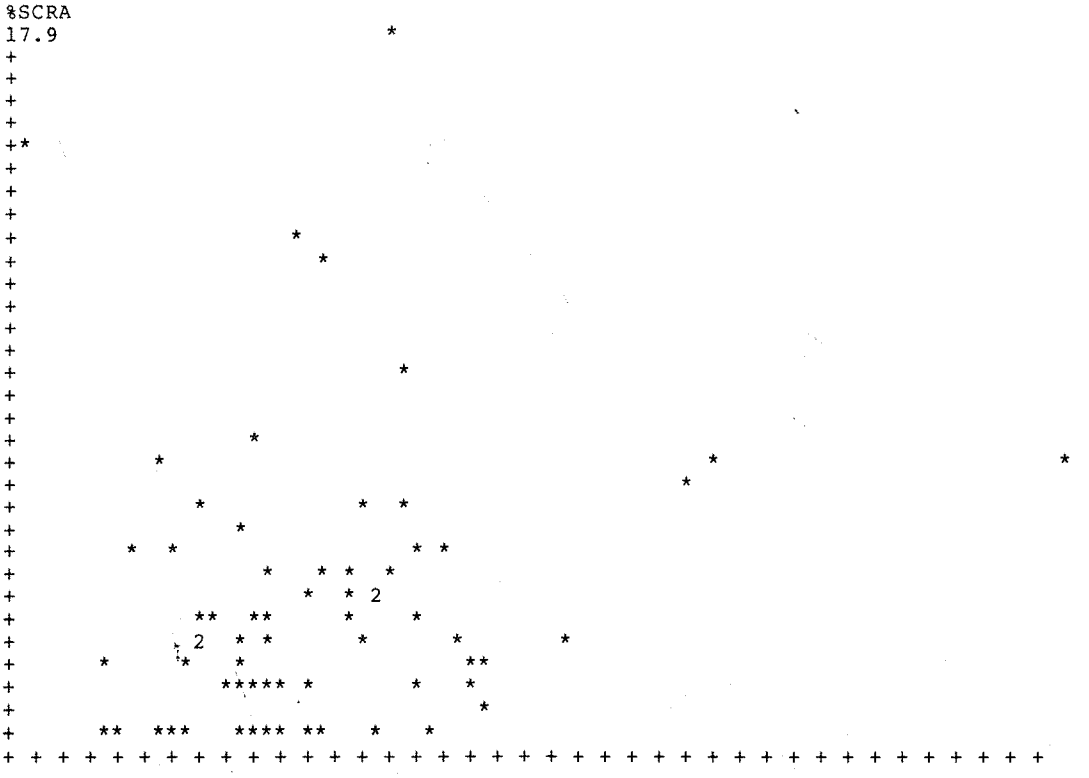


HORIZONTAL AXIS: %PRIM
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 51.7

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 25.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.31

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %PRIM AND %SCRA
ON THE Y



HORIZONTAL AXIS: %PRIM
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 51.7

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 17.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.32

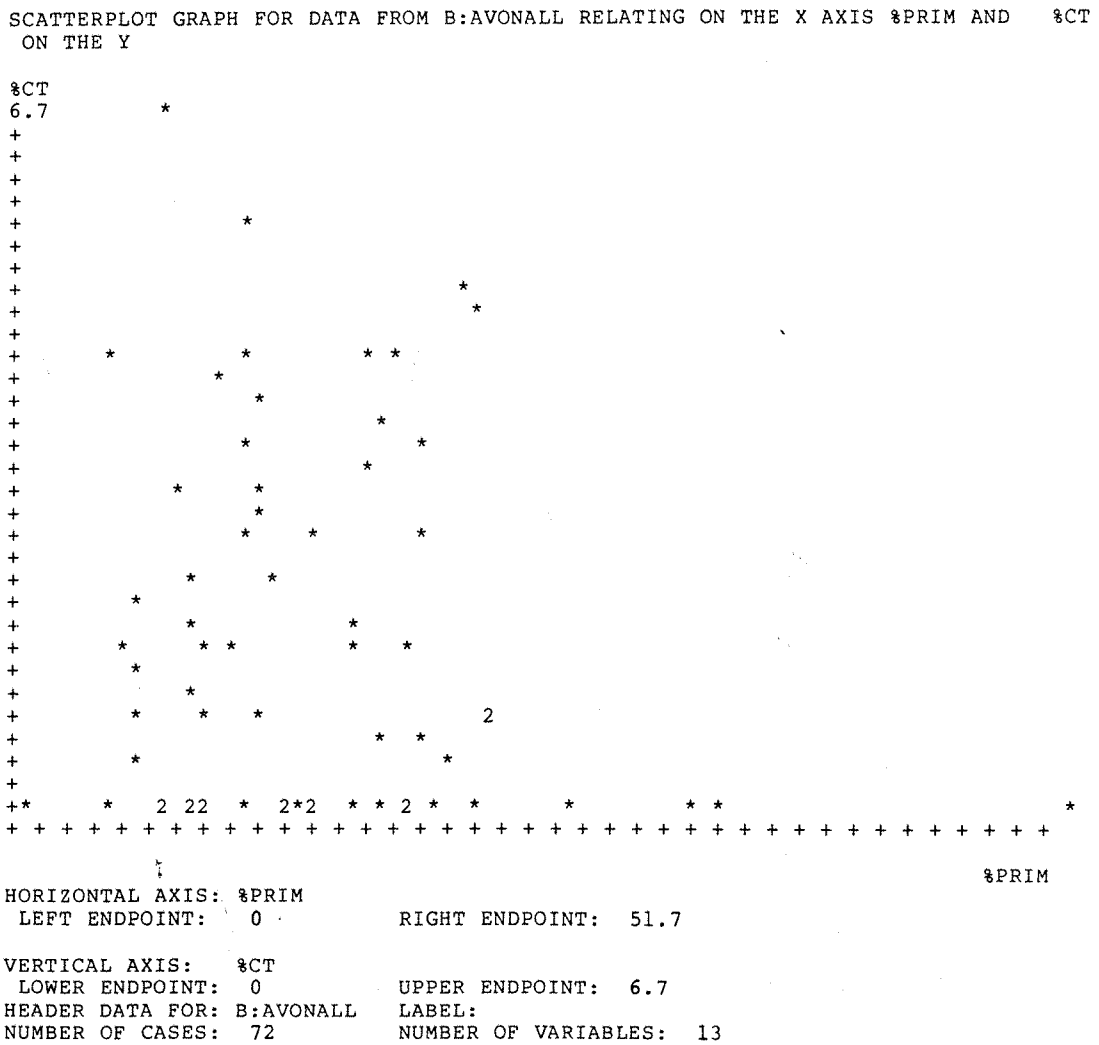
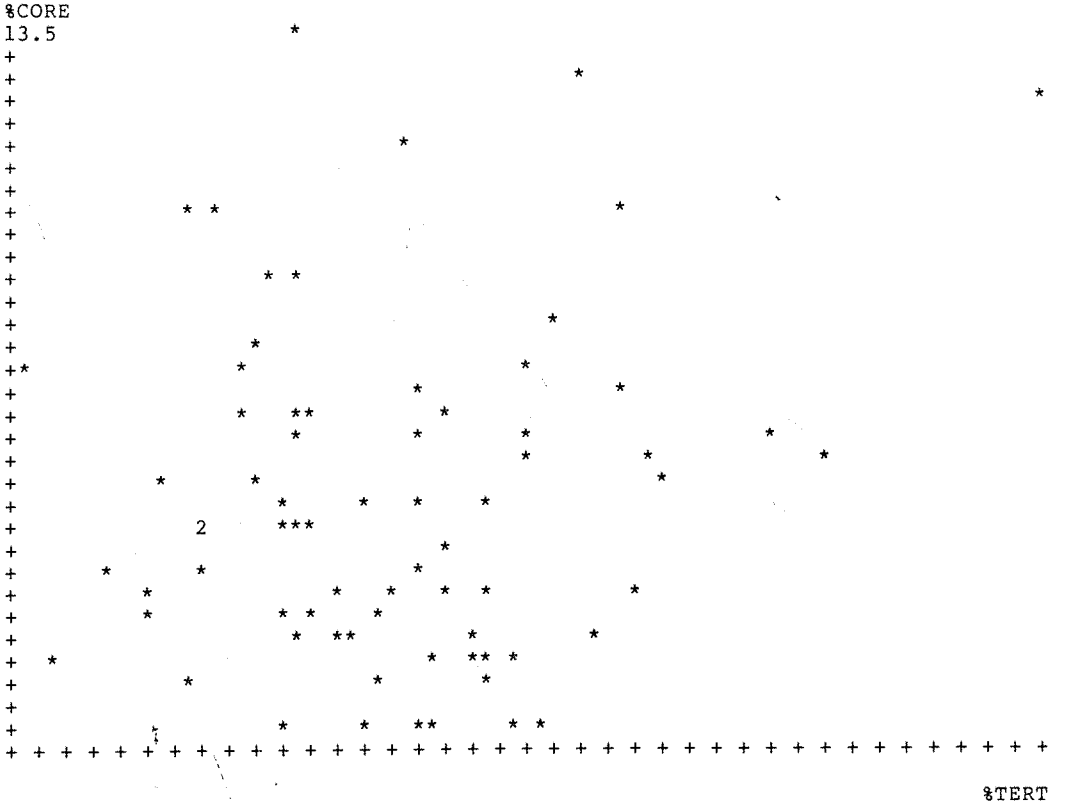

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %PRIM AND %CT ON THE Y
%CT
6.7
%PRIM
HORIZONTAL AXIS: %PRIM
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 51.7
VERTICAL AXIS: %CT
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.7
HEADER DATA FOR: B:AVONALL
LABEL:
NUMBER OF CASES: 72
NUMBER OF VARIABLES: 13

Figure 6.33

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %TERT AND %CORE ON THE Y

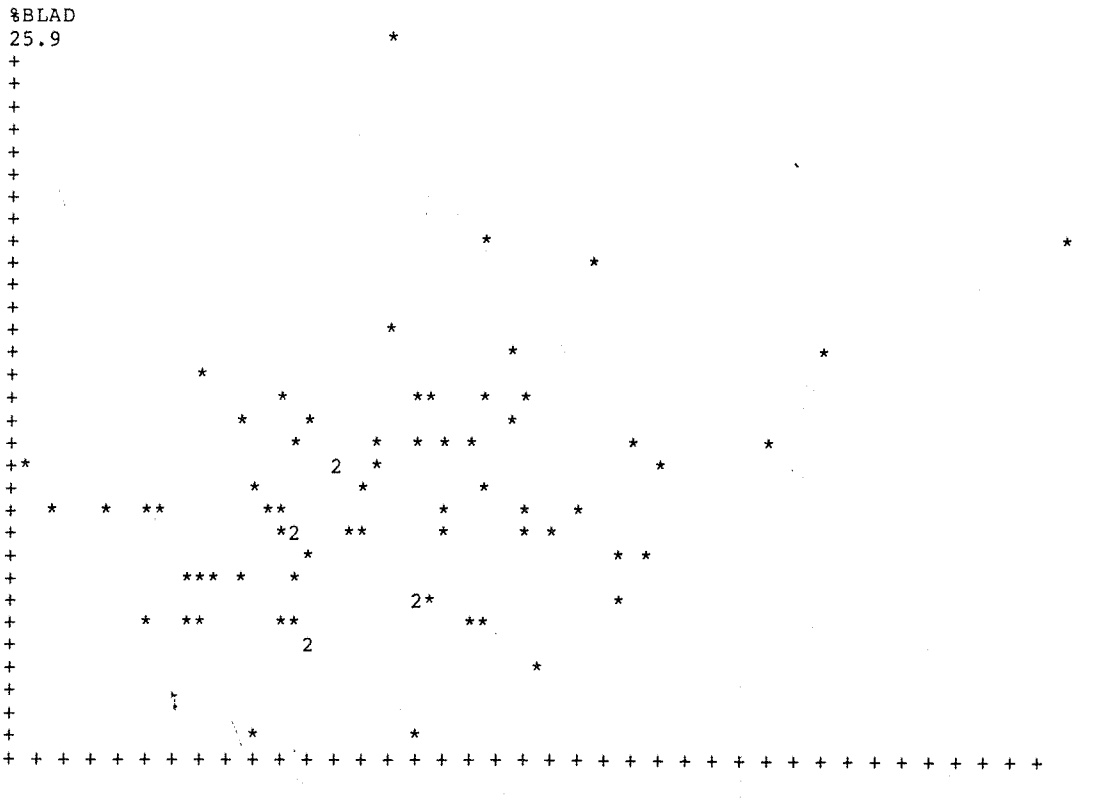


HORIZONTAL AXIS: %TERT
LEFT ENDPOINT: 7.2 RIGHT ENDPOINT: 60

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 13.5
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.34

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %TERT AND %BLAD
ON THE Y

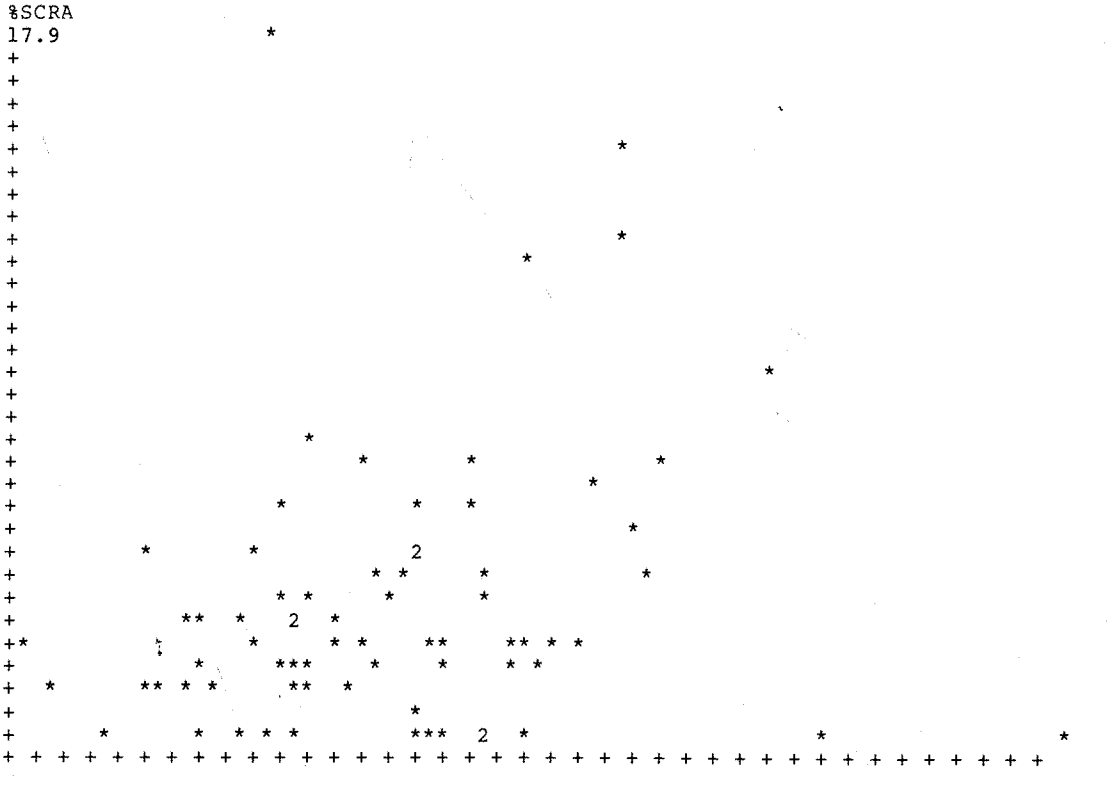


HORIZONTAL AXIS: %TERT
LEFT ENDPOINT: 7.2 RIGHT ENDPOINT: 60

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 25.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.35

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %TERT AND %SCRA
ON THE Y



HORIZONTAL AXIS: %TERT
LEFT ENDPOINT: 7.2 RIGHT ENDPOINT: 60

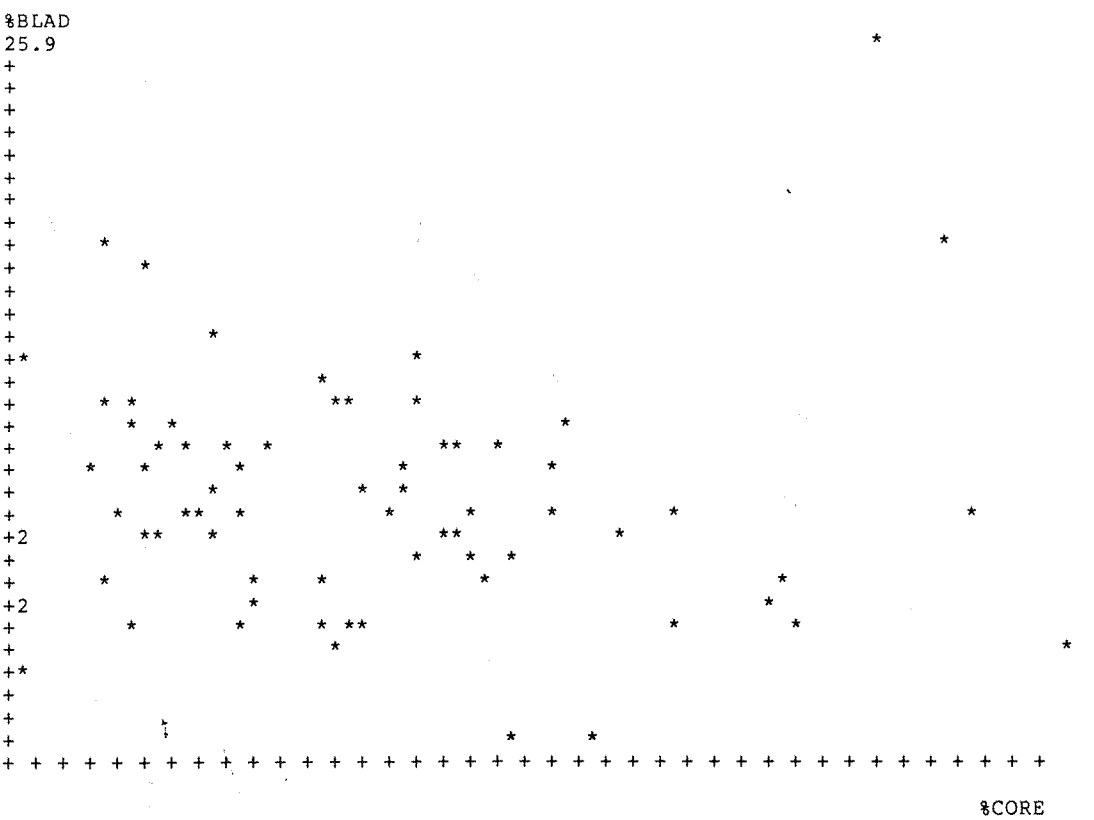
VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 17.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.36

```
SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %TERT AND   %CT
 ON THE Y

%CT
6.7                                   *
+
+
+
+
+                *
+
+
+
+                    *
+           *
+
+                      *      *        *       *
+              *
+                       *
+                            *
+*          *
+                     *
+                  *                 *
+        *
+              *         *               *
+
+                        *             *
+                        *
+                        *    *
+                     * *    *     *    *
+                                        *
+                                       *
+               *       **         2
+                    * *
+           *                         *
+
+  *           2   *   2    2 ** **** ** * **   * 2***         *    *                  *
+ + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + +

                                                                                %TERT

HORIZONTAL AXIS: %TERT
 LEFT ENDPOINT:    7.2          RIGHT ENDPOINT:   60

VERTICAL AXIS: %CT
 LOWER ENDPOINT:   0            UPPER ENDPOINT:   6.7
HEADER DATA FOR: B:AVONALL      LABEL:
NUMBER OF CASES:  72            NUMBER OF VARIABLES:  13
```

Figure 6.37

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %CORE AND %BLAD
ON THE Y

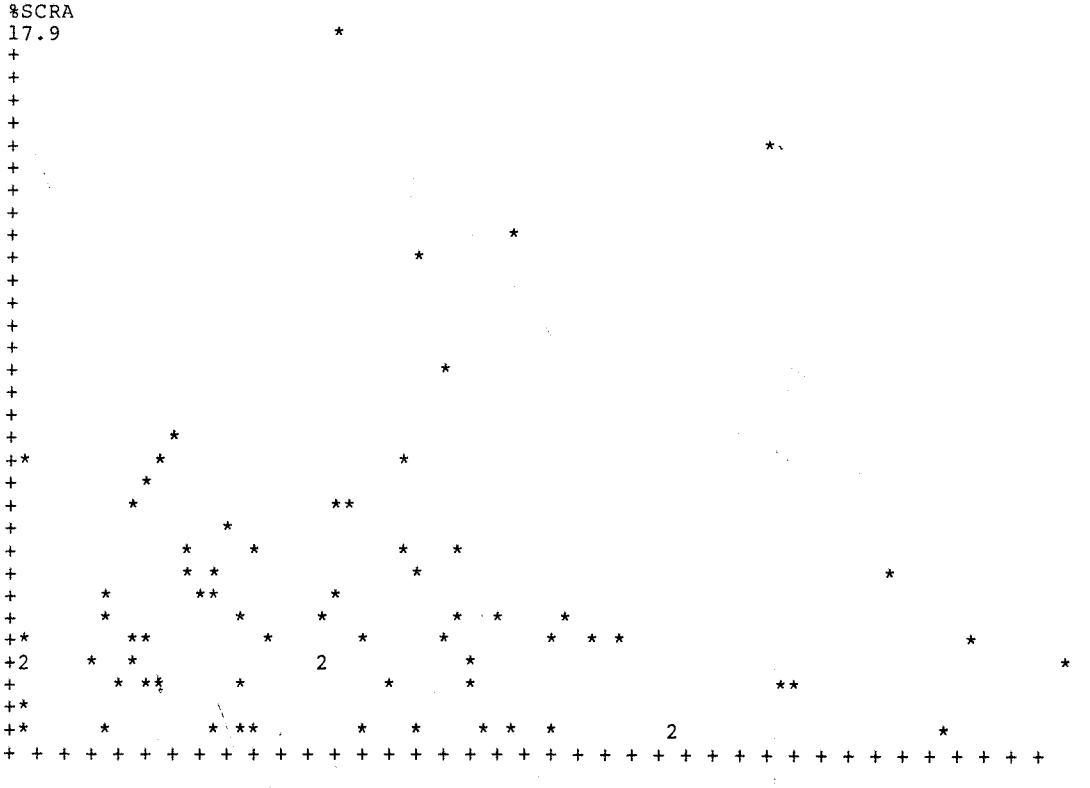


HORIZONTAL AXIS: %CORE
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 13.5

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 25.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.38

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %CORE AND %SCRA
ON THE Y



HORIZONTAL AXIS: %CORE
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 13.5

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 17.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.39

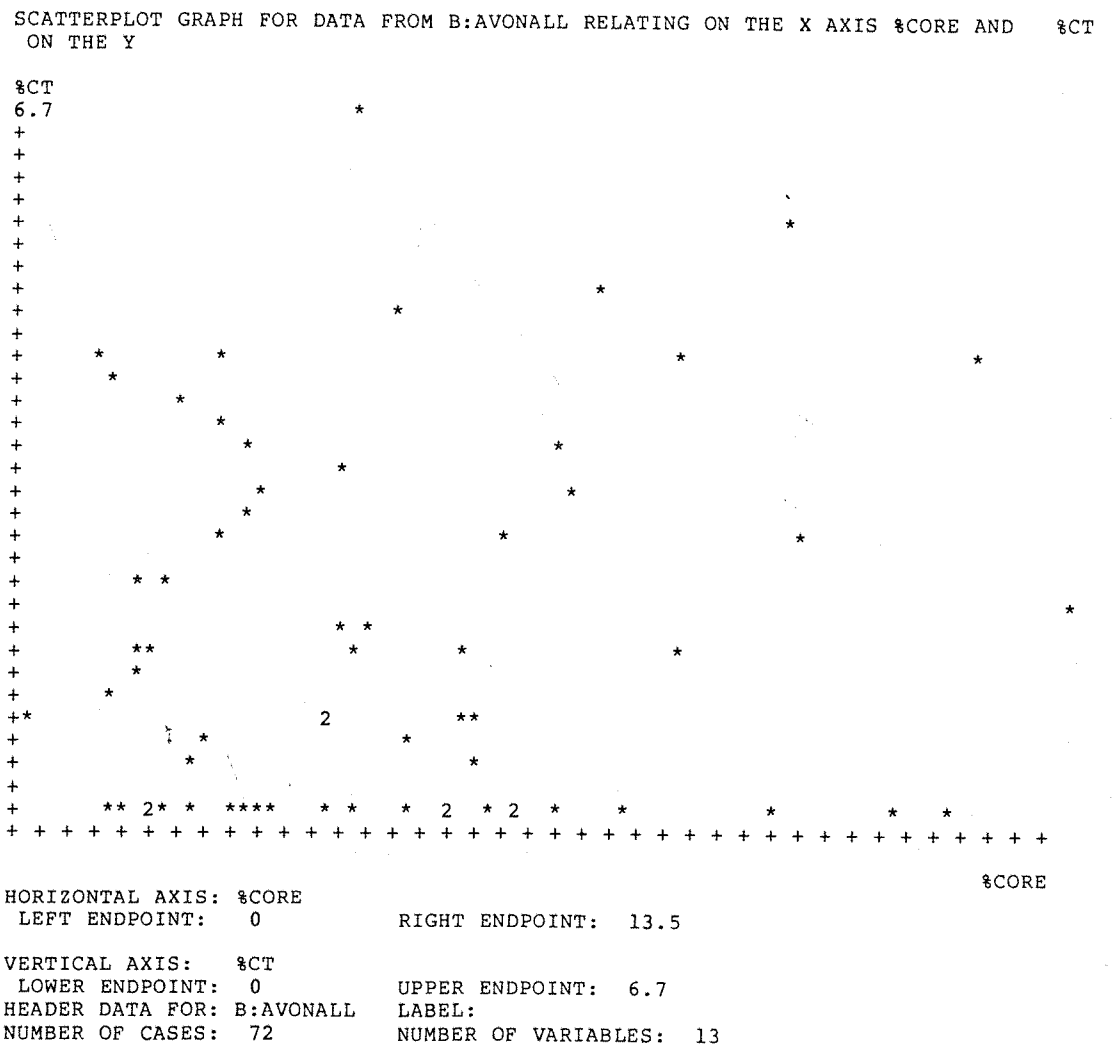
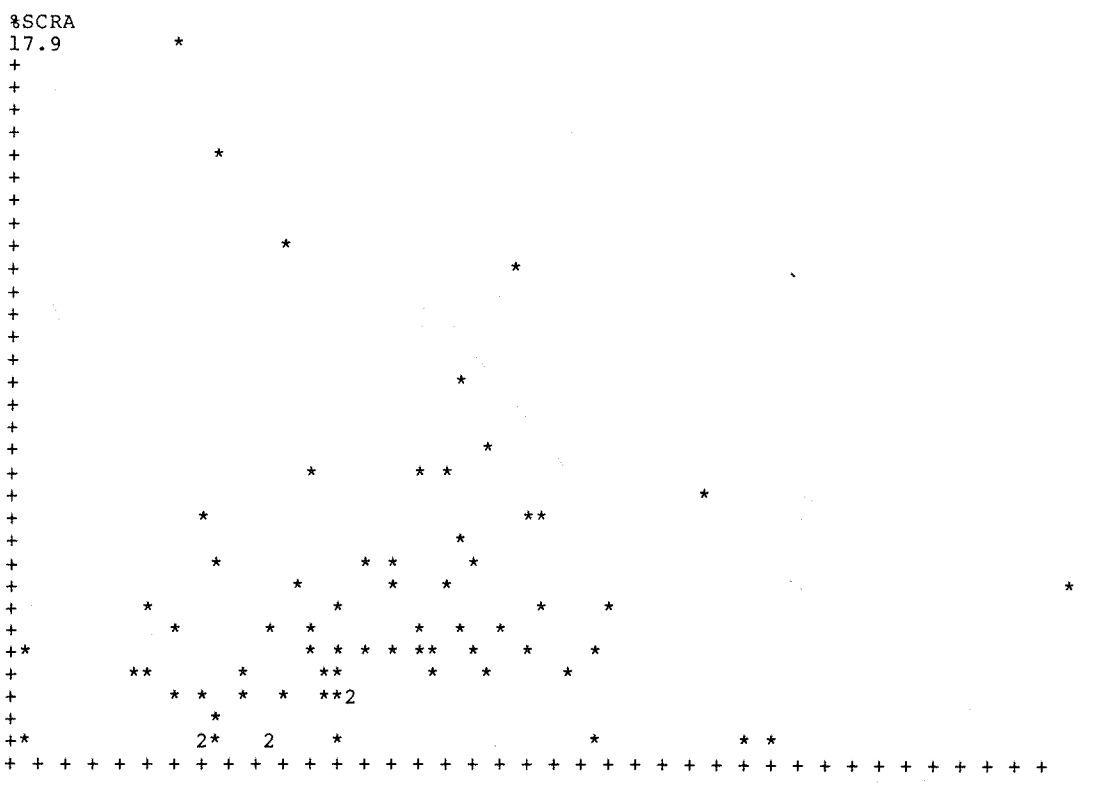

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %CORE AND %CT ON THE Y
%CT
6.7
%CORE
HORIZONTAL AXIS: %CORE
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 13.5
VERTICAL AXIS: %CT
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.7
HEADER DATA FOR: B:AVONALL
LABEL:
NUMBER OF CASES: 72
NUMBER OF VARIABLES: 13

Figure 6.40

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %BLAD AND %SCRA
ON THE Y

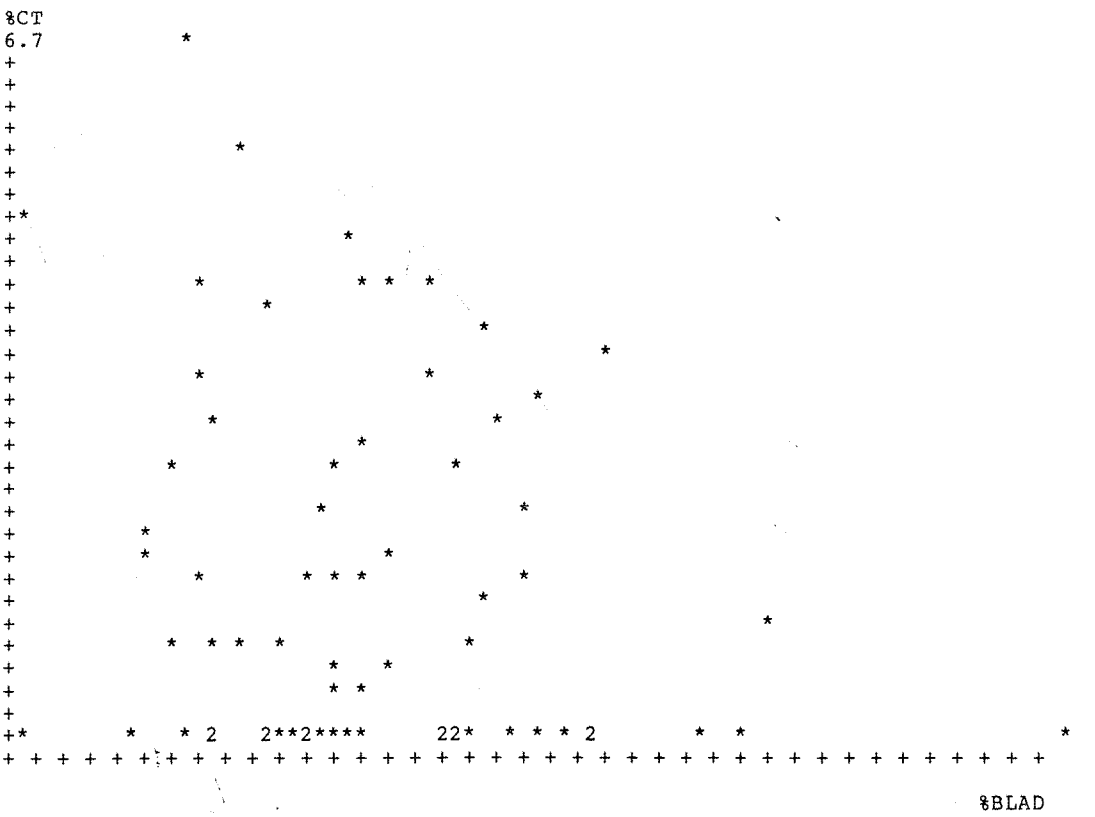


HORIZONTAL AXIS: %BLAD
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 25.9

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 17.9
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.41

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %BLAD AND %CT
ON THE Y

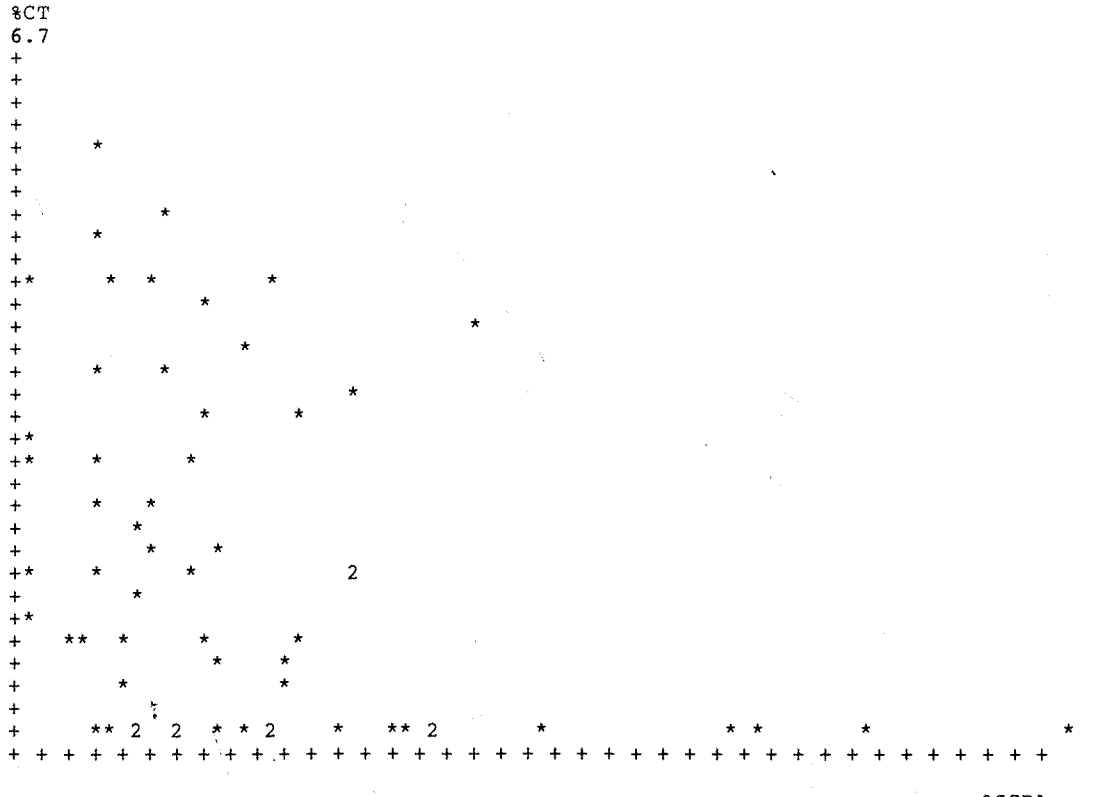


HORIZONTAL AXIS: %BLAD
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 25.9

VERTICAL AXIS: %CT
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.42

SCATTERPLOT GRAPH FOR DATA FROM B:AVONALL RELATING ON THE X AXIS %SCRA AND %CT ON THE Y



HORIZONTAL AXIS: %SCRA
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 17.9

VERTICAL AXIS: %CT
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.7
HEADER DATA FOR: B:AVONALL LABEL:
NUMBER OF CASES: 72 NUMBER OF VARIABLES: 13

Figure 6.43

Chapter 7

The upper Meon valley survey

> '...as regards the Meon valley generally, it has not much history.' (Trinder 1907,70).

> 'We must picture to ourselves the Meon all through the early years...as carrying more water than it does now and flowing through dense, marshy thickets of trees and scrub...Few people would have lived in the valley. They lived on the dry chalk hills on either side and went into the valley for fish, wildfowl and water.' (Collins and Hurst 1978,8).

This chapter will concentrate on the results of a second surface collection project, carried out by the author in the upper reaches of the Meon valley, south-east Hampshire (Figure 7.1). Again the aim is to investigate the extent to which a coarse-grained response can be identified, and to consider the results in terms of those described in the previous chapter.

7.1 The data

A total of 5217 flint artefacts were recovered from 44 fields over two winter seasons in 1985 and 1986. Once again flint was examined in such a way that comparisons could easily be made between this and other survey projects in the region. The same attributes were recorded as for the Avon valley and the same recording system adopted. A number of variables however made interpretation more difficult than was the case in the previous chapter. Type of flint and the nature of cortex for example was of little value as virtually all the flint recovered was derived from the upper chalk; cortex was therefore identical in all cases while patination was present on the majority of artefacts and hence the colour of flint and degree of translucence

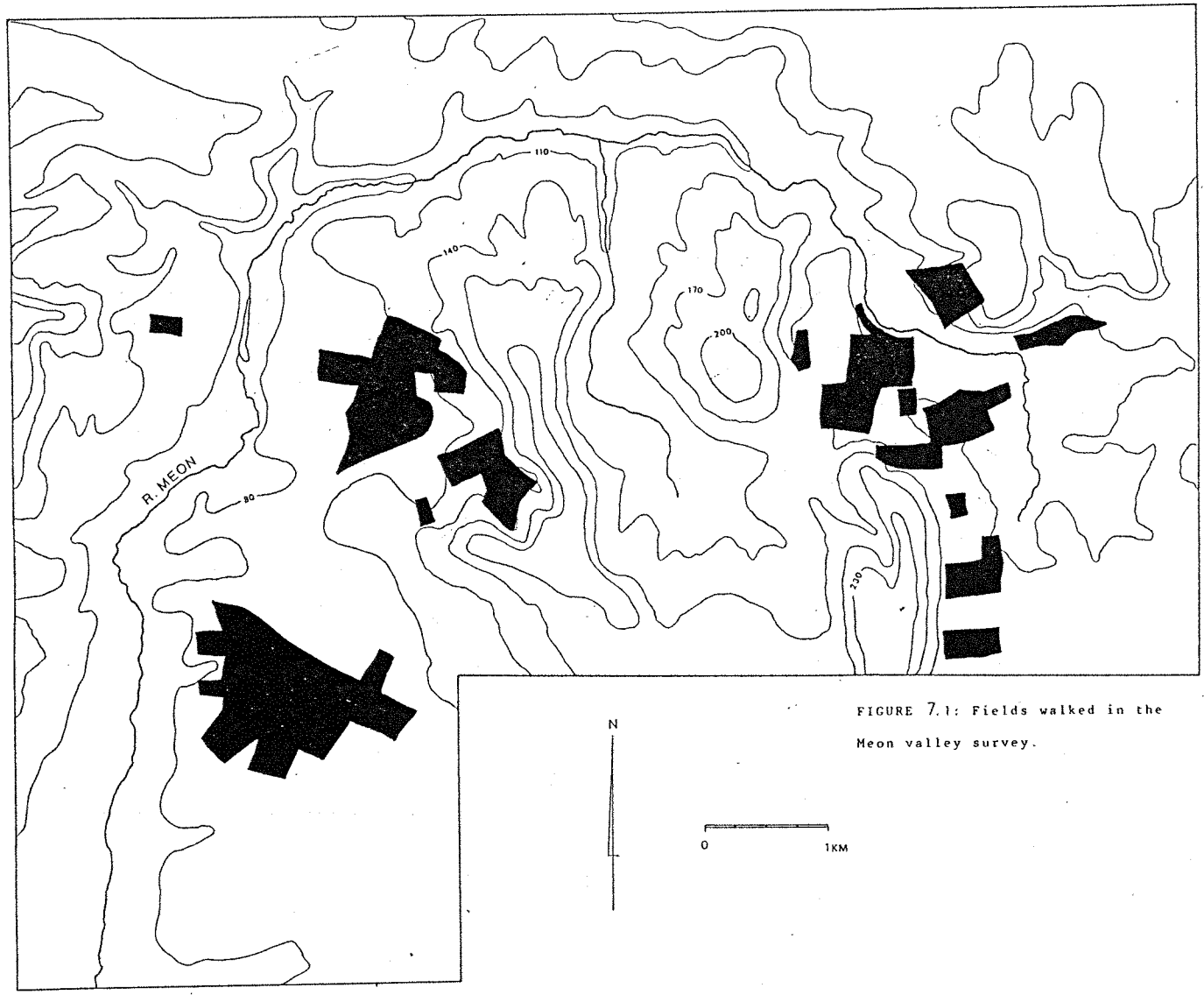


FIGURE 7.1: Fields walked in the Meon valley survey.

were not discernible.

A large quantity of flint was therefore available for analysis and due to the similarity in collection strategy and the nature of the recording system, comparison could be made between results achieved here and in the Avon valley.

Analysis is again supported by regression and correlation, with significance testing in the form of t-test, chi-square and analysis of variance.

7.2 The study area

The Meon valley is situated at the interface between two major zones: On the one hand the monument-poor area of the Hampshire Basin for which relatively little is known of the prehistoric period, and the monument-rich area of west Sussex which maintains a complex landscape of burial monuments and causewayed enclosures. The region differs considerably from the Avon valley in two major respects. First, although both are technically chalk streams, they are of a totally different scale. The Avon is 80km in length and, in its middle reaches there is a confluence of numerous minor and major tributary streams. The Meon on the other hand is only 25km in length, is much narrower, maintains a significantly lower discharge and contains only 3-4 minor tributaries throughout its length.

The second major difference concerns the physical geography of the two areas. The Avon valley is dominated by a wide expanse of valley gravels and alluvium which make up 60% of the study area. In the Meon valley however, alluvium is less significant, ranging in width from 100 to 300m. Instead the study area is divided evenly between two geological deposits, the lower chalk which displays marked variations in topography, and the upper chalk which is less diverse. Some of these points may now be described in more detail.

7.2.1 Topography

As was described in chapter 6, the broad belt of cretaceous chalk deposits which are characteristic of the Meon valley, separate the tertiary beds of the Hampshire Basin in the south from those of the London Basin in the north. This broad anticlinal structure is of Miocene age and is complicated by two small east-west anticlines, one of which has caused the exposure of lower and middle chalk from Winchester in the west to the northern perimeter of the Meon valley survey area in the east. It is this same anticline which is most likely responsible for those higher points in the region such as Old Winchester Hill (197m OD). Further to the south lie the tertiary deposits of the Hampshire Basin. These include Reading Beds containing variable bands of sands, clays and loams; London clay containing grey/yellow sands and clays; Bagshot sands which consist largely of yellow and white sands, and Bracklesham beds consisting of yellow/grey sands and dark laminated clays.

Within the survey area, distinct contrasts are apparent between lower and upper chalk. On the lower chalk in the north the topography is diverse with steep-sided slopes rising abruptly from the floodplain to heights of over 100m. River terraces are scarcely visible in this part of the landscape although traces do appear around East Meon. On the upper chalk the landscape is less diverse. Although ground is on average higher, it is also relatively flat beyond river terraces which are clearly visible in transect 2, and to a greater extent in transect 3. In the former a slight rise in ground level is apparent running parallel to the river on the eastern bank and at a distance of some 500m. On the west side the terrace is both more pronounced and more consistent. In transect 3 the terrace is more pronounced with steeper gradients on both sides rising to a level plateau beyond a distance of some 750m. Both within

the lower and upper chalk, dry valleys are in evidence and are probably the result, as was described in chapter 3, of initial fluvial action and subsequent periglacial activity.

7.2.2 Climate

Many of the points made regarding climatic conditions in the Avon valley are equally relevant in this case. The chalklands of the Avon valley were exposed to prevailing winds and higher mean precipitation. The Meon valley would undoubtedly have been subjected to broadly similar conditions. Obviously the less diverse environment of the upper chalk would have provided little protection, either for habitation or for agriculture. On the lower chalk, in an area where the valley narrows to become more of a corridor and offer natural protection, the topography would have produced 'pockets' of land suitable for occupation. In particular, east-facing slopes around the villages of Warnford and East Meon would have been favourable.

7.2.3 Soils

Almost the entire survey area is today considered to be, what may be termed high grade arable land, yet although the chalk provides a homogenous material over a wide area, a number of distinct soil types do nevertheless exist (Figure 7.2). Much of the area is covered by rendzina, a shallow soil which develops on the chalkland and consists of an A horizon of <27cm of dark grey or brown friable loam. This overlies a C horizon of calcareous loam and chalky brash. Variations occur on a local scale, often the result of soil creep and the downwashing of both fine-textured calcareous material from the chalk slopes and non-calcareous material from superficial deposits. A mosaic therefore exists contrasting rendzina soils such as 342a and 343h on the chalk slopes, and brown calcareous earths such as 511d and 581d in the valleys.

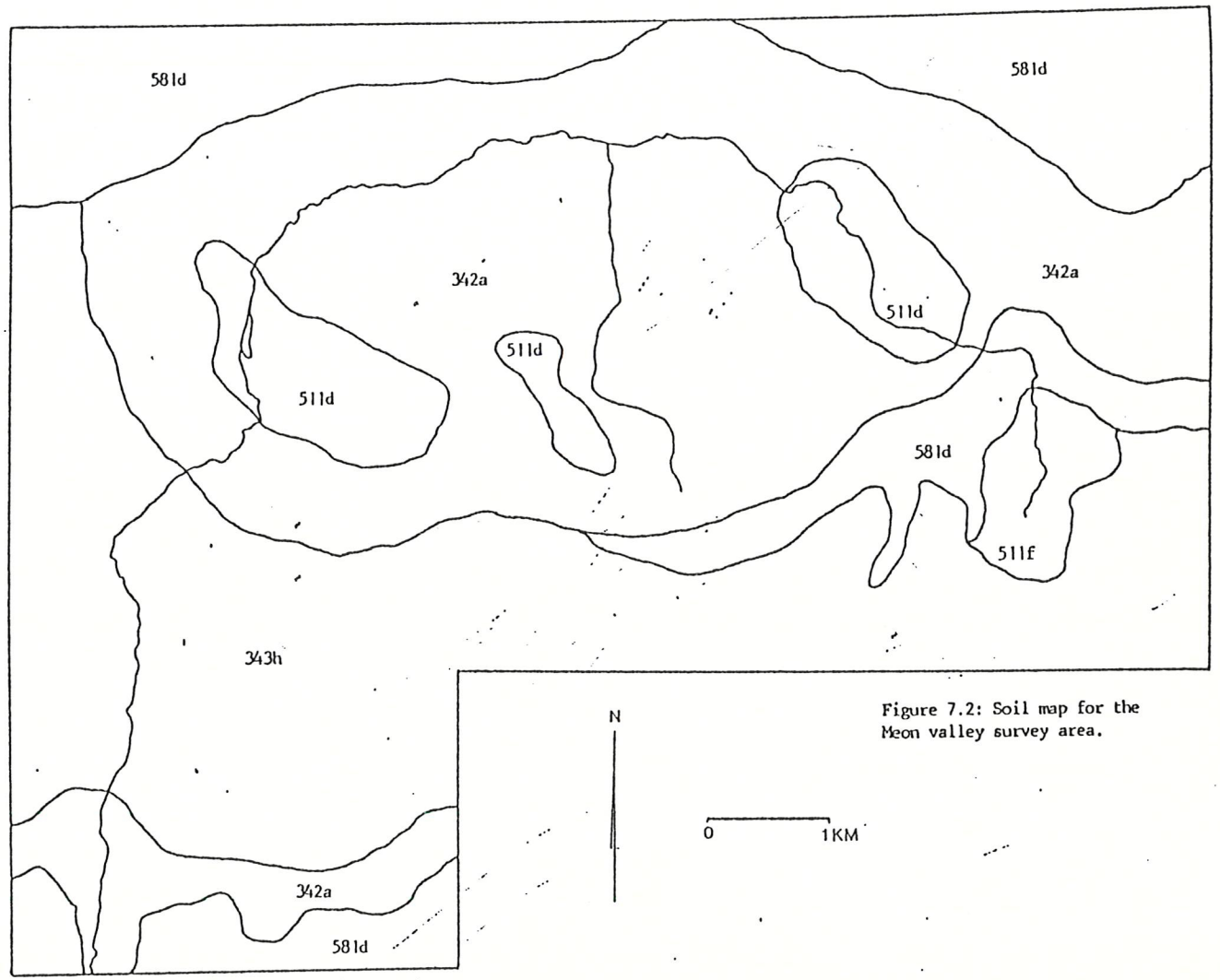


Figure 7.2: Soil map for the Meon valley survey area.

As was suggested in chapter 3, the nature and distribution of soils would have been different in the prehistoric period (Moffat and Cope 1984), and hence to regard the chalk as high grade arable land during the Neolithic may be rather too subjective. What has probably not changed through time however is the nature of that distribution, the distinction between zones defined on the basis of geology and hence soils. Although the actual composition of soils in valley and upland contexts may have changed, the relative value of those two areas for arable may remain unaltered. This is worth bearing in mind when we consider the settlement evidence from the Meon valley.

7.2.4 The collection strategy

The collection strategy adopted for the upper Meon valley survey has already been described briefly in chapter 2. It was suggested that, 1: in order to achieve the maximum output from only limited resources, areas had to be carefully selected and sampled accordingly, and 2: that in order to enable a comparison to be made between this and the Avon valley and East Hampshire surveys, a 15m line based collection strategy was required. Fieldwalking was carried out in this case largely by the author, although on occasion volunteers familiar with surface collection and the identification of lithics were available. Survey was carried out largely under ideal conditions (see chapter 2 for clarification) over two consecutive seasons.

As for the Avon valley, the total number of fields can be divided into categories according to their ecological context. Once again even representation of the various zones was achieved. In terms of soil type (Table 7.1), fields were divided according to each of the four varieties present within the survey area. 28% of fields were situated on the grey rendzina (342a) and 44.5% on the brown rendzina (343h). This provides even representation both within the rendzina category, and in comparison with the 20.5% of

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Soil																
342a n=11	12.3	6.2	8.0	4.2	8.9	4.2	22.0	8.8	8.2	5.1	10.1	5.6	1.9	1.8	0.7	1.1
343h n=17	40.1	31.2	4.6	3.5	7.8	3.3	20.9	3.6	3.4	4.6	7.9	2.1	1.3	1.3	1.4	1.4
511d n=8	23.4	18.1	10.9	5.2	8.6	4.1	17.7	4.1	6.4	3.7	8.6	1.9	2.3	2.2	2.2	2.4
581d n=3	6.1	3.4	6.5	4.6	7.2	2.1	17.0	8.8	12.7	8.0	10.8	3.0	1.7	2.4	0.4	0.6

Note: sd = standard deviation

Table 7.1: Assemblage composition in relation to soil type

fields located on brown calcareous earth (511d) and 7% on 581d, a well-drained fine silty soil, situated on plateau drift and often very flinty.

Geology also provides a clear distinction between two zones (Table 7.2). On the one hand the area of lower chalk to the north of the survey area which represents 66.6% of the fields covered, and on the other 33.3% of fields situated on the less diverse expanse of upper chalk. One field is situated on alluvium but was the only field in both survey projects - a total of 121 fields - to produce no worked flint whatsoever. This could not be considered representative as it was the only case in the Meon valley survey; it was therefore excluded from statistical analyses.

Table 7.3 shows the proportion of fields situated within the various topographical zones, defined on the basis of height OD. The two largest classes represent heights of less than 70m and between 101 and 130m OD with those areas higher up less well represented. As only one class is poorly represented and two classes are represented by between 33 and 35%, four of the five classes may be considered suitable for inter-zonal comparison.

As was the case in the Avon valley, the majority of fields are once again located within 800m of the river, with the largest single group - 43.6% - between 401 and 800m distant (Table 7.4). Beyond 800m the various classes are smaller with only two fields beyond 1600m. Once again therefore, there are problems of representivity, with only two classes large enough for comparison.

Again, however, we should bear in mind that the various distinctions made between ecological zones are rarely exclusive and more often than not the geological, topographic and pedological boundaries display a broadly similar distribution. This probably applies not only in

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Geology																
lower chalk n=26	14.5	12.6	8.8	4.9	8.7	4.1	19.6	7.4	8.5	5.5	9.2	4.2	2.0	2.1	1.2	1.7
upper chalk n=13	49.6	29.8	3.2	1.6	7.3	2.7	21.5	2.7	1.2	0.8	8.3	2.0	1.2	0.8	1.5	1.4

Note: sd = standard deviation

Table 7.2: Assemblage composition in relation to geology

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Topography																
<70m n=14	41.6	33.2	7.4	5.9	9.2	3.5	19.0	4.0	3.9	3.9	8.4	2.8	1.6	1.9	1.3	1.5
71-100m n=7	29.2	12.0	4.6	2.1	5.8	2.7	23.5	3.9	1.4	1.1	9.4	1.7	1.3	0.9	1.9	1.5
101-130m n=13	10.1	6.1	7.8	4.3	8.9	4.1	18.7	8.9	10.9	5.9	7.7	3.9	1.9	2.0	1.4	1.9
131-160m n=4	9.8	1.4	7.8	5.0	6.9	3.2	23.4	2.5	5.9	4.1	12.9	5.1	2.2	2.1	0.1	0.2
>160m n=1	66.0	-	3.9	-	8.3	-	22.3	-	6.3	-	10.2	-	1.5	-	0.5	-

Note: sd = standard deviation

Table 7.3: Assemblage composition in relation to topography

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Distance from river																
<400m n=13	43.8	35.9	5.6	4.2	8.6	2.4	19.8	4.9	4.6	4.6	8.1	3.6	1.6	1.5	1.4	1.8
401-800m n=17	20.3	13.2	8.6	4.9	7.8	4.2	18.8	5.9	6.1	6.3	9.2	2.7	1.7	2.1	1.4	1.7
801-1200m n=2	12.1	1.2	1.1	1.1	5.8	0.9	22.1	0.8	6.4	2.9	7.1	0.9	0.7	0.7	1.4	1.0
1201-1600m n=5	13.8	3.6	8.6	3.8	7.4	3.1	22.1	8.1	6.8	4.8	11.5	5.3	2.5	2.0	0.4	0.5
>1600m n=2	7.3	3.3	3.8	3.8	13.8	4.4	29.4	7.0	12.9	5.4	6.4	2.7	1.0	1.0	1.9	1.9

Note: sd = standard deviation

Table 7.4: Assemblage composition relating to distance from the river Meon.

space but also in time, and while the tendency for resources to be arranged in a linear fashion along river valleys may be valid, it must be assumed that those resources are not the same as existed during the prehistoric period.

7.2.5 The results of test-pitting

In the autumn of 1986, two 1.0 x 0.5m trenches were excavated on the slope of a dry valley orientated NE-SW at grid reference SU 164178 (Figure 7.3). The field had previously been line-walked and a distinct contrast appeared to exist between the high density of artefacts at the foot of the slope with the lower density higher up. The location of two trenches could therefore provide an indication both of the degree of representation along the valley profile as well as the degree of colluviation present. It has been suggested in chapter 3 that many dry valleys throughout the region have seen the accumulation of extensive colluvial deposits (Bell 1983), while other similar contexts have yielded virtually none, for example dry valleys in the Stonehenge environs (Richards pers.comm.). If, as Kwaad and Mucher (1979) have suggested, colluvium accumulates in relation to the intensity of agricultural activity, then its presence or absence in the Meon valley may be significant.

Both trenches are shown in plan and section in Figure 7.3 along with a schematic section of the valley profile. Both trenches yielded archaeological material although in a surprisingly small quantity, despite sieving the entire volume of soil with a .25cm mesh. Both revealed indications of a linear feature - possibly a field boundary - which is aligned at right angles to the current field boundary at the top of the slope. Trench 1 also produced the base of a post hole of approximately 15cm diameter. The most important results however concern the quantity of flint and pottery which the two trenches produced. These figures are

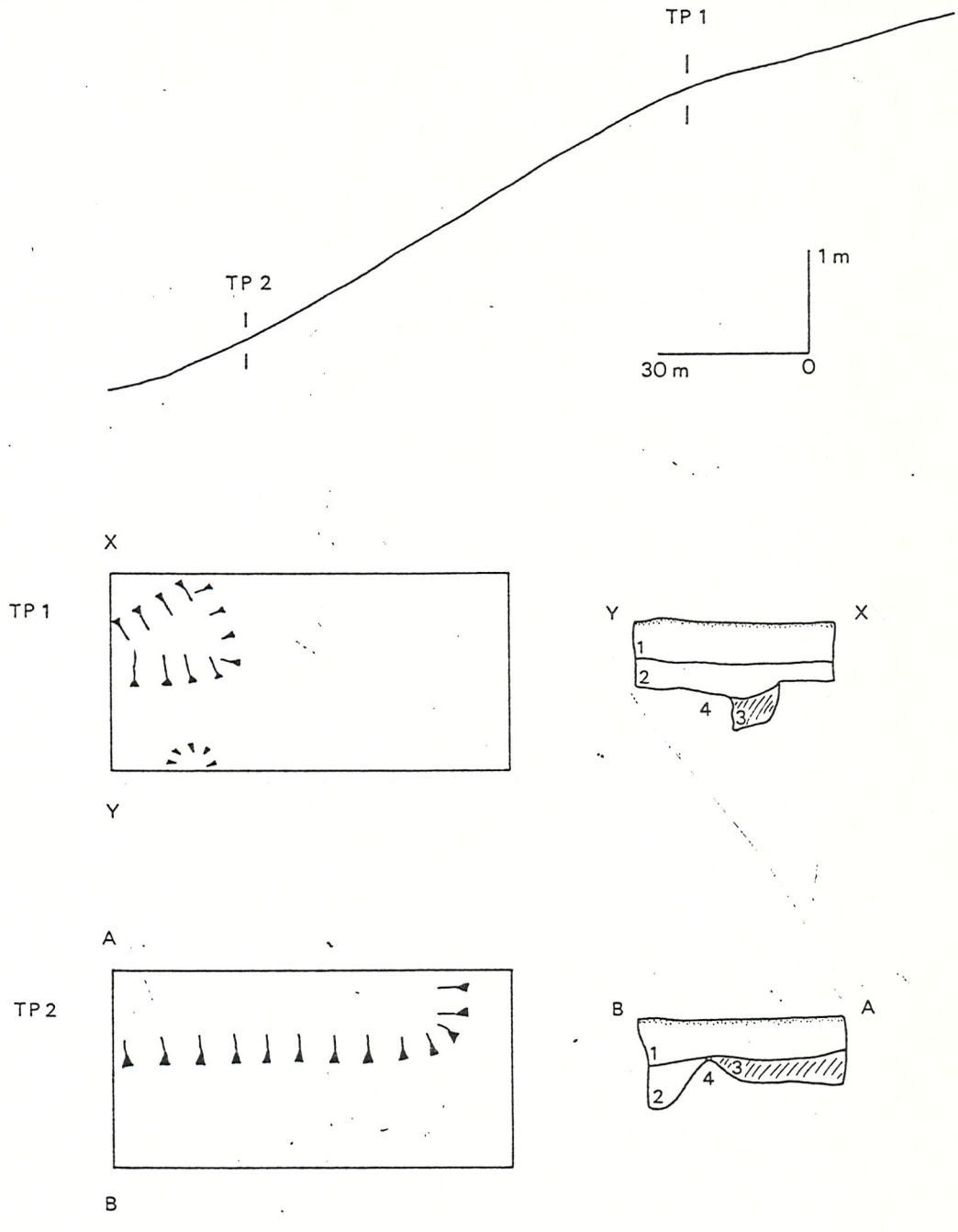


Figure 7.3 Results of test-pitting in the Meon valley. 1, plough-soil. 2, gravelly pan. 3, brown earth. 4, subsoil.

as follows:

		flint	pottery	other
trench 1	surface	0	0	1
	layer 1	9	2	4
	layer 2	9	0	3
trench 2	surface	10	4	3
	layer 1	29	3	4
	layer 2	20	1	0
% on surface		13.0	40.0	27.7

In this case therefore, both flint and pottery appear to concentrate on the surface and in layer 1 (the ploughsoil). This contrasts with test-pits in the Avon valley where ceramics tended to concentrate in layer 2, the underlying gravel pan. Pottery also appears to be better represented on the surface here than in the Avon valley while the predominance of flint in the latter case is totally reversed.

It is particularly interesting to note that in both cases, despite a horizontal distance of some 90m and a vertical distance of 2.5 to 3m, soil depth - both of the ploughsoil and of the underlying gravel pan - is virtually identical. In trench 2 at the foot of the slope the gravel is .001m deeper than in trench 1. What this may suggest is that the accumulation of deposits on the slope is limited although this would need to be confirmed by more detailed excavation.

Having therefore described in some detail the survey area

itself and the collection strategy adopted, we may now turn to the results of the survey. The format will be identical to that of the previous chapter, looking first at general aspects of location and distribution concentrating on the extent of relationships between artefact discard and the physical environment. In a second section the distribution and nature of technological variables will be considered, while the third section will consider evidence from individual periods. Finally we shall consider general patterns of human behaviour in relation to the home-range model described in Chapter 5.

7.3 Aspects of Location and Distribution

7.3.1 Geology

As has already been described, the study area is divided into two geological zones which were both well represented by the surface collection strategy adopted. It remains now to consider the extent to which drift geology influenced the organisation of activity within the survey area. For the Avon valley no significant relationships were observed between density or waste classes and geology, while the relationship between retouch and geology was only significant at the .05 level of probability.

For the Meon valley a very different picture emerged. By examining Table 7.2 and the results of significance of means tests (Tables 7.49 to 7.52), it appears that both density, retouch, scraper and core frequency all display significant variation, while standard deviations suggest some variation within groups. Tertiary waste for example, while displaying a higher mean score on the upper chalk, shows low variation between fields (Table 7.2). In other words the area as a whole displays little variation from the mean. On the lower chalk however, a lower mean percentage is combined with a standard deviation of around 7.4%, suggesting the opposite to be the case.

Core frequency indicates a broadly similar picture. Low frequency on the upper chalk is combined with a low standard deviation, while high mean frequency on the lower chalk is combined with a standard deviation of just over half that score. This suggests that on the upper chalk tertiary waste was distributed more evenly across the area while core distribution was both minimal and localised. On the lower chalk however, cores and tertiary waste exhibited local variations, reflected in greater variation from the mean. These relationships are confirmed by chi-square analysis (Tables 7.44 to 7.46). While variations in the frequency of tertiary waste displayed no significant relationship, the distribution of cores was significant at a .02 level of probability. This therefore confirms the results of significance of means tests which suggested that in each case, variation between the means was significant at a .005 level of significance. The only exception are scrapers for which a significance level of .05 was suggested.

Another significant contrast appears to exist between density and drift geology. In a previous chapter it was noted how retouch and density may display a negative correlation, particularly where industrial activity has occurred; it is clear that this is also a reflection of the ecological distinction between upper and lower chalk. On the upper chalk for example, mean density and standard deviation are almost five-times that on the lower chalk, while on the contrary mean retouch frequency on the lower chalk is three-times greater than that on the upper chalk, although variation within the upper chalk is virtually non-existent (Table 7.2). These relationships are confirmed by chi-square analysis (Tables 7.44 to 7.46). The relationship between geology and density is significant at a .001 level of probability, while that between geology and retouched items is significant at a .05 level. Again these results support those of t-test analyses.

Clearly therefore there is a correlation between geology and the organisation of human behaviour as described in the previous sections. The questions which must now be asked concern the extent to which those relationships are confined to geology alone, or whether other associated factors such as topography or soil type were equally significant. Clearly the relationships outlined here provide a contrast to the situation which existed on the sands and gravels of the Avon valley described in the previous chapter.

7.3.2 Soil

Four soil types are represented within the survey area: 343h which covers 44.5% of those areas examined and is associated with the upper chalk in area 1. 342a and 511d are situated on lower chalk, the latter covering the whole of area 2 and the former representing about 70% of area 3. The fourth group is 581d and covers around 30% of area 3.

It should not be surprising therefore to note a general correspondence between the nature of relationships observed here and in the previous section (Table 7.1). Mean density for example is exceptionally high on 343h, a brown rendzina, silty and well-drained. This relates closely to the correlation between geology and density outlined above. Low density on the lower chalk however does not suggest any standard pattern of exploitation. The variation in density for example between the two soil types 511d - a typical brown calcareous earth - and 342a - a calcareous soil proved significant by a significance of means test, at a .01 level (Table 7.28).

Retouch also corresponds with observations made in the previous section. Mean percentages and standard deviations are higher on 342a and 511d and substantially reduced on soils covering the upper chalk. Within the lower chalk it

is 511d which maintains the higher mean density and standard deviation. This point also confirms one to be made in the discussion of the home-range (section 7.5), that density and retouch frequency display a negative correlation. It would appear that the root of that relationship may lie within the two soil divisions of the lower chalk. 511d does appear to display the characteristics of a home-range in two separate locations within the study area. That each outcrop of this particular soil type corresponds with higher retouch and scraper frequency is of interest.

As far as core-reduction is concerned, clear distinctions appear to exist between mean frequency of primary and tertiary waste and cores, distinctions which were again apparent in the context of geology. On the one hand primary waste shows a mean frequency greatest on 342a and lowest on 581d - again representing the lower/upper chalk divide - although this was not significant and standard deviations were remarkably similar. Tertiary waste displays a similar trend - lowest on 581d, highest on 342a. Cores also appear to complement this general picture, with a mean frequency of 8.2% on 342a, 6.4% on 511d - both maintaining high and proportional standard deviations - and a score of only 3.4% on 343h. All are far exceeded however by 581d for which the mean core percentage is 12.7% and the standard deviation is 8%. Analysis of variance showed this to be significant at a .01 level (7.28 to 7.31).

This clearly supports the observations made above, but also adds detail of variations occurring within the area of lower chalk. For example that a greater frequency of cores and primary waste appears to exist on 342a while 511d maintains a slightly higher frequency of retouched items. Some of these relationships are confirmed by means of the chi-square test. On the one hand the relationship between soil type and density is significant at a 0.001 level of probability - similar to that between geology and density -

and supported by analysis of variance which suggested a significance level of 5%. Soil type and fields maintaining >10% of retouched artefacts produced a similar result. Cores also proved to vary significantly between soil types. This suggests therefore that both geology and soil type could be seen to influence aspects of human activity in the survey area, although if we are dealing primarily with farming communities then soil type may well be the most important.

Soil therefore was influential in terms of the distribution of domestic activity but less so in the organisation of industry and technology. In chapter 3 the close relationship in the study area between geology and soil was described, and it is this closeness-of-fit which makes it all the more difficult to distinguish between the two variables.

7.3.3 Topography

One variable which does not correspond to those described above is that of topography or height OD. Again the proportion of fields is evenly distributed with the only exception being those over 160m OD, for which only 2.5% of the area is represented (Table 7.3). Density is at its highest in those areas which lie below the 70m contour, and declines with height. Indeed this relationship was significant by both chi-square and analysis of variance to a .01 level of significance (Tables 7.32 and 7.47). Fields below 70m appear both on lower and upper chalk and hence do not correspond to those relationships identified in the previous sections. All those fields lie on the river terrace slightly above the level of the floodplain with just two exceptions. This contrasts with the Avon valley where mean density on the terraces was considerably lower than that on the upper chalk.

Between 71 and 160m OD density is considerably lower. These

areas invariably represent the upper terraces and raised plateaux which appear behind the lower terraces, and maintain areas of exposed and often undulating chalk downland. It is nevertheless in these areas that retouch is most frequent and that cores appear in the highest proportions. This suggests both industrial and domestic activity and to explain this we need to return once more to the distinction between lower and upper chalk. The two types of activity are apparently distributed within the same topographical zone, the evidence for domestic activity being predominant on the more northerly lower chalk and industrial activity being characteristic of the upper chalk to the south of the study area.

The only case of marked deviation from the mean concerns the distribution of cores. On the lower terraces, below 70m OD, mean core frequency is low while standard deviation is relatively high. Between 101 and 130m OD on the other hand, mean core frequency was high while the standard deviation was relatively low. The means were compared by a t-test and proved to be significant at a .01 level (descriptive statistics used in the t-test are presented in Tables 7.14 and 7.15). This reinforces the observation made earlier that the upper terraces were a primary industrial area. It also suggests that core-reduction within that area was evenly distributed both in time and space, suggesting a degree of continuity. On the lower terraces however, core-reduction did occur but sporadically, either in a particular area or at a particular time. Certainly the organisation and continuity apparent on the upper terrace was not present further down.

Again chi-square tests tended to confirm these observations (Tables 7.47 and 7.48). Density produced a significant relationship but at a probability of .01, lower than that for other variables. Frequency of retouch was again not influenced by topography, while the relationship between cores and topography was only significant at a .30 level of

probability. It was however significant through analysis of variance (Table 7.34). Topography therefore did influence the distribution of human activity but to a lesser extent than geology. Where significant relationships do exist they appear to correspond to those in previous sections while the broad distinction between topographical zones appears to mask the relationship between soil and geology within those areas.

7.3.4 Proximity to river

Proximity to the river is linked inextricably to topography; river valleys tend to appear as narrow, compact ecological zones with contours of variation running parallel along their length. As distance from the river increases so too does height OD. It is nevertheless possible to identify several points of variation which appear dependent upon the former and independent of the latter (Table 7.4).

In the previous section it was observed that density was highest below 70m OD, decreasing to a height of >160m OD. Retouch on the other hand showed an inverse relationship, increasing with height and then dropping on areas of high ground. With distance from the river these relationships are less clearly defined. Within 400m of the river, mean density is at a maximum yet standard deviation is higher, suggesting considerable variation within that zone. This may be explained by the distinction between valley floor and lower terrace and between lower and upper chalk. Retouch on the other hand is relatively low closer to the river. Between 401 and 800m, mean density is considerably lower and retouch greater again suggesting an emphasis towards home-range activity (section 7.5, below). On the upper terraces density remains fairly uniform while retouch peaks once more between 1201 and 1600m.

Analysis of variance suggested that density variation was

significant at a .01 level (Table 7.36). The problem concerns the extent to which the river as a habitat influenced that pattern, or whether topography or soil type was a more important locational factor. This will be considered in more detail in a later section.

7.3.5 Summary

As was the case for the Avon valley, certain environmental variables had an influence on the nature and intensity of specific aspects of human behaviour. Clear distinctions could be made between types of activity and intensity on the lower and upper chalk while other relationships also appear to have existed in relationship to topography and soil type. Certainly a clear distinction appears to exist within the study area between domestic activity on the terraces of the lower chalk, especially in area 2, and an emphasis towards industrial and extractive behaviour on the less diverse upper chalk further to the south.

Again it is hard to establish which, if any was the primary factor in affecting the location of human activity, although in most cases geology tends to provide the 'solid base' upon which spatial and temporal variations in pedology, topography and palaeohydrology may occur. In many respects the distinctions are clearer in this case than in the Avon valley, suggesting perhaps a more distinct pattern of use and continuity. We may suggest in other words that in the larger and possibly more productive valley system, occupation will tend to be more intensive, continuous and long-term. It may be argued that the more an area is occupied the more likely it is to display shift and overlap between zones or resource patches. In a smaller valley system where settlement may have been seasonal or non-permanent, zones of activity would not have been subject to 'blurring' on the same scale and hence the distinction between home-range and extra home-range environments may have remained distinct. Unfortunately the density figures

do not support such a picture and we must attempt to explain this phenomenon by examining the evidence for temporal and technological continuity.

7.4 Technological Patterning

It was suggested in chapter 4 that a number of both dependent and independent variables may serve to illustrate the nature of lithic procurement strategies within the survey area. The so-called 'ASDA Factor' may be visible through both variations in flake morphology and the frequency of both core-reduction flakes and possibly hinge fractures. It has already been suggested that such patterns may occur in relation to zones of industrial activity and that such an industrial zone appears to occur on the upper chalk terraces and at the foot of steep slopes within the more diverse area of lower chalk.

Primary waste appears to concentrate in all three areas, though in each case with different associations. On the upper chalk for example it corresponds with localised high artefact density, a virtual absence of cores, retouched items and scrapers. On the lower chalk of area 2, a high proportion of primary flakes appears on one steep-sided west-facing slope and again on the valley floor associated with low density, high proportions of retouch and scrapers and a large proportion of cores. Area 3 again maintains a high frequency of primary flakes with the major concentrations appearing beneath steep east-facing slopes. Again this is associated with a low density of worked flint, a high proportion of retouched artefacts and cores.

Area 2 contains evidence for home-range activity dating to the Mesolithic and Neolithic periods, but in contrast to the Avon valley no clear distinction between procurement strategies can be discerned. In all cases where blades appear in high frequency in areas 2 and 3, blade cores are also present. This is despite low overall density in those

cases. If flint were being knapped in other areas such as the upper chalk where flint is most plentiful, then we should expect more blade cores within that area, the increased frequency being a function of greater artefact frequency. That this does not occur suggests that the correspondence between blade and blade-core distribution is a realistic one. A similar case can be argued for the proposed Neolithic home-range in area 2, described below, where again low density and high retouch correspond with higher core frequency. These relationships are confirmed by the correlation matrix (Table 7.5) and regression analyses (Table 7.6 and associated scattergrams, Figures 7.26 to 7.53). Density shows a negative correlation with core frequency (-0.489) while the coefficient of determination suggests a percentage level of explanation of 23.93%. Core frequency also shows a positive correlation with retouch frequency (0.362) and a percentage level of explanation of 13.10%. These relationships therefore suggest a distinction between industrial (area 1) and domestic (area 2) domains, while it would appear that some overlap occurs within area 3.

These relationships appear to be confirmed by a concentration of tertiary waste in area 2. What is surprising however, and appears to go against the apparent clarity of these distinctions is the nature of flake size variability (Table 7.7). If a strong correlation exists then a similar relationship to that noted for the Avon valley should be apparent, namely that a decline in mean flake size and standard deviation should appear with distance from the source area (Figures 7.4 and 7.5). If we assume that the source in this case was the area of upper chalk then that expectation is in fact reversed with flake size and standard deviation increasing with distance. Two factors may explain this: First that area 1 was also used as a hunting/foraging domain and not solely for industrial purposes. This may explain the decrease in flake size but does not explain the low standard deviation. The second

	flint	%retouch	%primary	%tertiary	%cores	%scrapers	%blades	%coretrimmer
flint	1.000							
%retouch	-0.425	1.000						
%primary	-0.103	-0.040	1.000					
%tertiary	0.070	-0.446	0.110	1.000				
%cores	-0.489	0.362	0.099	-0.432	1.000			
%scrapers	-0.086	0.451	-0.038	0.030	-0.031	1.000		
%blades	-0.098	-0.006	0.093	0.391	-0.261	0.294	1.000	
%coretrimmer	0.067	0.050	-0.086	0.175	-0.244	0.264	-0.225	1.000

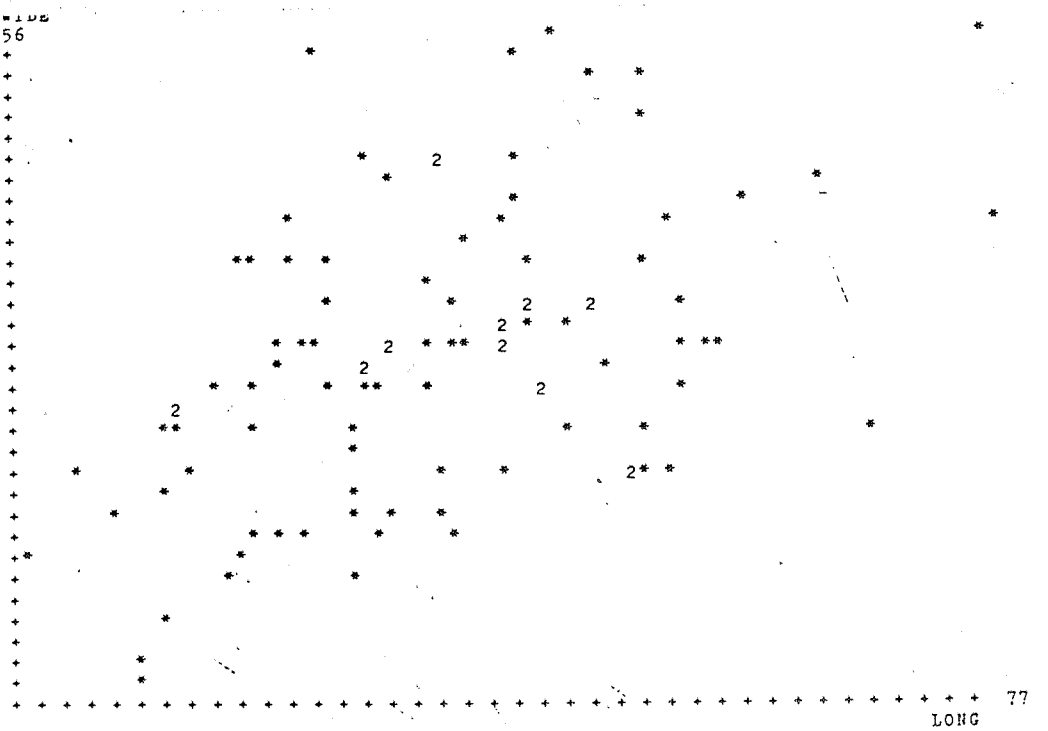
Table 7.5 Correlation matrix for the Meon valley survey.

Dependent variable	Independent variable	r	r^2
Density	%retouch	-0.43	0.18
	%primary	-0.10	0.01
	%tertiary	0.07	0.00
	%cores	-0.49	0.24
	%blades	-0.10	0.01
	%scrapers	-0.09	0.01
	%core-trimmers	0.07	0.00
%retouch	%primary	-0.04	0.00
	%tertiary	-0.45	0.20
	%cores	0.36	0.13
	%blades	-0.01	0.00
	%scrapers	0.45	0.20
	%core-trimmers	0.05	0.00
%primary	%tertiary	0.11	0.01
	%cores	0.10	0.01
	%blades	0.09	0.01
	%scrapers	-0.04	0.00
	%core trimmers	-0.09	0.01
%tertiary	%cores	-0.43	0.19
	%blades	0.39	0.15
	%scrapers	0.03	0.00
	%core trimmers	0.18	0.03
%cores	%blades	-0.26	0.07
	%scrapers	-0.03	0.00
	%core trimmers	-0.24	0.06
%blades	%scrapers	0.29	0.09
	%core trimmers	-0.22	0.05
%scrapers	%core trimmers	0.26	0.07

Table 7.6: Regression values for the upper Meon valley

Area	length		breadth	
	mean	sd	mean	sd
1	37.8	2.6	30.1	2.0
2	42.2	3.5	33.0	2.5
3	40.5	4.3	30.9	2.8

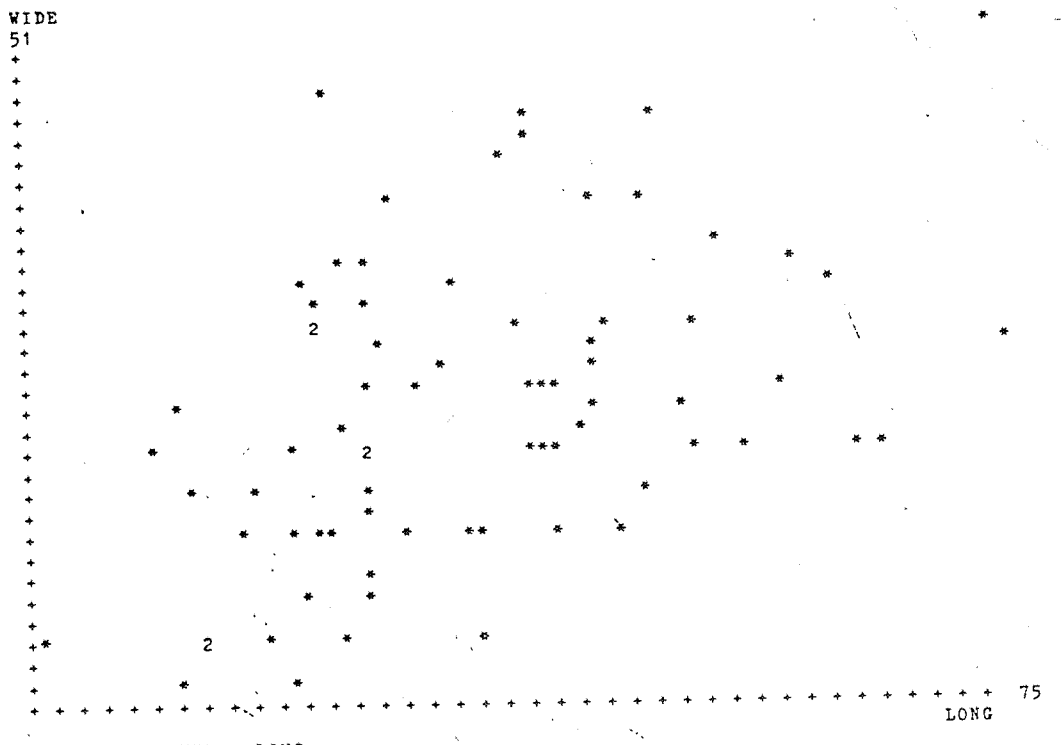
Table 7.7 Flake size variation in the Meon valley survey area.



HORIZONTAL AXIS: LONG
LEFT ENDPOINT: 13 RIGHT ENDPOINT: 77

VERTICAL AXIS: WIDE
LOWER ENDPOINT: 9 UPPER ENDPOINT: 56
HEADER DATA FOR: B:PF1 LABEL: FLINT DIMENSIONS
NUMBER OF CASES: 100 NUMBER OF VARIABLES: 2

Figure 7.4: Flake size diagram for SU 630215 (area 2).



HORIZONTAL AXIS: LONG
LEFT ENDPOINT: 11 RIGHT ENDPOINT: 75

VERTICAL AXIS: WIDE
LOWER ENDPOINT: 12 UPPER ENDPOINT: 51
HEADER DATA FOR: B:WE2 LABEL: FLINT DIMENSIONS
NUMBER OF CASES: 75 NUMBER OF VARIABLES: 2

Figure 7. 5: Flake size diagram for SU 622226 (area 2).

argument could be that area 3 was exploited more intensively as an industrial zone. This seems unlikely as flint is both more plentiful and of better quality on the upper chalk.

In the Avon valley the relationship between behavioural domains and flake size fitted the technological model - defined in chapter 4 as the ASDA Factor. In this case it does not and hence the gradients between types of activity may not be as acute. Although behavioural domains are still distinctive and the location of industrial and domestic activity still apparent, It may simply be that the 'ASDA Factor' does not work on such a local scale. Further work in the south of the Meon valley may throw more light on this suggestion.

7.5 Spatial distribution of behavioural domains

For this investigation the survey area was divided into three zones each corresponding to approximately one third of the fields covered and each displaying a very different set of ecological criteria (Figure 7.6 and Table 7.8). Results are presented in Tables 7.5, 7.6 and 7.9, and Figures 7.7 to 7.12 with associated scattergrams in Figures 7.26 to 7.53. Once again the idea was to attempt to identify broad distinctions in the nature and intensity of activity in the three areas and to interpret any patterns in terms of the home-range model presented in chapter 5. Expectations in this case were based on the results presented in the previous chapter, namely that a home-range may be expected to appear in a similar location to that in the Avon valley with areas of extra-home-range activity spanning out from a particular focal area onto areas of undifferentiated upland. The former would be manifested in the form of high proportions of retouch and evidence for the later stages of core-reduction, while the latter may be characterised by a more diverse scatter of artefacts and inparticular extractive items such as microliths, axes and

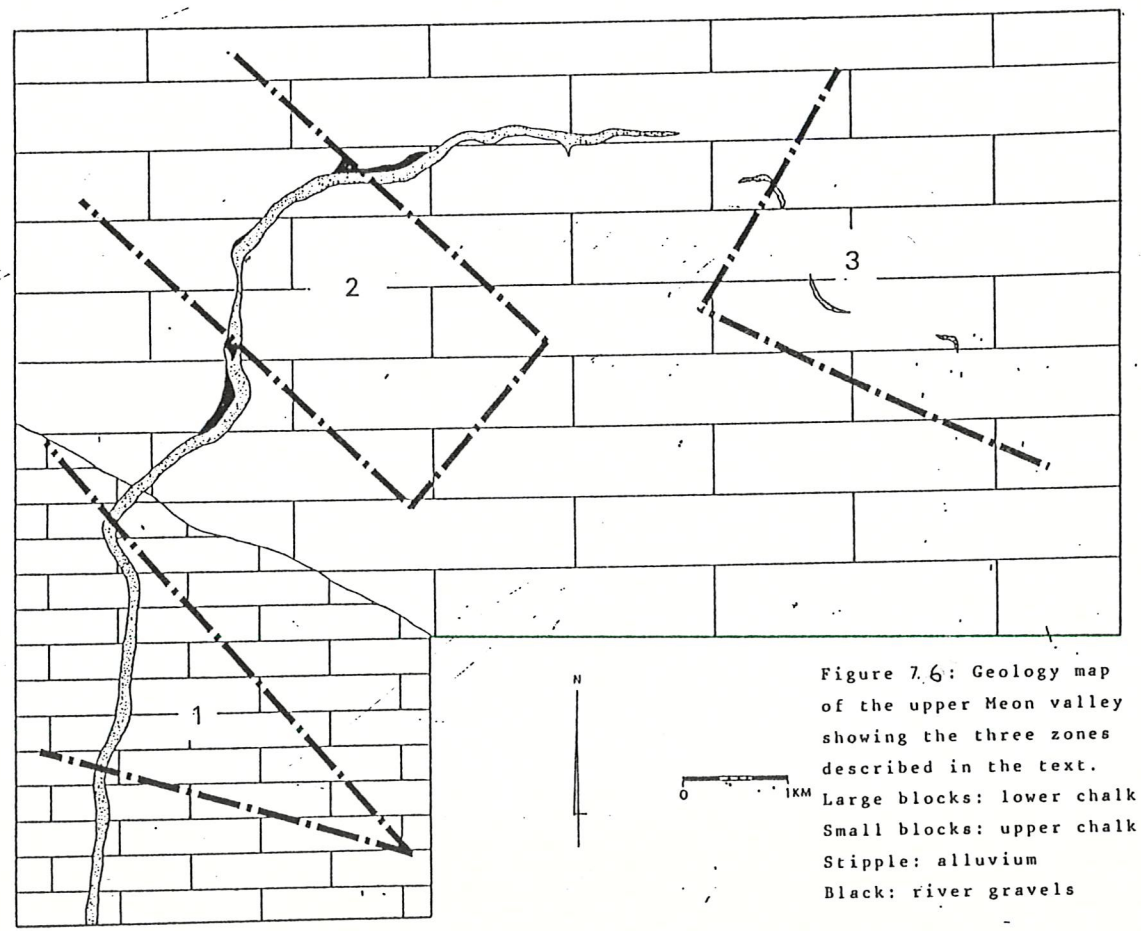


Figure 7.6: Geology map of the upper Meon valley showing the three zones described in the text.
Large blocks: lower chalk
Small blocks: upper chalk
Stipple: alluvium
Black: river gravels

Area	Geology	Topography	Soil
1	upper chalk downland with flint.	gently undulating, rising up from the river Meon to a height of 90m OD.	shallow, well-drained calcareous silty soil over chalk on slopes and crests. Striped soil patterns locally.
2	lower chalk	rising from Meon to first river terrace and backing onto scarp slope running WNW-ENE.	well-drained calcareous fine silty soils - deep in valley bottoms, shallow on valley sides.
3	lower chalk	diverse topography with steep slopes and narrow valley corridor.	well-drained calcareous silty soil over chalk Deeper fine silty calcareous soils in valley bottom.

Table 7.8: Ecological characteristics of the three ecological zones in the Meon valley (see Figure 7.6 for location).

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Zones																
1 n=13	49.6	29.8	3.2	1.6	7.3	2.7	21.5	2.7	1.2	0.8	8.3	2.0	1.2	0.8	1.5	1.4
2 n=14	15.9	7.9	9.4	5.2	9.0	4.5	20.9	7.7	7.5	5.0	9.6	4.2	2.3	2.2	1.2	1.6
3 n=12	12.9	16.3	8.2	4.4	8.3	3.5	18.2	6.9	9.8	5.8	8.7	4.1	1.6	1.9	1.1	1.8

Note: sd = standard deviation

Table 7.9: Assemblage composition for the three ecological zones

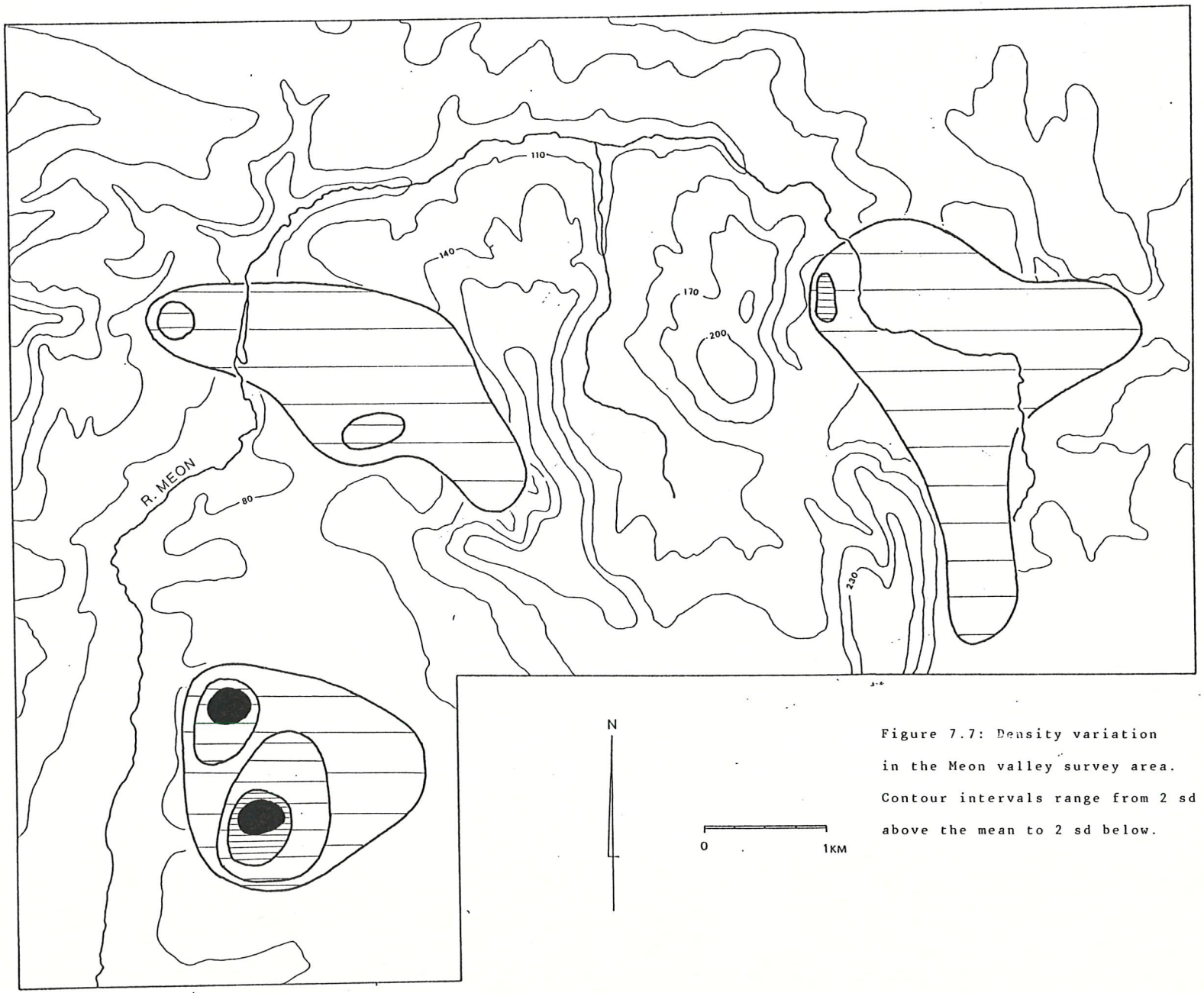


Figure 7.7: Density variation in the Meon valley survey area. Contour intervals range from 2 sd above the mean to 2 sd below.

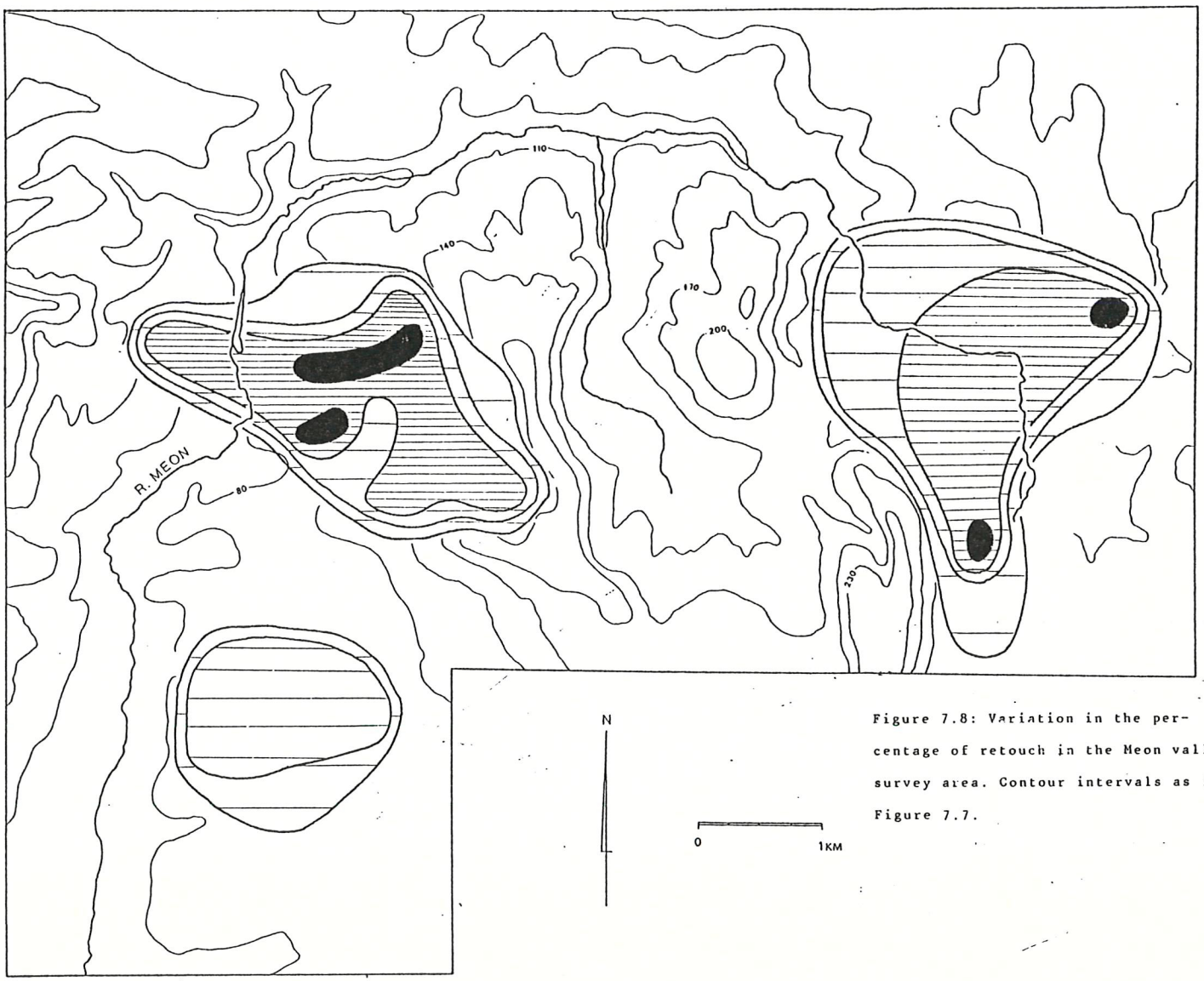


Figure 7.8: Variation in the percentage of retouch in the Meon valley survey area. Contour intervals as for Figure 7.7.

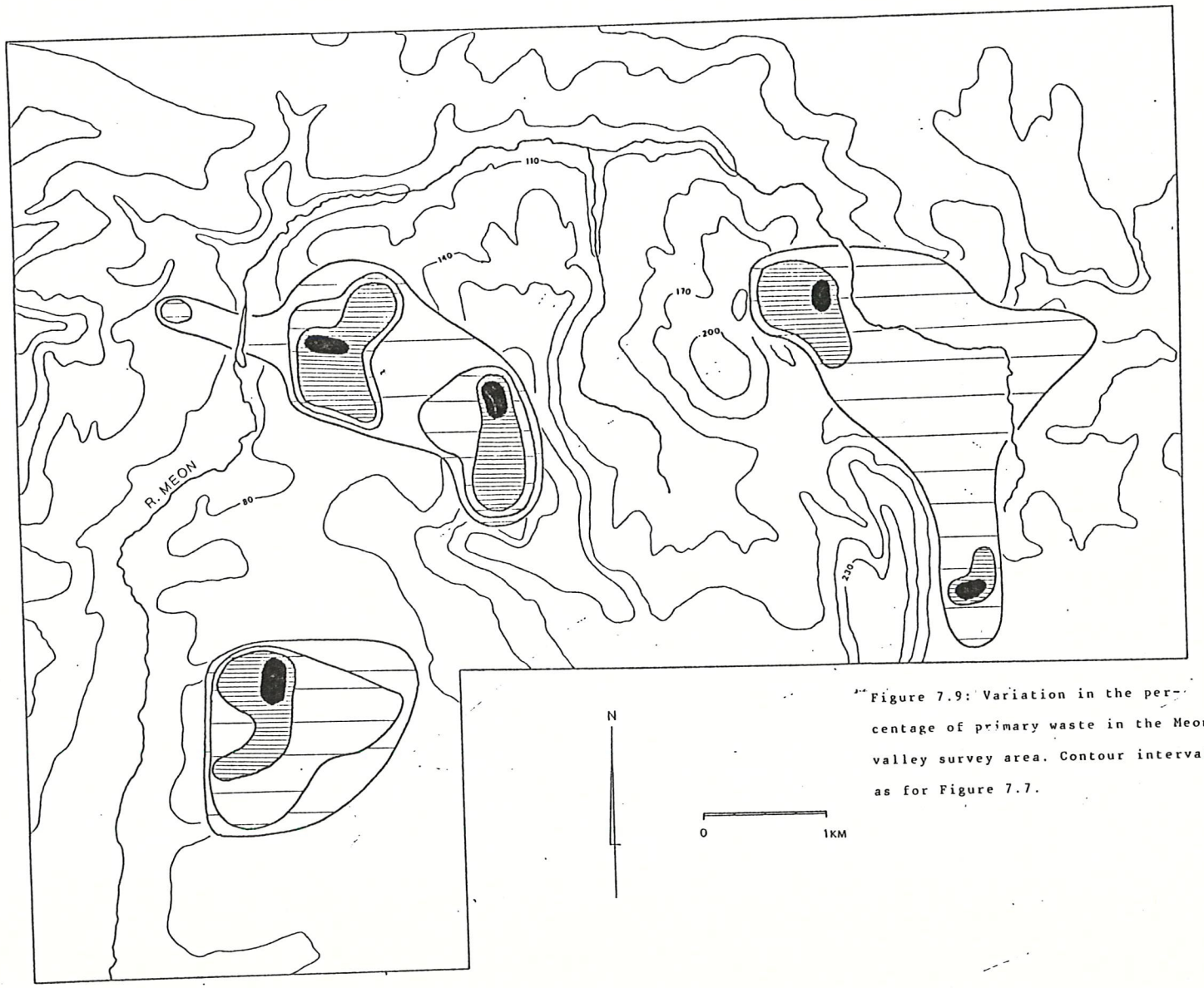


Figure 7.9: Variation in the percentage of primary waste in the Meon valley survey area. Contour intervals as for Figure 7.7.

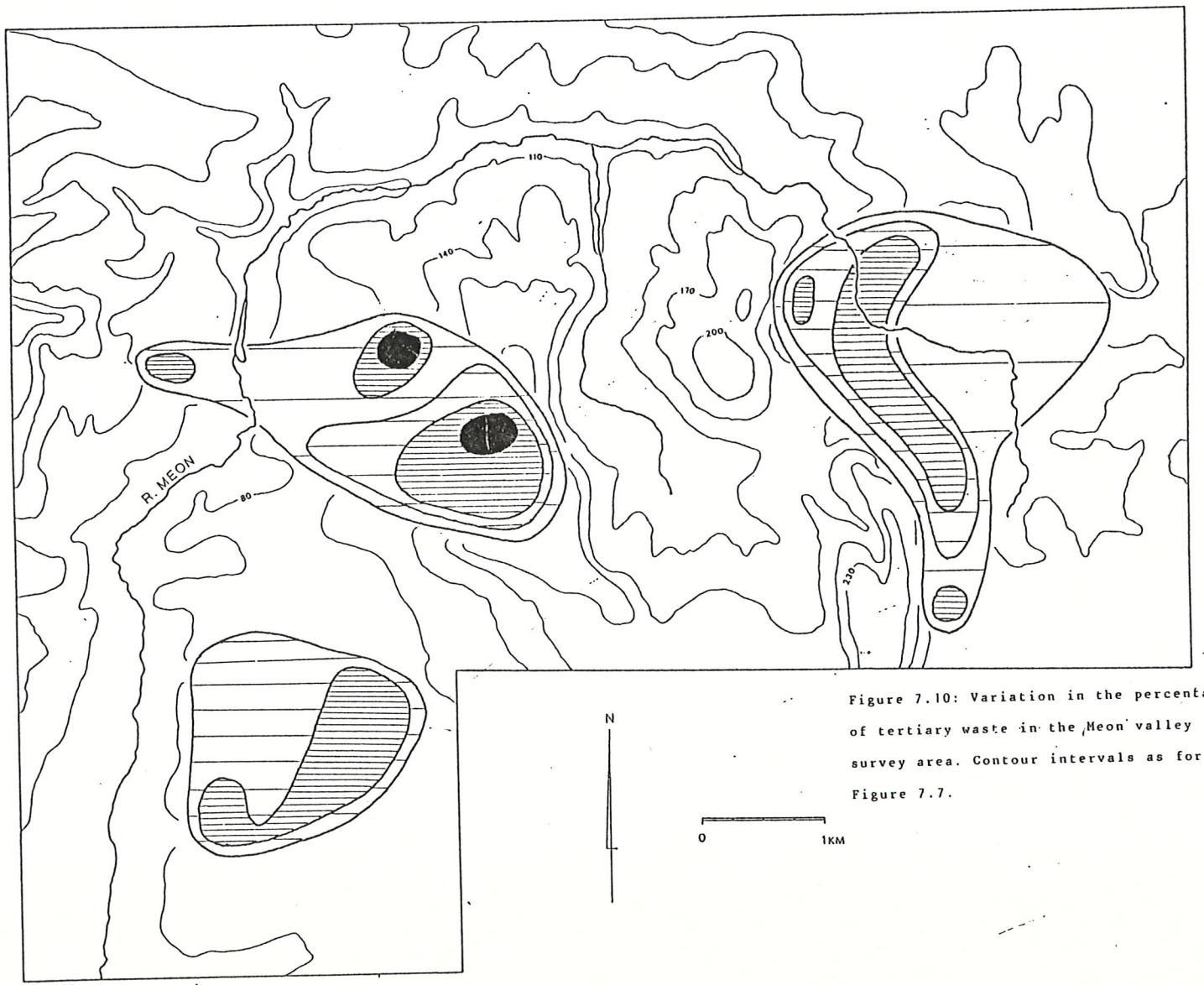


Figure 7.10: Variation in the percentage of tertiary waste in the Meon valley survey area. Contour intervals as for Figure 7.7.

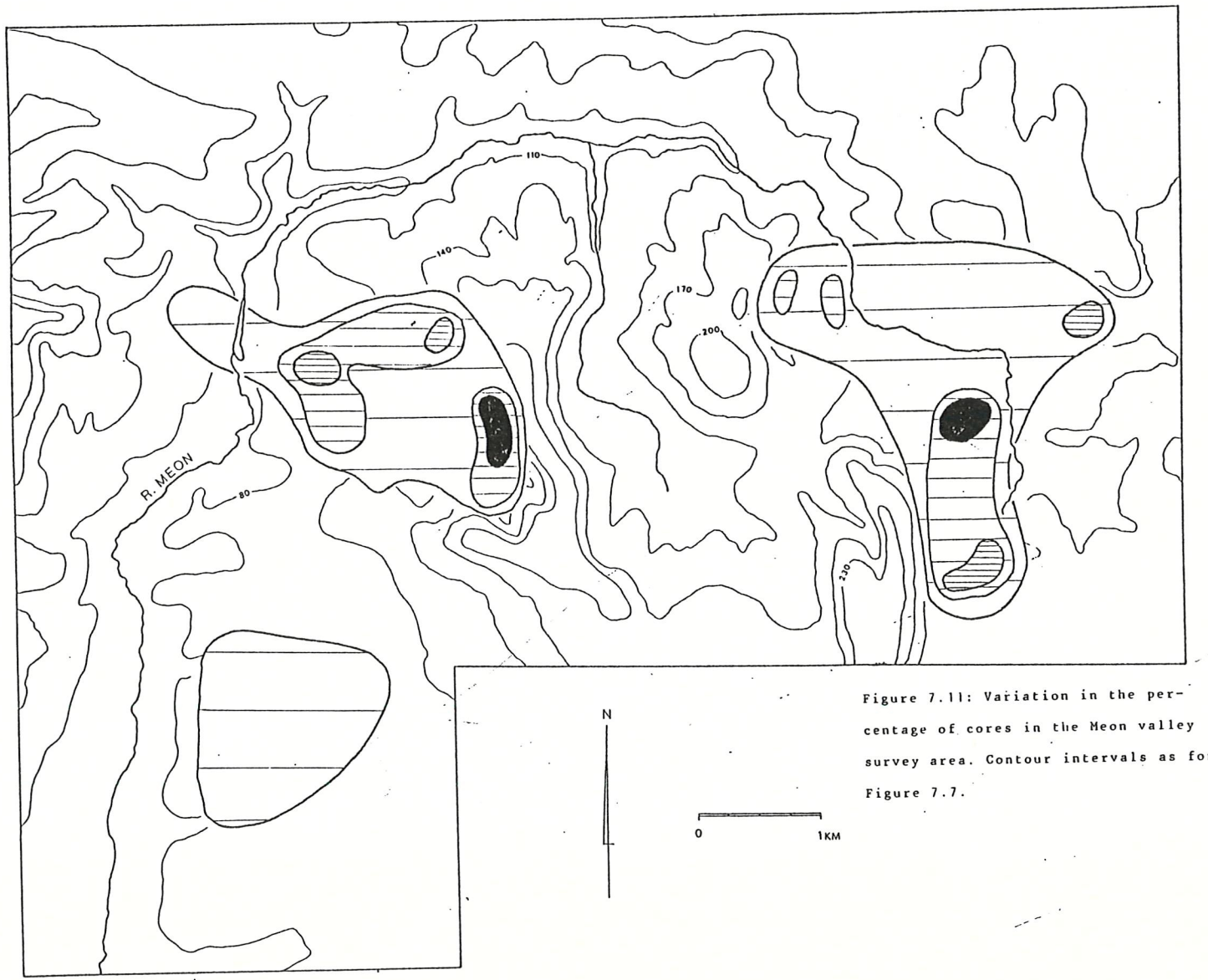


Figure 7.11: Variation in the percentage of cores in the Meon valley survey area. Contour intervals as for Figure 7.7.

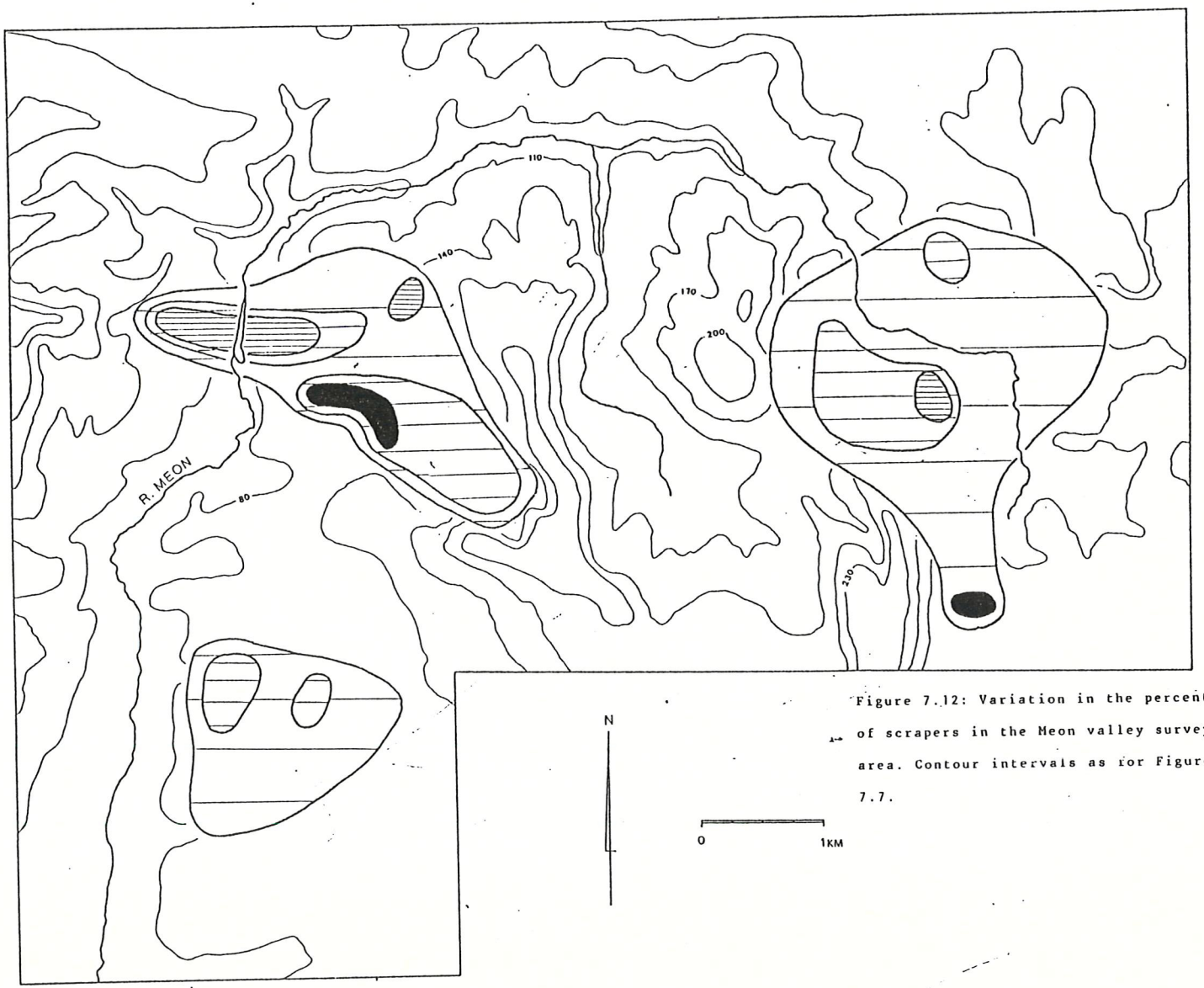


Figure 7.12: Variation in the percentage of scrapers in the Meon valley survey area. Contour intervals as for Figure 7.7.

arrowheads.

The statistical techniques used for this investigation are similar to those adopted for the previous chapter with an emphasis once more on regression based upon a series of dependent and independent variables and significance of means testing. The extent to which behavioural domains may be regarded as distinct depends largely upon the relationship between those variables and the nature and strength of correlation as well as the significance of variation between means. The three categories may now be considered.

7.5.1 Home-range

Once again there are a number of factors which we may expect to be predominant in the home-range in terms of artefact discard and assemblage composition. These will include a higher overall density of artefacts - at least in those cases where sedentary communities are represented - a higher proportion of retouched artefacts and lower proportions of primary industrial waste. As a first point, the relationship between density and the proportion of retouch appears as a negative correlation of -0.425 with a percentage level of explanation of 18.07%. In other words the frequency of retouched items tends to decrease as scatters become larger in size. It may be suggested that retouch is a more accurate measure of home-range activity than density simply because density may reflect an accumulation of any type of activity which occurs within specific locations. Hence industrial locations may be interpreted as 'settlements' - according to the traditional equation of density = site = settlement - simply on the basis of high artefact density. This is confirmed by the nature of relationship between these two categories on the one hand and scrapers on the other. The correlation matrix (Table 7.5) shows a slight negative correlation between density and scrapers (-0.086) and a far

stronger positive correlation between retouch and scrapers (0.451). For density and scrapers the coefficient of determination is .0075 (Figure 7.31) while for retouch r^2=.2031 (Figure 7.26). In other words scraper frequency accounts for 20.31% of variation in the proportion of retouch and only 0.75% of variation in artefact density.

What is clear therefore is that, as was the case for the Avon valley, density does not account for the variations in retouch frequency, suggesting that a simple combination of high density and high retouch proportions will not necessarily indicate home-range locations. Indeed a far more suitable index would appear to be one based on high retouch and high scraper frequencies rather than density. This was suggested in chapter 5 and is based on the assumption that although density may vary considerably both in relation to formation processes and according to the nature and length of occupation, frequency of retouched/maintenance items will remain relatively uniform in a home-range context. Another useful indication as to the presence/absence of home-range specific activities may be achieved by examining the proportions of waste classes most commonly associated with retouched items. For primary waste r^2=0.0016 (Figure 7.33) and the correlation -0.04 while for tertiary waste r^2=0.1989 (Figure 7.34) and the correlation is -0.446. Again therefore tertiary waste accounts for a greater variation in retouch frequency than does primary waste, a point also made for the Avon valley. Not surprisingly the relationship which clearly exists is a negative one, similar to that between tertiary waste and core frequency on the one hand and density and core frequency on the other.

I would suggest therefore, on the basis of these observations and the expectations raised in chapter 5, that area 2 and to a lesser extent area 3, fit the category of home-range (Figures 7.7 to 7.12). As a first point, density is lower in areas 2 and 3 than it is in area 1, a

relationship which proved significant by analysis of variance at a .01 level (Table 7.40). This was suggested above as being less significant a distinguishing factor than retouch, as quarry sites and other special purpose locations may accumulate quantities of waste without ever yielding retouched items. Density as recovered through surface collection is more likely to be interpreted merely as evidence of repeated episodes of activity than of a particular type of activity which may have been short-lived but intensive. Retouched artefacts in area 2 appear in higher frequency than in area 1, a variation which was again significant through analysis of variance (Table 7.40). Scrapers appear in higher frequency across area 2 with particular focal areas clearly outstanding and apparently concentrated on the foot of the first river terrace. Waste classes are fairly evenly distributed throughout the survey area while cores are a far more common occurrence in areas 2 and 3 than in area 1. Again this proved to be significant at a .01 level (Table 7.42).

I would suggest from this evidence, that both areas 2 and 3 appear to contain evidence for home-range activity although evidence is more convincing for area 2 than for area 3 (Tables 7.9). In addition, the scrapers in area 3 are found in fields containing larger proportions of retouch and these are clearly exceptions to the rule. Both classes display larger standard deviation scores in area 3 than in area 2 suggesting that the latter exhibits some degree of repeated activity and continuity.

7.5.2 Secondary home-range

Two types of activity were suggested in chapter 5 as being characteristic of the secondary home-range and visible through surface collection. Both are apparent within the survey area and both appear to concentrate in area 3, the zone with the most diverse topography situated on lower chalk and at the head of the Meon valley.

The first type of activity is industrial and appears to cluster, as in the Avon valley, at the foot of steep slopes where nodules would be naturally outcropping. Primary waste does appear throughout the study area but is highest in frequency in area 3. We have already noted the positive correlation between cores and retouched artefacts, both regarded as characteristic of home-range behaviour. It is also interesting to note the very low correlation (0.099) between primary waste and cores, confirmed by an r^2 value of 0.0098 (Figure 7.40). No correlation is therefore suggested implying that primary reduction occurred within an industrial - secondary home-range - context, while further reduction was home-range specific.

Another type of activity is that associated with 'special task locations'. One of these is situated within area 3 on an exposed hilltop at a height of 175m OD. The composition of the lithic collection goes against the pattern observed within the home-range with high retouch associated with high density and a virtual absence of scrapers. Blades also appear in relatively high proportions. All these observations are at variance with the correlation matrix which suggested negative correlation in each of these cases (Table 7.5). The coefficient of determination in the latter case for example, suggests that only 0.96% of variation in blade frequency will have influenced overall density. Clearly therefore this case is an exception and it may be no coincidence that so too is its situation. From this field it is possible to see the landscape for 3-4km in most directions and would have been an ideal location from which hunter-gatherers could have monitored the movement of game. Surely in this case density cannot possibly indicate the location of a settlement?

7.5.3 Extra home-range

This forms a zone around the home-range in which back-up

resources may be available and which may support groups living within the home-range. It is suggested that area 1, situated largely on undifferentiated upper chalk downland represents such an area. Clearly from the various diagrams one point is outstanding and that is the extraordinarily high density of artefacts which appear within that area. The mean density per hectare is 37.4, over twice that of area 2 and over three-times that of area 3, a point confirmed by analysis of variance (Tables 7.40 to 7.43). Similarly scrapers are less frequent, retouch is only a third that of areas 2 and 3, while cores are virtually absent. It is certainly true that flint occurs widely and in high frequency over the upper chalk and therefore would surely have been intensively exploited. The lack of cores within the area may be explained by their removal to the home-range for further reduction.

If we examine Figures 7.13, 7.14 and 7.15 however, a pattern emerges within area 1 which may suggest organised industrial activity over a long period of time. Both primary waste and high density are concentrated on the river terrace and at the front of the adjoining plateau or interfluve. This goes against the general trend which points to a low correlation of -0.103. The distribution of tertiary waste on the other hand appears to be mutually exclusive, located some distance away on the interfluve, separated from the primary industrial zone by perhaps only a few hundred metres. This is closer to the proposed correlation values of 0.070 and 0.110 respectively and may indicate one of two things; either an organised industrial complex in which primary and tertiary reduction were spatially segregated, although if this were the case we should expect cores to appear in association. The alternative is that the distinction is temporal with heavy industrial activity on the terrace proceeding or preceding general hunting/foraging behaviour widespread on the upper chalk.

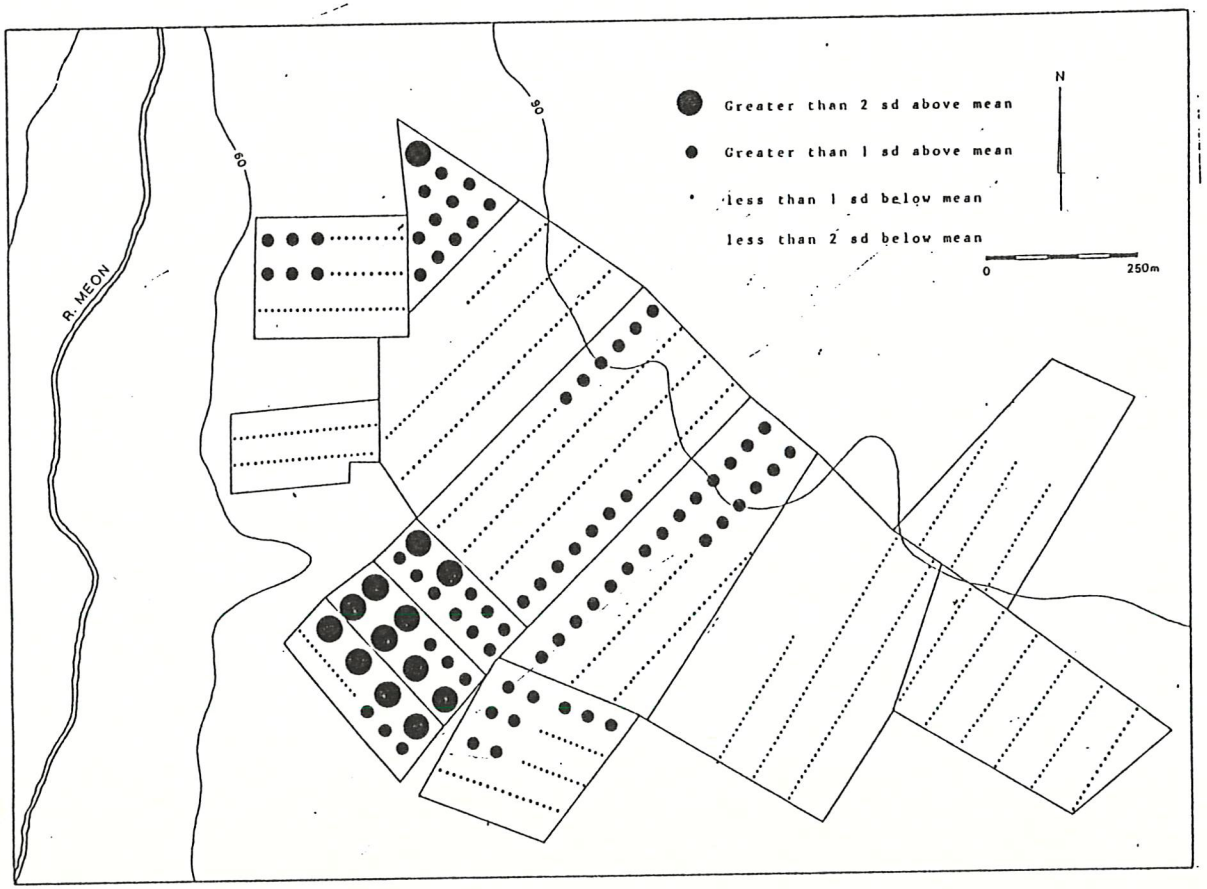


FIGURE 7.13: Density variation in area 1 (Bushy Down Farm, Soberton).

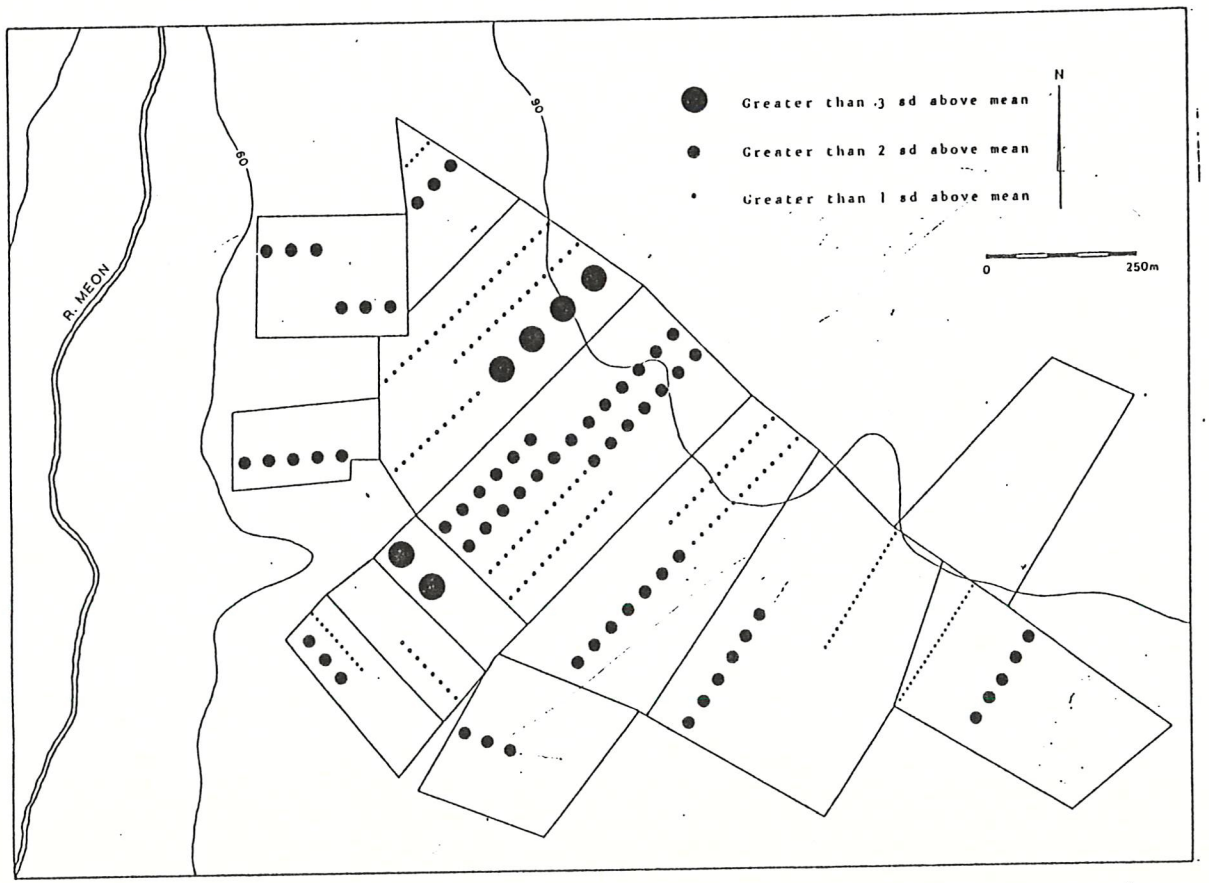


FIGURE 7.14: Proportion of primary waste in area 1.

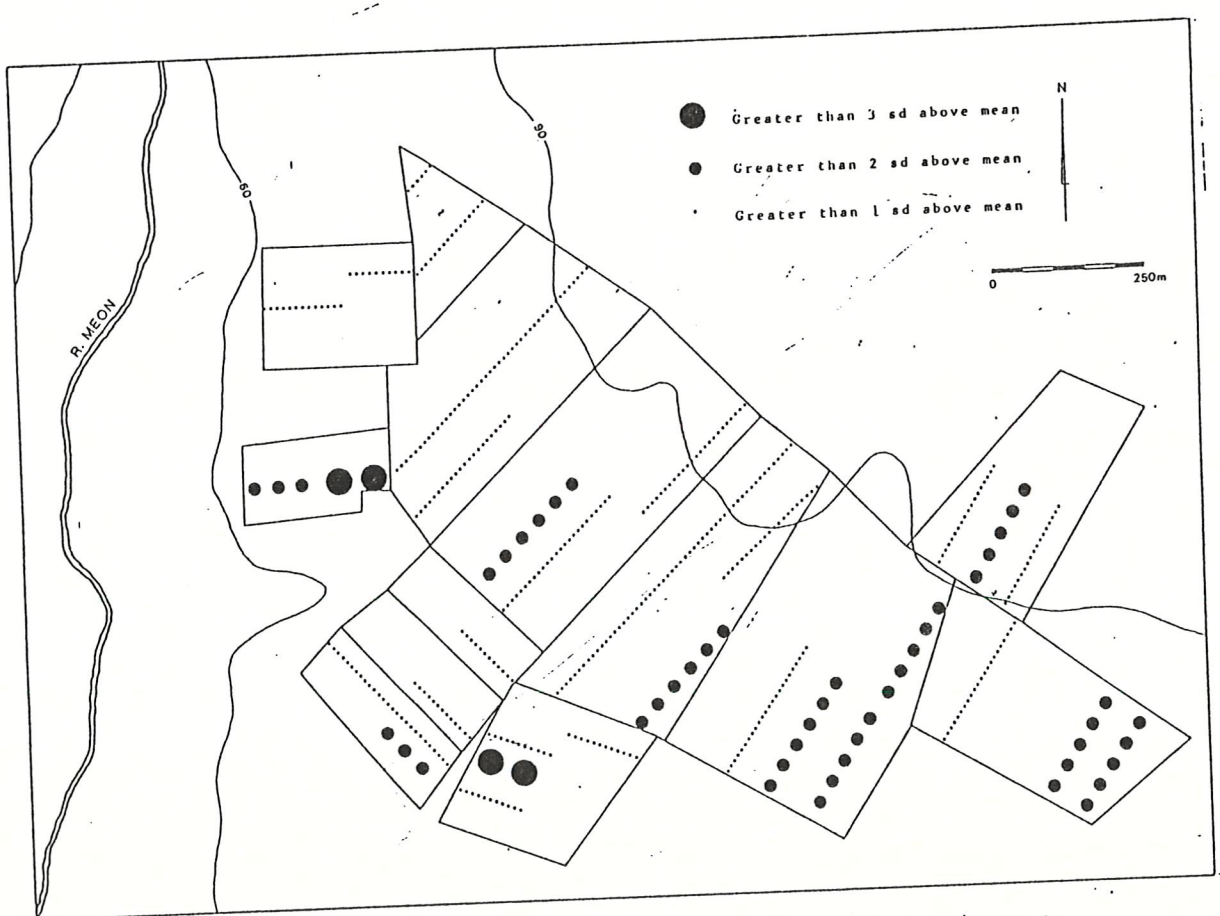


FIGURE 7.15: Proportion of tertiary waste in area 1.1

Examination of Figure 7.16 reveals a concentration of extractive artefact types - axes, microliths and arrowheads - on this area of upper chalk. It is interesting to note that retouched artefacts are generally low in frequency but also widely dispersed in a uniform distribution across the area. Density is only high in the industrial sub-zone and is relatively low in comparison over the remainder of area 1.

In summary therefore, area 1 does represent part of an extra home-range territory but one which is both functionally and perhaps temporally variable. We may suggest that the area was used extensively for hunting/foraging and the felling of timber. This is confirmed by the general distribution, unique to the upper chalk, of microliths, leaf shaped and barbed and tanged arrowheads, tranchet and polished stone axes as well as uniform density and retouch frequency. At some stage the terrace was exploited intensively for industrial purposes. Fields on the river terrace maintain far higher densities of worked flint, exceeding 100 per ha. in one case and characterised by an unusually high proportion of primary waste. If this density were the result of settlement or home-range activity, then we may expect to see an increase in the frequency of retouched items and scrapers. That these do not appear clearly points to some other form of activity.

7.6 The evidence of chronology

7.6.1 Mesolithic

Evidence for Mesolithic activity within the survey area is once more dominated by the distribution of chipped stone artefacts recovered from ploughed fields over the past 30-40 years (Figure 7.16). Included amongst these are a tranchet axe from Corhampton, microliths from Droxford and a thick blade of Portland chert from Exton. On Salt Hill,

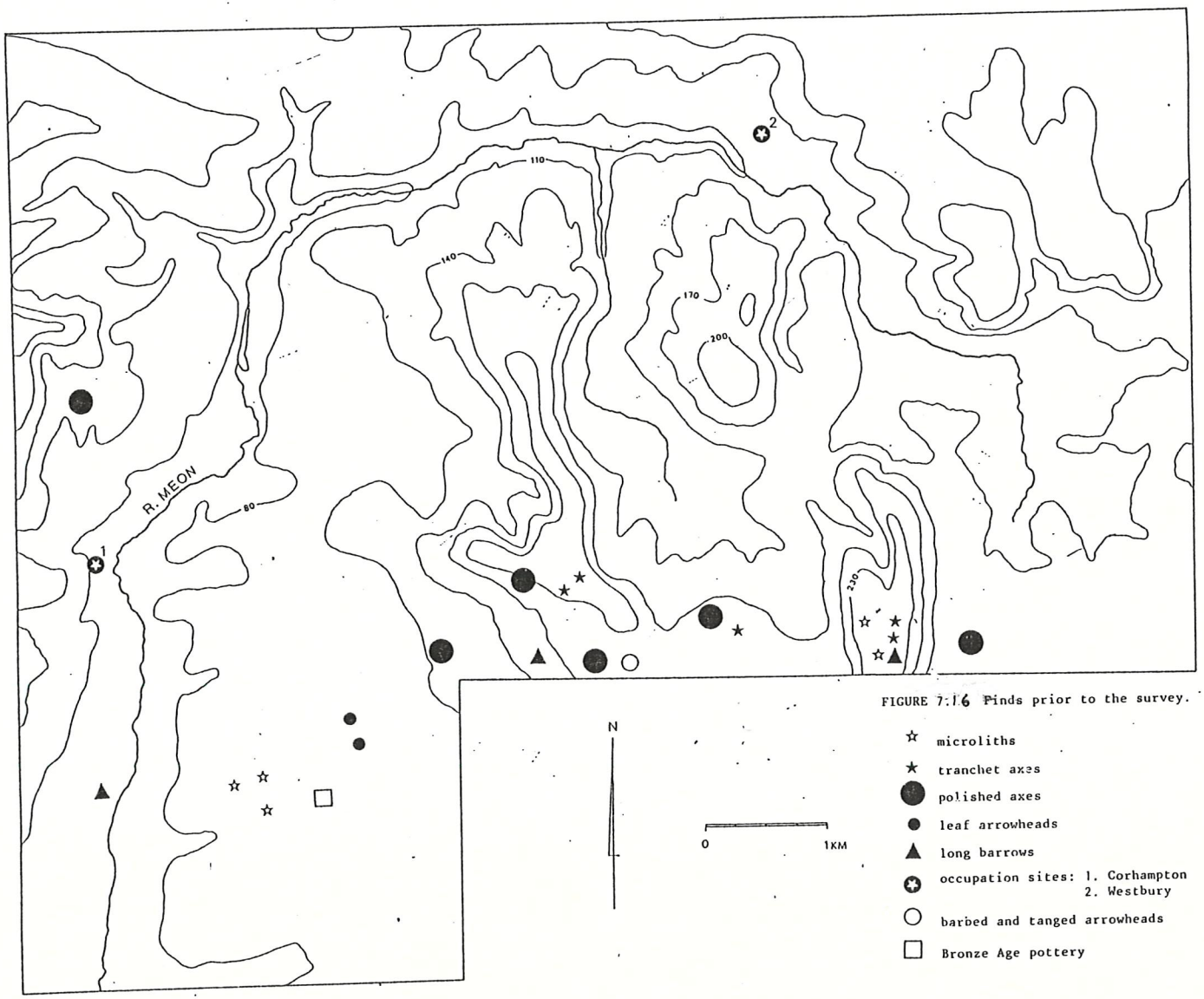


FIGURE 7:16 Finds prior to the survey.

East Meon basally retouched points were recovered in association with chronologically later forms of microlith (Draper 1955). A further location was identified by Draper on Old Winchester Hill, situated on the main South Downs ridge, 5km east of Warnford. A total assemblage of 350 artefacts was recovered, all apparently the product of locally obtained raw material and consisting primarily of waste.

The bias prior to systematic survey was therefore clearly in favour of upland areas such as Salt Hill, and it is no surprise that this apparent concentration led Draper (1955,199) to the conclusion that, 'a recurring pattern of Mesolithic sites on hilltops...is significant.'

One further indication of Mesolithic activity in the survey area is achieved by means of analogy with the excavation at Wakefords Copse, a short distance to the south (Bradley and Lewis 1974). Here, as at Downton in the Avon valley the indication was one of a small-scale activity area, in this case represented by a series of pits, some of which were encircled by stake holes. Jacobi (1981,19) suggested that if these were structures of some form, then a floor area of only 3.1m could possibly be represented.

Certainly this idea of small-scale, dispersed units is one characteristic of the Mesolithic of southern England and is confirmed by numerous other excavations in the region (described in chapter 5). Surely if Mesolithic activity is present in the study area, it is a pattern such as this that we must expect to encounter. Density will therefore be low and diagnostic items few and far between.

What the survey demonstrated above all else was that the opinions expressed by both Draper (above) and by Collins and Hurst (1978) and Trinder (1907) at the head of the chapter, were based on an unrepresentative sample of human behaviour within the survey area. Surface collection within

the valley has demonstrated a density and diversity of artefacts which far outweighs that achieved by previous less systematic investigations.

Once again the problem is one of distinguishing Mesolithic activity from that of early farming communities and once more we must rely on aspects of scale and distribution as much as on the location of specific types of artefact. Certainly it is acceptable to point to areas maintaining concentrations of microliths and blade cores, but that alone is not sufficient. That information provides a frame but in order to fill in the background we need to look to a more complex set of interrelationships, concerning not just presence/absence but the scale and nature of exploitation.

In terms of a framework, numerous Mesolithic 'type-fossils' appear within the survey area, both from the survey itself and from previous collections. From the survey, Mesolithic occurrences provide a ubiquity value of 11.4%, while a clear distinction appears to exist between the distribution of blade cores - indicative perhaps of home-range activity - and tranchet axes and microliths, probably representing the extent of an extra home-range and foraging domain. The former, without exception lie on the terraces situated on lower chalk, both in areas 2 and 3. The latter on the other hand appear to concentrate on the upper chalk of area 1. This picture is confirmed by the distribution of existing findspots prior to the survey. The two blade cores are once again situated on lower chalk at the head of the river Meon, while the numerous occurrences of both microlith and tranchet axe are situated both on the upper chalk of area 1 and on the outcrops of both Old Winchester Hill and Salt Hill. In other words the two groups of artefact appear mutually exclusive and in totally different situations - one sheltered on the lower chalk, one exposed on the upper chalk.

If we consider blade frequency in relation to chronology a

similar pattern is suggested (Figures 7.17 and 7.18). Fields maintaining a proportion of blades >1 standard deviation above the mean appear in four separate locations but all in an similar setting. Two units within area 2 appear at the foot of river terraces on opposite sides of the river. Both coincide with low density and a relatively high proportion of both retouched items and scrapers. In area 3, the two units with high blade frequency again appear at the foot of a steep east-facing slope and slightly above the level of the floodplain. Again these coincide with a relatively high frequency of retouch, low density and in one case a high proportion of scrapers. It would appear both from the scale and low density that these represent only short-term home-range locations and judging from their close proximity, were occupied at different times rather than being contemporary. The extent of upper chalk to the south was almost certainly maintained as an extra home-range hunting and foraging domain, clearly segregated from the purely domestic activities occurring further to the north.

In terms of technology, no clearly diagnostic traits are apparent. Mean flake size is greater in areas 2 and 3 than it is in area 1, while only one of the four units designated a 'Mesolithic home-range' maintain an exceptionally low mean flake size. It may be that once again we are seeing evidence for logistical lithic procurement with core-reduction occurring 'on-site' in the north (Mode 1 production, as defined in chapter 5). If on the other hand, raw material were being obtained from the upper chalk as part of an embedded procurement strategy (Mode 3 production), then depending on the scale of operation, resource stress may not have been a governing factor within the home-range. Certainly the flake size ratios suggest this to be the case.

A further distinction made in the previous chapter was that based on Juel Jensen's (1986) observation that retouched

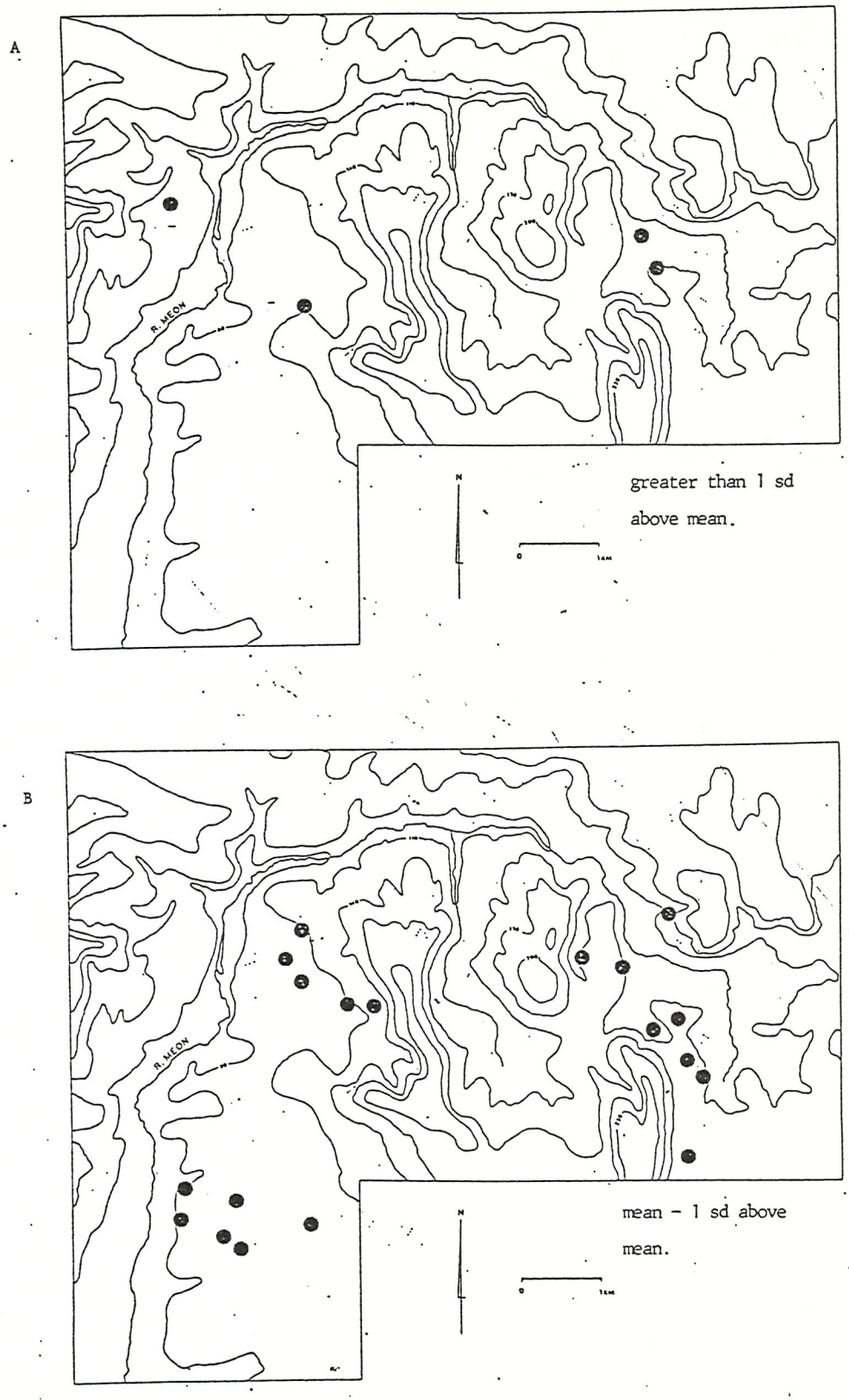


Figure 7.17: Blade frequency diagram for the Meon valley.

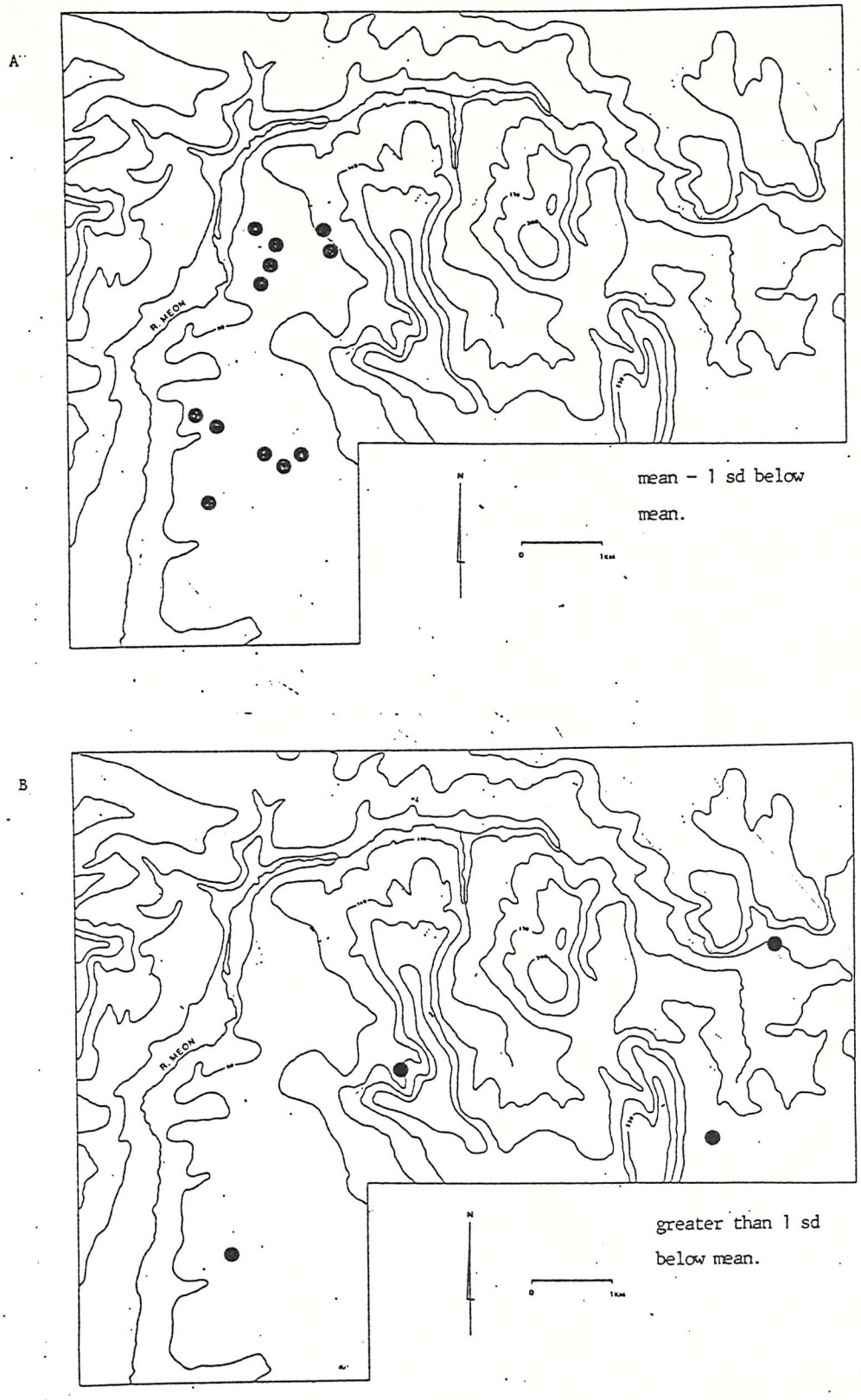


Figure 7.18: Blade frequency diagram for the Meon valley.

blades may represent cutting or whittling tools used within a general foraging radius while unretouched blades may have been used for manufacturing other tools and may indicate only single task 'on-site' events. The expectations in this case were not upheld with retouched blades representing 1.5%, 7.0% and 5.6% in areas 1, 2 and 3 respectively. The low proportion of retouched blades in area 1 may well be a function of the low overall frequency of retouched items while only two of the four units representing home-range locations maintain a total absence of retouched blades.

In terms of a general statement therefore, a number of points can be made:

1. That a clear distinction can be made within the survey area between 'domestic' activity on the lower chalk with an apparent concentration at the foot of both river terraces and steep slopes, and 'industrial/extractive' behaviour on the less diverse topography of the upper chalk. Concentrations within the domestic domain almost certainly represent the location of small-scale home-ranges, occupied by forager communities at some stage during the Mesolithic.

Their location is characteristic. Not only are they situated within the valley and 'protected' by locally diverse topography, but they also lie at the centre of a complex resource map. Within a 5km radius, a diversity of ecological patches occur. To the south lie outcrops of upper chalk with abundant supplies of flint for tool manufacture, and to the north a more diverse topography and soil map, providing a varied set of conditions ideal for sustaining a mosaic of species, both diverse and abundant.

2. Regarding the scale of activity, once again we are seeing only a limited presence. Density is low within those units maintaining 'Mesolithic' material, while the close proximity yet clear segregation of units does point to

temporal rather than spatial separation. Whether these 'points in time' represent repeated visits by a single community is unclear. What is certain is that occupation was not long-term. In contrast to exploitation of the lower chalk however, the upper chalk does appear to have functioned as a general territory with no clear concentrations of activity and certainly no evidence for settlement. The area was - by analogy (chapter 3) - almost certainly wooded and such extensive tracts of woodland with local clearings would have been ideal for hunting and the gathering of plant foods.

3. In comparison with the Avon valley, again we appear to be seeing a structured, coherent adaptation with groups returning to similar locations within a specific geological context on numerous occasions. Clear gradients appear in both cases between the home-range and the more general hunting/foraging domains. It must surely be the case therefore that the overall land-use strategy in the chalkland valleys of southern England cannot have altered much during the early postglacial period.

It was suggested in the previous chapter that the Mesolithic of southern England was characterised largely by small, mobile communities traversing the landscape, integrating into the seasonal round coastal, riverine and upland resource habitats. Here, as in the Avon valley the results tend to confirm that view and suggest that we are dealing primarily with a valley adaptation with settlement concentrating at the base of river terraces in areas displaying diverse topography, and a more general hunting/foraging domain on areas of less diverse upper chalk downland.

In terms of the optimal foraging model presented and described in chapter 5, groups would have located their settlements at a point central to the widest variety of resource patches. Again, as with the Avon valley this

appears to have been the case. The general hunting/foraging domain which appears on the upper chalk in the south of the survey area is defined both by the distribution of tranchet axes/axe fragments and the distribution of microliths. A number of points can be made regarding this distribution in relation to those made by Mellars and Reinhardt (1978). A first point concerns the distribution of tranchet axes and the observation that axe concentrations correspond precisely to those areas of southern England for which suitable supplies of flint for axe manufacture were readily available (1978,269). Another explanation for their concentration on the upper chalk however may be that they reflect the distribution of localised extractive activity, concerned primarily with the felling of timber, either for manufacturing purposes or to produce localised clearances for the manipulation of game.

Another point made by Mellars and Reinhardt (1978) concerns the distribution of microliths and the suggestion that a clear concentration appears to exist both on lighter sandy soils and on the boundaries between major geological formations of the Weald. It was these points in space which were described in chapter 5 as providing 'least cost' locations from which the widest variety of resource patches could be exploited. This is a point which results from both the Avon and Meon valley surveys tend to confirm albeit on a local or 'micro-scale'.

A further model which appears to be supported by the evidence from the Meon valley is that presented by Mellars (1976) regarding the proposed relationship between inland, riverine home-range contexts and the coastal resources to the south and west. Both within and close to the survey area, slate, chert and other geological occurrences of SW origin appear in the archaeological record. At Exton for example, a backed blade of Portland chert was recovered suggesting beyond doubt, contact of some form between the study area and the coastal 'summer' occupation areas

further to the south and west (Jacobi 1981,18). Indeed the suggestion by Palmer (1977) that estuaries were important to Mesolithic communities is supported by work both in Portsmouth (Bradley 1975) and Chichester (Cartwright 1983) harbours. In both cases intensive survey of the mudflats produced a large quantity of worked flint, in particular microliths (suggesting the hunting of wildfowl or small mammals) and scrapers.

Within the Meon valley therefore, remnants of an entire settlement system appear to exist and were recovered through intensive area-specific surface collection. On the one hand there are four separate locations which may be described as individual home-ranges. Each maintains a high blade frequency, a high scraper frequency, a large proportion of retouched items combined with low density, as would be expected if we were dealing with short-term occupation (chapter 5). Blade cores combined with a high proportion of primary waste suggest that the final stages of core reduction were carried out close to the proposed home-range. Primary knapping almost certainly occurred in the areas where flint is naturally outcropping slightly further to the south on the upper chalk. Also on the upper chalk we are seeing the extent of an extended hunting/foraging domain or extra home-range characterised by a general scatter of microliths and axes. At three locations - on Old Winchester Hill, Salt Hill and on a hill to the west of East Meon - the evidence appears to suggest the presence of special task locations, possibly used for the monitoring of game. In the previous chapter it was suggested that river valleys would have acted both as corridors for migration and winter territories. Indeed it was noted that smaller herds and therefore greater herd frequency would have provided an ideal resource base for hunter-gatherers sharing valley habitats. If this were the case then we should certainly expect to see high, exposed hilltops functioning as game monitoring stations. Certainly in these cases there is no evidence for either industrial

or purely domestic activity.

In conclusion therefore we may suggest that the observations made by both Collins and Hurst (1978) and Draper (1955) are both inaccurate and invalid. The river valleys were a focus of activity in the Mesolithic with settlement concentrating within sheltered habitats and extended territories expanding onto the upper chalk further to the south.

7.6.2 The Neolithic

Evidence for the presence of early farming communities in the survey area is broadly similar to that for the Mesolithic, consisting largely of stone artefacts recovered by surface collection over the past 30-40 years. On the upper chalk, west of the river at Soberton, two leaf arrowheads were recovered while further to the north at Corhampton a petit tranchet arrowhead was found. In addition a number of polished and unpolished stone axes display a marked concentration towards upper chalk downland with a particular concentration on the downs surrounding Old Winchester Hill (Figure 7.16).

Perhaps the single most important discovery prior to the survey however was that of an apparently early Neolithic occupation on the west terrace of the river Meon at Corhampton (Grigson and Smith 1985). The location is at a point where the middle and lower chalk of the northernmost part of the valley gives way to the less diverse upper chalk and all indications suggest a transitory short-term occupation. The date range suggested covers a period of between 5300 and 4500bp, confirmed by the presence of between 4 and 7 'Hembury type' vessels, all of which appear to contain flint and quartz inclusions. Clearly this cannot represent a settlement of any size and is far more likely to represent some form of special purpose location, possibly connected with herding or foraging. Whichever the

case, the location on a major geological boundary may again be significant.

Another point of interest concerns the locational characteristics displayed by earthen long barrows within the survey area. It is widely acknowledged that characteristic locations for this type of monument in Wessex are generally exposed hilltops. This is a point recently investigated by Drewett (1986,49) in west Sussex. He noted considerable variation in the siting of both long and oval mounds with some appearing in false-crest locations with single directional views, and others deliberately orientated towards the Weald and Cuckmere valley. Indeed his suggestion that long mounds may be earlier than oval mounds and may relate to the primary settlement of river valleys could be argued for the Meon valley. Two of the three long mounds in the survey area are situated within or adjacent to the valley bottom, in close proximity to each other and on or immediately to the south of the lower/upper chalk divide. The only example of an oval mound is situated on the summit of the adjacent Old Winchester Hill and, according to Drewett, may represent 'secondary filling-in' (1986,49).

As in the Avon valley, the survey produced few diagnostic items. Leaf arrowheads were recovered on the upper chalk and a polished axe fragment on the lower chalk close to Old Winchester Hill. This, combined with evidence recovered prior to the survey does appear to suggest a fairly well structured, intensive coarse-grained adaptation during the early Neolithic. In total a ubiquity score for the early Neolithic of 1.3% was obtained. For the later Neolithic an even lower score was apparent with two fabricators providing evidence for occupation. This produced a ubiquity score of 0.9%.

A more convincing picture may be suggested when the distribution of technological traits and behavioural

domains is considered. It has already been suggested that high density on the upper chalk combined with high proportions of primary waste, a low and uniform dispersal of scrapers and retouched items and a concentration of so-called extractive tools - axes, arrowheads - probably indicates the presence of an extended territory or extra home-range and not an occupation area. Indeed it was suggested that quite the opposite should be apparent if short-term or discontinuous settlement was the case.

Such a case is argued for area 2, and in particular those units situated east of the river and slightly above the level of the floodplain. Density within this area is on the whole low - although higher than that in area 3 - with the two higher densities appearing in one case to the west of the river - described previously as a Mesolithic home-range - and in the other to the east and immediately above and adjacent to the valley floor. The latter is also characterised by an exceptionally high frequency of both retouched items and scrapers. Indeed all but one of the seven fields situated within 750m of the river maintain retouch proportions >1 standard deviation above the mean (Figures 7.19 and 7.20).

Cores are not especially frequent within the immediate environs although a peak appears to exist on a steep west-facing slope at the foot of Old Winchester Hill. This corresponds with exceptionally high frequencies of both primary and tertiary flakes and almost certainly represents a localised industrial complex. This may date to the Neolithic but equally may represent sporadic activity over a long period. This contradicts the evidence for industrial activity further south on the upper chalk where the sheer density of material clearly points to long-term intensive industrial activity.

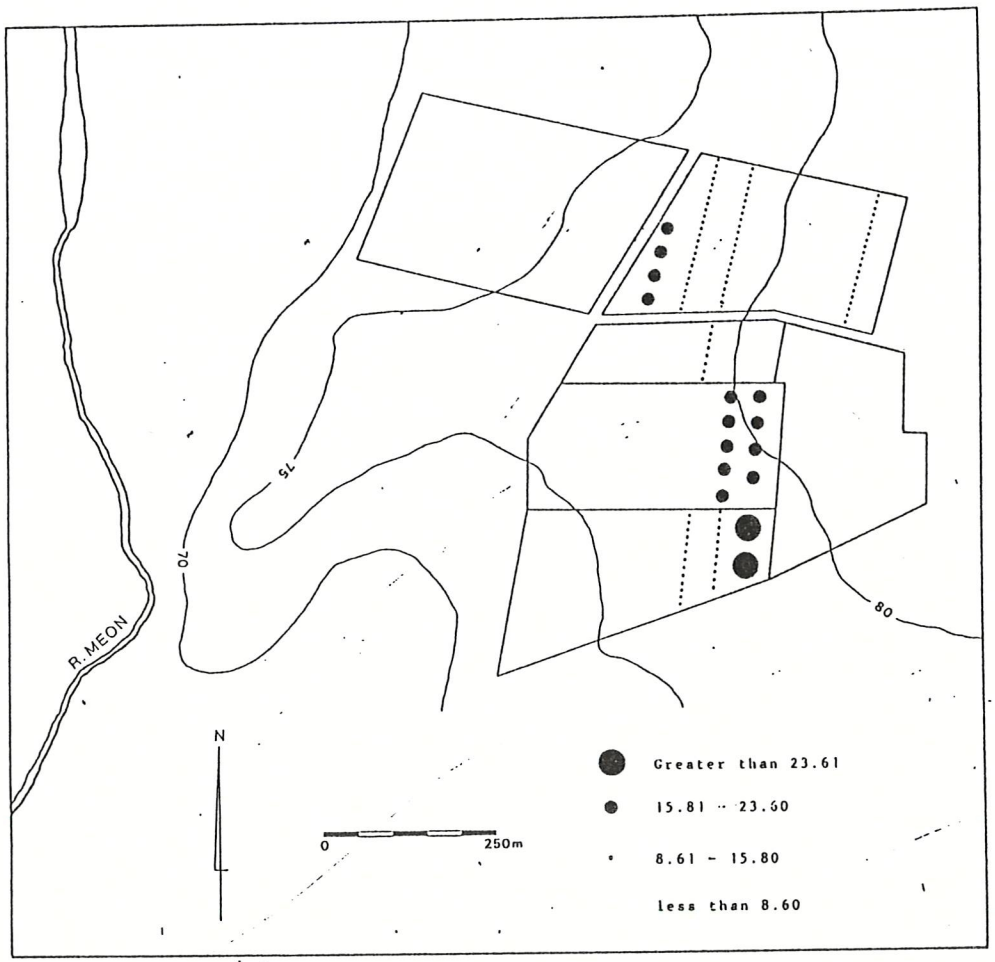


FIGURE 7.19: Density variation in area 2 (Peake Farm, Warnford).
Number per 100m.

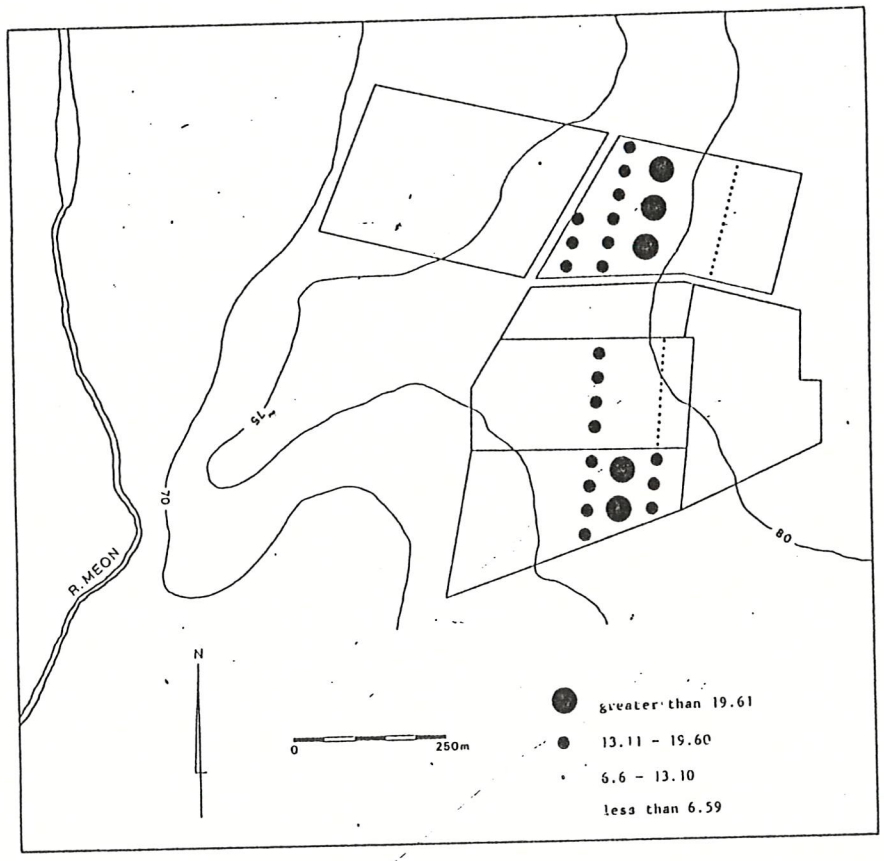


Figure 7.20: Variations in the percentage of retouch in area 2 (Peake Farm, Warnford).

The evidence provided by relative blade frequencies suggests a general correspondence with that suggested by the home-range model (section 7.5, above). Again this suggests a uniform scatter within the home-range with a less uniform distribution, overlapping with later activity on the upper chalk.

Once again therefore the location of a farming community appears to have been governed by reasons of cost-reduction and optimality. Moffat and Cope's (1984) observation that chalk soils may not have been ideal for early farmers must point to some other aspect of occupation being predominant in the process of location and distribution. Clearly the proposed home-range is ideally situated with regard to both lithic sources, the river, high quality pasture - especially for winter grazing - and timber and plant resources in abundance. Yet it would appear that occupation was less intensive here than in the Avon valley. Are we therefore seeing a distinction between arable- and pasture-based farming systems, one apparently locating their burial monuments high on the chalk, one low in the valleys? One further clue to this distinction may lie in the concentration within the Hampshire Basin as a whole of what may be termed 'prestige items', items that were not functional yet which were being imported from the Continent at least as early as the early Neolithic. Smith (1963) for example noted a distinct concentration of jade axes within this area of central-southern England and in particular on areas of high grade arable land. Although the source of jadeite is unclear and their 'value' the subject of some speculation, that they represent prestige items is beyond any doubt. The question remains therefore, why this concentration and why in this particular area?

A further addition to Smith's (1963) list was recovered as part of the Meon valley survey and tends to confirm the picture already apparent, that the main body of the distribution lies within river valley contexts. This may

provide an answer to the questions raised above. The axe from Soberton (Schofield forthcoming) was located at the head of a dry valley situated about 500m from the river Meon and on a south facing slope of the upper chalk (Figure 7.21). Although heavier than most examples, the grain size, colour and extent of polish all afford comparison with axes such as that from Breamore, described in the previous section and derived from a similar context.

It is tempting to suggest that this concentration may reflect not only the distribution of the earliest farmers, with an emphasis on the Test, Itchen, Avon and Meon valleys, but the location of high-status farmsteads within the region. If this is the case then it confirms both the notion of a 'valley adaptation' in the Neolithic, and the idea of the chalkland river valleys of southern England playing an integral role in the establishment of farming within the region as a whole. Certainly the density figures achieved by surface collection appear to conform to this hypothesis.

From the finds made prior to, and diagnostic items recovered as a part of the survey (Figure 7.16), the upper chalk to the south of the region appears to have seen an emphasis towards extractive activity. In this respect there appear to be clear indications of continuity between the Mesolithic and Neolithic periods. Arrowheads appear to concentrate closer to the valley while axes appear in clusters around focal points such as Old Winchester Hill. Clearly it is from these points that Collins and Hurst (1978) and Draper (1955) made their observations regarding hill-top and hill-slope settlement. As was clearly stated in the previous chapter however, such occurrences do not indicate settlements so much as <u>negative</u> settlements, areas away from the home-range from which back-up resources were obtained.

It may be suggested therefore that the Meon valley was

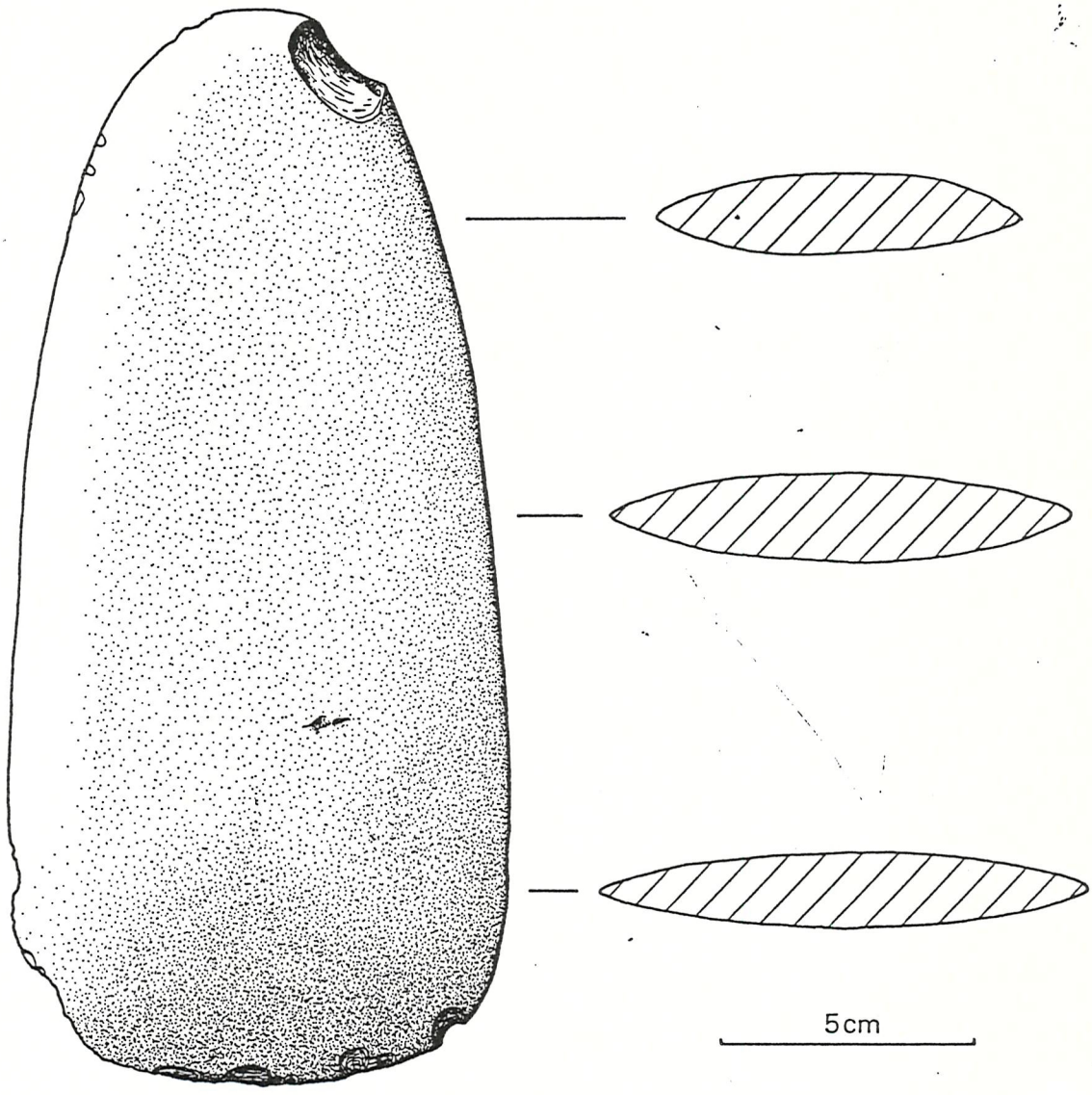


Figure 7.21: Jade axe from Soberton, Hampshire.

occupied during the Neolithic period, again confirming that areas outside the 'monument zone' were not devoid of habitation. Indeed it may further be suggested that it was within these areas and not the monument zones where occupation was predominant. In terms of presence/absence, the picture of Neolithic activity corresponds with that presented in the previous chapter. The analogy goes no further however, and clear distinctions are apparent in terms of both scale and chronology.

As a first point it is possible to make a comparison between cultural episodes by means of the ubiquity index used in a previous section and described in chapter 2. Although diagnostic items from the survey are only small in number, the distinction between early and late Neolithic frequencies is confirmed by the relative proportions of artefacts recovered prior to the survey. In the Avon valley for example, early Neolithic artefact types from both sources are outnumbered 3:1 by later Neolithic types, while for the Meon valley this trend is reversed by even greater proportions. In other words the Meon valley appears to support a predominance of early Neolithic artefact types while for the Avon valley, later Neolithic type fossils are far more abundant. In the light of these observations it is interesting to note that from the Meon valley, excavations at Corhampton produced early Neolithic dates and Hembury style pottery, while 2 of the 3 long barrows are situated in the valley bottom. For the Avon valley on the other hand, excavations at Downton produced Mesolithic and later Neolithic material including Peterborough pottery, but only little of early Neolithic date. In this case long barrows were situated in the more characteristic hill-top locations.

An explanation for this dichotomy may lie in the ecological context of the two valley systems. The Meon was occupied by farmers at an early stage of the Neolithic. The area maintains exceptional pasture but soils which were not

necessarily ideal for arable (Moffat and Cope 1984). The Avon valley on the other hand provided both resources within a fairly limited catchment area. The gravels and alluvium provide some of the best arable land in southern England while the adjacent terraces and plateaux would have maintained pasture ideal for summer grazing. Whether or not this distinction is an accurate reflection of shifting emphasis during the Neolithic is uncertain. It is however a hypothesis which may be examined further through any regional survey which provides tighter chronological control than was possible in this case.

7.6.3 Bronze Age

Evidence for Bronze Age activity in the survey area is derived largely from two sources: Burial monuments and the excavation of a 'Deverel-Rimbury' type settlement at West Meon (Lewis and Walker 1977). Burial monuments are particularly abundant in the survey area and also display a marked diversity in relation to neighbouring areas of chalk upland (Figure 7.22). They appear as a distinct and diverse cluster for example on Old Winchester Hill, where a number of both bowl and saucer barrows exist as well as single examples of both pond and oval barrows, the latter perhaps indicating a local transition between the Neolithic and Bronze Age. Their distribution is particularly interesting as it appears to correspond with the chalk ridge which traverses the study area from NW to SE. Along this line burial monuments appear in particular abundance. By contrast, to the west of the river Meon, barrows tend towards a more dispersed pattern of distribution.

This evidence for burial, apparently on a fairly large scale does not correspond with the far less substantial evidence for settlement. Only one habitation site is known and is located at the head of the valley at West Meon (Lewis and Walker 1977). Here a later Bronze Age occupation was excavated and produced Deverel-Rimbury type pottery and

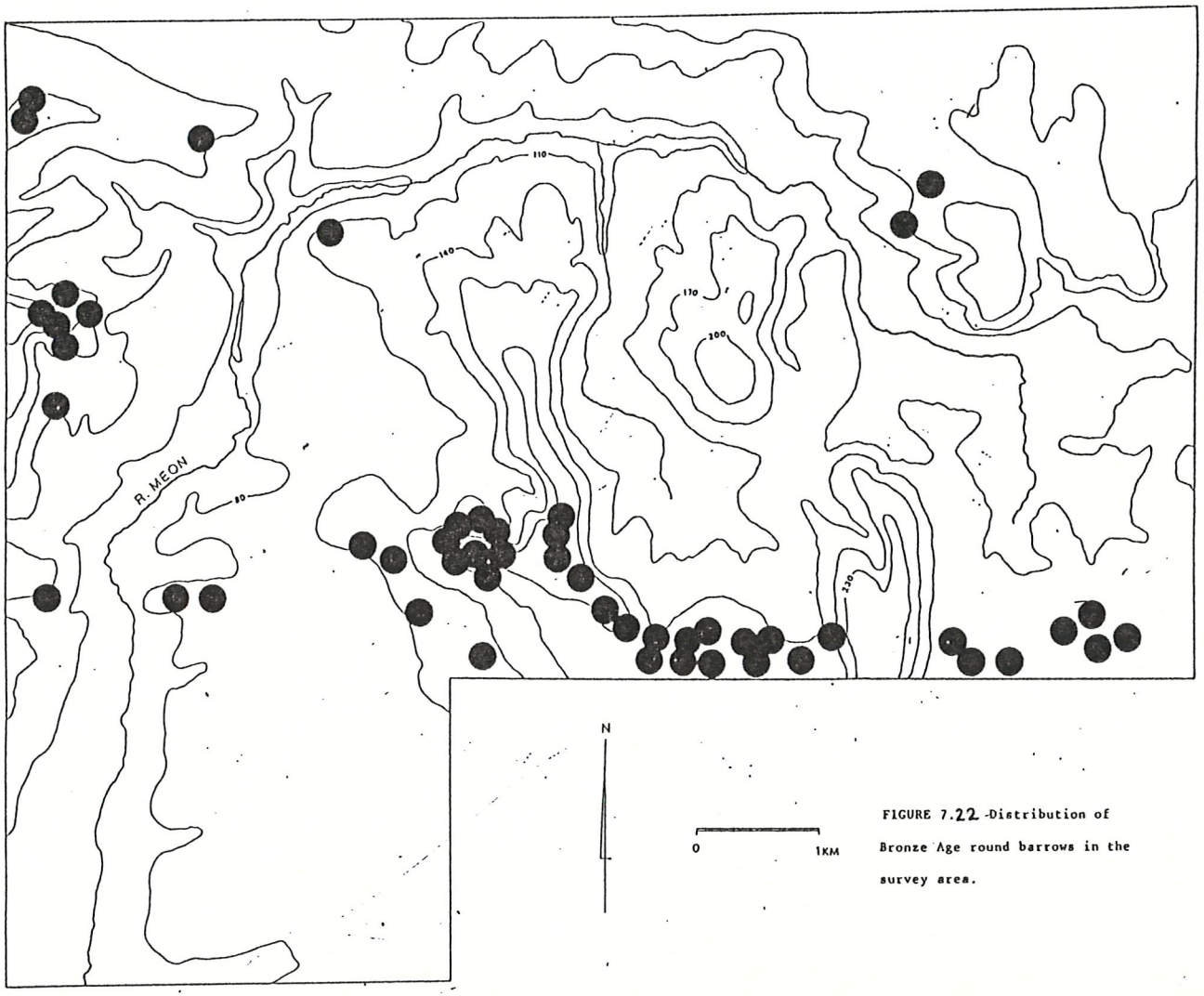


FIGURE 7.22 Distribution of Bronze Age round barrows in the survey area.

a series of post-holes representing at least one hut together with associated stone and flint work. In the previous chapter it was suggested that such small-scale settlements were characteristic of the 'Deverel-Rimbury culture complex' and appear to have concentrated in the smaller valley systems of central-southern England. If sites such as Westbury are typical then it is hardly surprising that so few have come to light; after all they are not only small in size but also small in terms of artefact density and diversity. Very little in the way of type fossils would be apparent as such within the ploughsoil - pottery survives for only a short time while only very few flint tools are truly diagnostic of the period. One barbed and tanged arrowhead was located prior to the survey and tends to fit the general picture of downland exploitation and the use of upper chalk as an extended territory throughout the prehistoric period.

In the previous chapter it was suggested that possible indications of Bronze Age activity may include fields maintaining low blade frequencies (Figure 7.18) and fields containing high proportions of hinge fractures (Figure 7.23) and core-rejuvenation flakes (Figure 7.24). It was also suggested however that these factors may equally represent aspects of core-reduction and the availability of or distance from lithic source areas. It is only in the absence of any diagnostic Bronze Age artefacts however, that such factors are considered. Flakes with hinge fractures are perhaps the most likely to indicate technological as opposed to chronological diversity. Their distribution shows a clear concentration in the area previously described as being primarily industrial on the upper chalk to the south of the study area. Also to the north, in the projected Neolithic home-range there appear high proportions of hinge fractures within several individual units.

Perhaps a more valid measure of later activity may be in

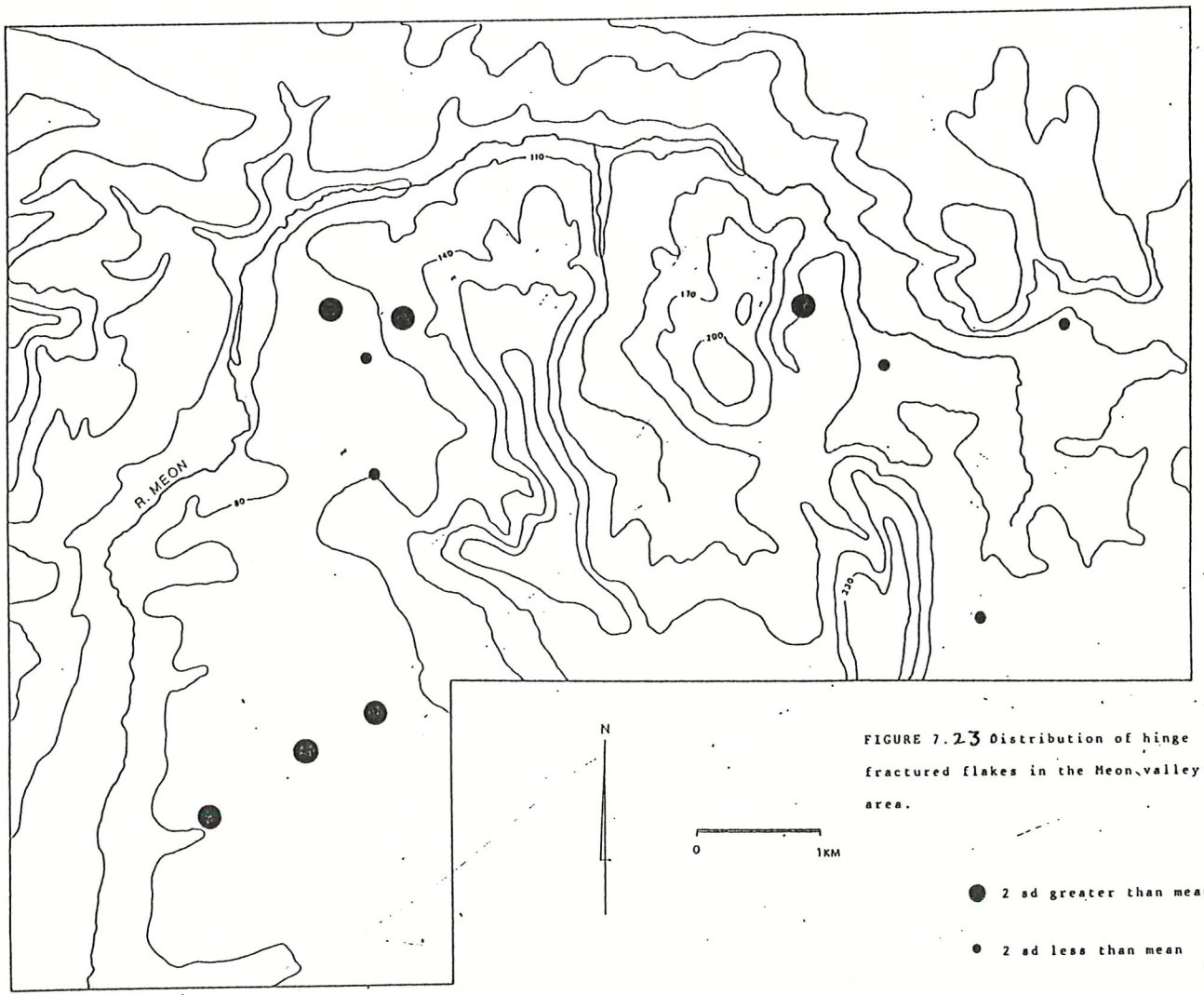


FIGURE 7.23 Distribution of hinge fractured flakes in the Meon valley survey area.

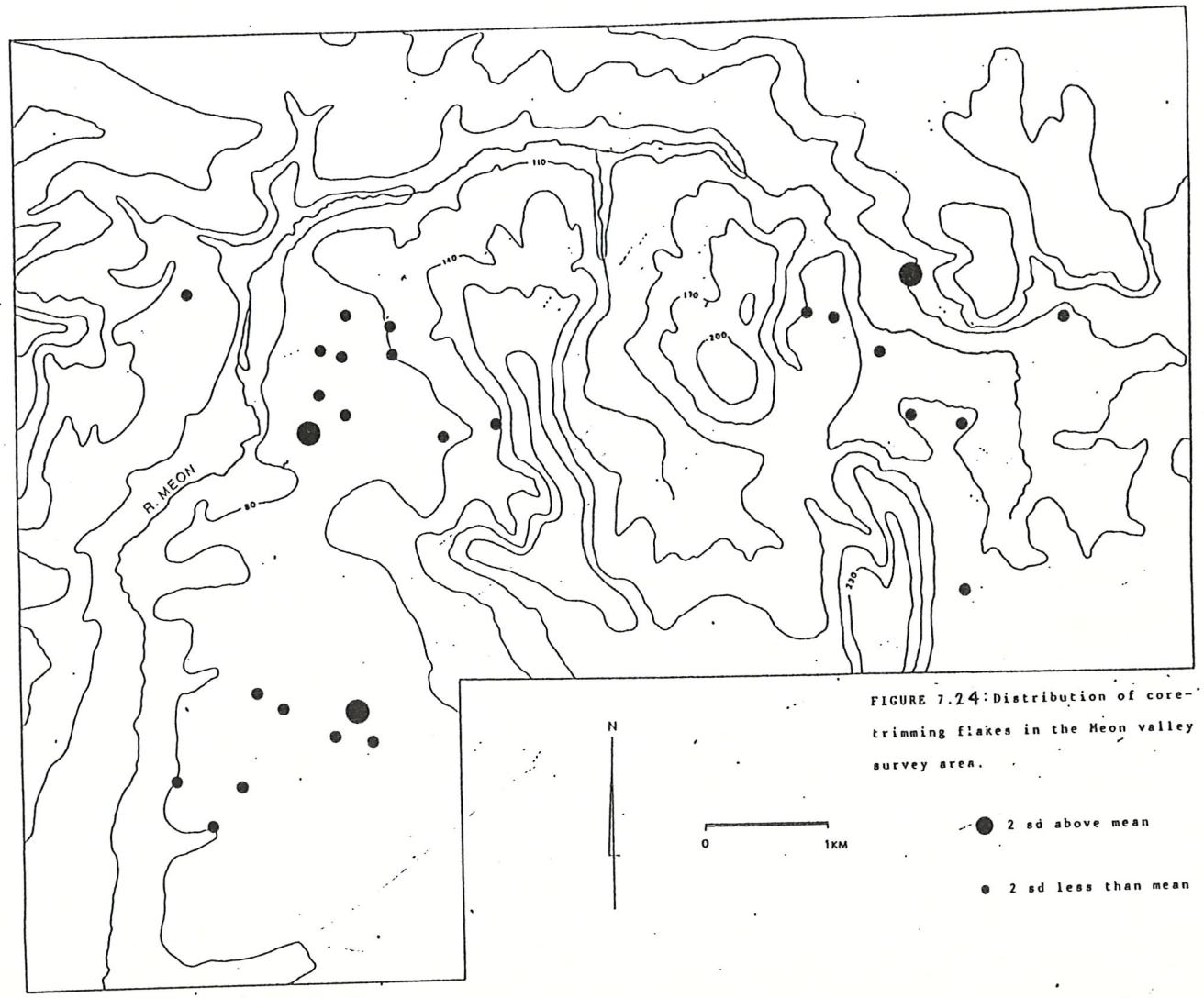


FIGURE 7.24: Distribution of core-trimming flakes in the Meon valley survey area.

the location of fields maintaining low blade frequencies. One apparent outlier in this distribution is the field immediately NW of Old Winchester Hill and situated within area 2. It is the only unit within that area maintaining a blade frequency less than 1 standard deviation below the mean. It may be significant that that field also maintained a particularly high frequency of core rejuvenation flakes. It is also within this general area that fields maintaining a high frequency of burnt flint tend to occur. In particular there appear to be concentrations in fields parallel to the river and indeed a distinct fall-off is apparent along the line of a small terrace within area 2 (Figure 7.25). If such an occurrence does represent the location of Bronze Age settlements, then it is interesting to note a general correspondence between the distribution here and in the Avon valley with high density possibly indicating the location of burnt mounds such as that excavated at Harbridge (Shennan forthcoming).

There does therefore appear to be some form of relationship between blades, hinge fractures and core rejuvenation flakes. Where hinge fractures and core rejuvenation flakes appear in high frequency, blades appear in low frequency. This general correspondence between the variables does suggest that perhaps they are related in time, although the possibility of their representing aspects of technology and core-reduction cannot be ruled out in other cases.

Unlike the previous two sections, it is virtually impossible to make firm suggestions regarding the location and intensity of activity in the Bronze Age. No diagnostic items were recovered by survey and although a few general patterns appear to emerge through the analysis of technology-related indices, it is only the excavations at Westbury which provide a solid foundation upon which to base any general conclusions. Certainly the valley was occupied during the Bronze Age but to what extent, only excavation and the distribution of burial monuments may

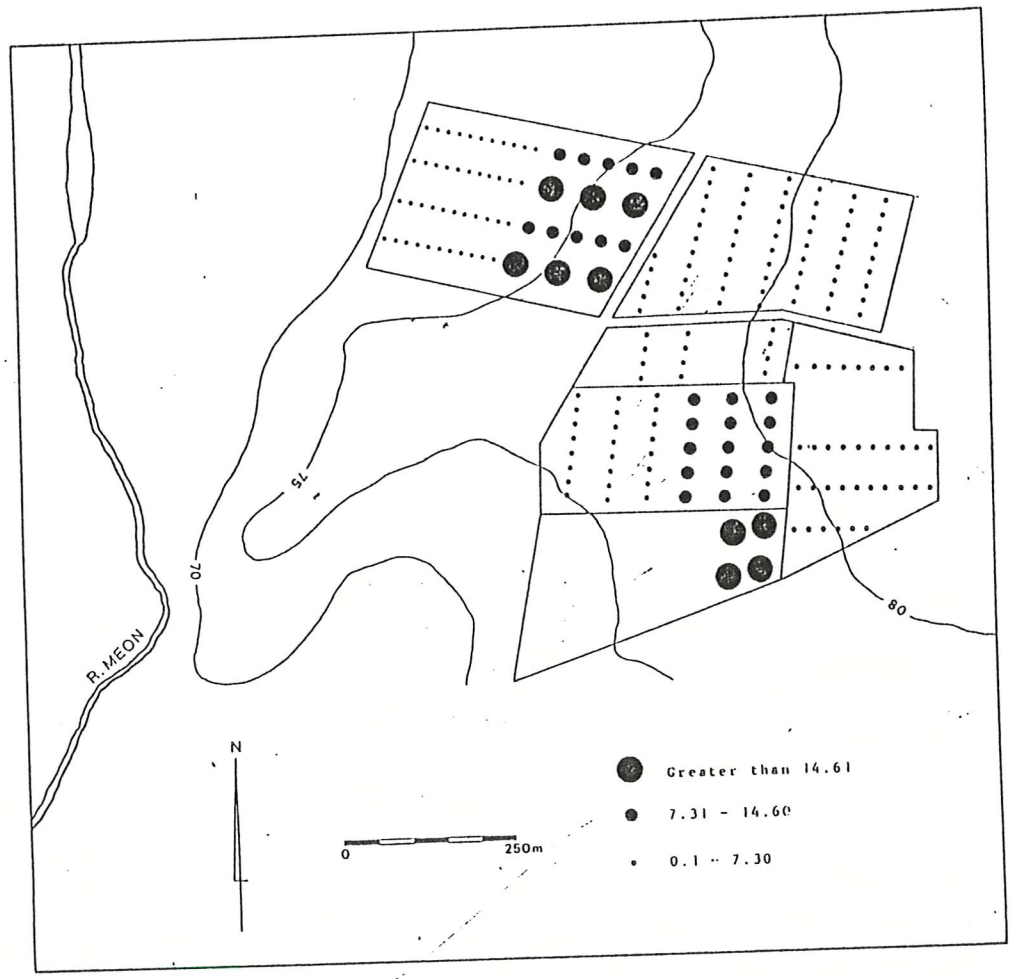


Figure 7.25: Distribution of burnt flint in area 2 (no. per 100m).

imply.

If, as Ellison (1981) has suggested, the subsistence economy of the Bronze Age in southern England was dominated by pastoralism and characterised by the distribution of small scattered farmsteads, then two points can be made regarding the results described above. First that the evidence from the Meon valley is far less substantial than that from the Avon. This is only a small area by comparison but nevertheless the scale of activity is limited. In the Avon valley, the home-range was represented by an intensive local distribution of burnt mounds, stray finds of metalwork, Deverel-Rimbury pottery and only a few kilometres upstream, a complex system of ring ditches concentrating on the terraces and around tributaries of the river Avon (Smith 1985).

Nowhere within the Meon valley catchment does anything on this scale exist. Westbury represents perhaps one small community living at the head of the valley. The location does not provide the same opportunities for communication as was the case at Harbridge while the ecological catchment is totally different. Does this dichotomy therefore represent two parts of the same pastoral system or are we overlooking the value and importance of sites such as Itford Hill and Black Patch which clearly point to aspects of a 'Downland economy'? Certainly judging from the burial record, the Meon valley rather than the Avon is exceptional - in terms of both localised density and diversity - and this is highlighted by the occurrence of monuments such as the 'Great Barrow' at Bishops' Waltham (Ashbee 1956).

What can be suggested beyond doubt is that despite the distribution of large Bronze Age settlements on the Sussex Downs to the east of the survey area and the clearance of large tracts of primary woodland from the chalk at this time (chapter 3), river valleys continued to be occupied by small - presumably family - groups. The Westbury settlement

combined with the limited evidence provided by surface collection suggest a presence, but a presence which was on a small scale compared to those domestic compounds appearing on the chalk further to the east. Whether this was seasonal and special-purpose or longer-term and by smaller communities only further excavation may tell.

7.7 Summary

It is argued from the case study described above, that interpretation based on a traditional chronology-based framework, will not provide sufficient information, at least where questions of land-use intensity and long-term exploitation are concerned. It will provide dots-on-maps, though in this case, not very many, evidence which may be useful for establishing presence/absence for specific periods. To extend a chronological framework to include blades, flakes with hinge fractures and any other technological attributes, is however unrealistic. As was suggested in chapter 4, factors influencing blade frequency and hinge fractures are just as likely to reflect resource stress as cultural factors. Where there is any question, we should give technology, not chronology, the benefit of the doubt. For the Meon valley, as for the Avon, an approach based upon expected assemblage characteristics, not only density but composition as well, and co-association of variables, was considered the most appropriate for area intensive survey. A summary of the results achieved by this method are described below.

Emphasis appears to be towards a concentration of activity in the Mesolithic and early Neolithic periods with activity only occurring on a small and more localised scale after that date. The ubiquity index combined with the evidence for home-range location suggest that communities were exploiting the valley environment during this period. The clear gradients between core-reduction strategies visible in the Avon valley are not present to the same extent in

this case with the likelihood of a domestic/industrial dichotomy existing between lower and upper chalk throughout the period a possible explanation for this. Dating evidence - both relative and absolute - points to the same early date. The Neolithic horn-core from Corhampton (Grigson and Smith 1985), the jade axe - generally attributed early Neolithic dates - and the earthen long barrows in uncharacteristic locations may conform to this hypothesis.

Later periods are poorly represented in terms of artefact distribution. Few pre-survey locations are attributable to this period while the ubiquity index for the survey itself is low in comparison to that for the Avon valley. Excavations at Westbury and the distribution of a variety of burial monuments on the chalk ridge are the only firm indications of later prehistoric activity in the survey area.

Soil	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
342a n=11	4.0	26.7	2.0	0.0	14.3	1.3	2.3	18.2	1.3	4.8	36.4	2.8	0.0	18.2	1.6	0.0	21.6	1.8	0.0	5.4	0.6	0.0	3.7	0.3
343h n=17	6.8	110.6	7.8	0.4	14.3	0.9	1.3	15.8	0.8	10.5	26.3	0.9	0.0	15.8	1.2	4.9	12.0	0.5	0.0	5.6	0.3	0.0	5.3	0.3
511d n=8	5.8	66.0	6.9	3.9	18.0	2.0	4.0	17.9	1.6	10.0	22.4	1.6	0.0	14.0	1.4	6.0	11.9	0.7	0.0	6.6	0.8	0.0	6.5	0.9
581d n=3	3.5	10.9	2.4	0.0	10.0	3.2	4.8	10.0	1.5	4.8	25.0	6.2	5.0	23.8	5.7	8.0	15.0	2.1	0.0	5.0	1.7	0.0	1.3	0.4

Note: se = standard error of the mean

Table 7.10: Assemblage composition in relation to soil type

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Soil																
342a n=11	2082.6	418.4	895.3	197.7	1057.7	189.9	6172.0	852.4	1024.6	289.9	1465.6	343.5	78.7	37.5	17.4	12.4
343h n=17	43900.9	16532.6	563.6	211.2	1217.6	188.0	7620.6	219.9	555.2	363.4	1131.1	71.7	59.5	30.2	65.8	32.2
511d n=8	6997.6	2631.1	1162.0	213.7	734.8	136.3	2653.6	140.2	438.2	106.7	617.5	27.5	79.3	38.8	81.7	44.8
581d n=3	146.2	36.6	190.3	63.5	167.9	13.8	1101.7	231.3	677.9	194.1	379.3	27.2	25.0	16.7	1.7	1.1

Notes: a = sum of squares
b = deviation of sum of squares

Table 7.11: Assemblage composition in relation to soil type

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Geology																								
Lower chalk n=26	3.5	66.0	2.5	0.0	18.0	1.0	2.3	18.2	0.8	4.8	36.4	1.5	0.0	23.8	1.1	0.0	21.6	0.8	0.0	6.6	0.4	0.0	6.5	0.3
Upper chalk n=13	16.8	110.6	8.6	0.4	6.8	0.5	1.3	12.4	0.8	18.0	26.3	0.8	0.0	2.6	0.2	4.9	12.0	0.6	0.0	2.6	0.2	0.0	5.3	0.4

Note: se = standard error of the means

Table 7.12: Assemblage composition relating to geology

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Geology																
Lower chalk n=26	9601.6	4109.0	2642.1	614.6	2388.8	427.8	11458.2	1438.7	2669.8	786.2	2634.2	455.6	216.3	115.1	110.6	75.7
Upper chalk n=13	43525.6	11553.5	169.1	33.4	789.2	96.4	6089.8	97.7	26.2	8.1	959.2	53.7	26.2	8.1	56.0	26.2

Notes: a = sum of squares
b = deviation sum of squares

Table 7.13: Assemblage composition in relation to geology

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Topography																								
<70m n=14	5.8	110.6	9.2	0.4	18.0	1.6	4.0	17.9	1.0	10.0	26.2	1.1	0.0	14.0	1.1	4.9	15.6	0.8	0.0	6.6	0.5	0.0	5.0	0.4
71-100m n=7	16.8	49.9	4.9	2.2	8.6	0.9	1.3	10.9	1.1	19.1	31.7	1.6	0.0	3.2	0.4	6.9	12.0	0.7	0.0	2.7	0.4	0.4	5.3	0.6
101-130m n=13	3.5	26.7	1.8	0.0	14.3	1.2	4.8	18.2	1.2	4.8	36.4	2.6	3.5	23.8	1.7	0.0	15.0	1.1	0.0	5.6	0.6	0.0	6.5	0.5
131-160m n=4	7.4	11.0	0.8	1.5	14.3	2.9	2.3	10.8	1.9	19.7	26.5	1.4	0.0	10.6	2.4	8.6	21.6	2.9	0.0	5.4	1.2	0.0	0.5	0.1

Note: se = standard error of the mean

Table 7.14: assemblage composition in relation to topography

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Topography																
<70m n=14	39587.8	15418.2	1244.6	168.5	1342.4	168.5	5259.8	228.6	427.4	209.7	1099.9	107.0	84.5	48.0	56.0	32.9
71-100m n=7	6973.2	1016.4	180.0	31.9	287.4	50.7	3982.3	107.2	21.1	7.9	644.4	20.3	18.1	6.3	40.4	16.3
101-130m n=13	1822.3	488.0	1025.8	242.7	1247.4	214.1	5603.3	1034.9	2003.9	450.6	973.4	194.9	101.0	54.5	69.6	45.3
131-160m n=4	388.0	7.7	345.5	100.5	231.9	41.2	2205.2	24.4	204.0	67.1	771.7	103.5	36.6	17.2	0.3	0.2

Notes: a = sum of squares
b = deviation of sum of squares

Table 7.15: Assemblage composition in relation to topography.

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Distance from river																								
<400m n=13	5.2	110.6	10.4	0.4	14.3	1.2	4.8	13.3	0.7	4.8	26.2	1.4	0.0	14.3	1.3	0.0	15.6	1.0	0.0	5.6	0.4	0.0	6.5	0.5
401-800m n=17	3.5	49.9	3.3	2.2	18.0	1.2	1.3	17.9	1.0	4.8	26.3	1.5	0.0	23.8	1.6	5.3	15.0	0.7	0.0	6.6	0.5	0.0	5.3	0.4
801-1200m n=2	10.9	13.2	1.2	0.0	2.1	1.1	4.8	6.7	0.9	21.3	22.8	0.8	3.5	9.3	2.9	6.2	8.0	0.9	0.0	1.4	0.7	1.3	1.4	0.0
1201-1600m n=5	10.2	19.5	1.8	1.5	12.5	1.9	2.3	10.8	1.6	7.6	31.7	4.1	0.0	13.2	2.4	6.8	21.6	2.7	0.0	5.4	1.0	0.0	1.1	0.3
>1600m n=2	4.0	10.5	3.3	0.0	7.5	3.8	9.4	18.2	4.4	22.4	36.4	7.0	7.5	18.2	5.4	3.7	9.1	2.7	0.0	1.9	1.0	0.0	3.7	1.9

Note: se = standard error of the mean

Table 7.16: Assemblage composition in relation to distance from the river.

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Distance from river																
<400m n=13	41681.5	16759.3	639.6	230.7	1031.8	75.5	5391.7	315.0	546.6	270.6	1017.4	170.9	63.5	28.3	67.4	42.2
401-800m n=17	10010.2	2976.3	1673.5	414.4	1336.4	294.3	6580.4	590.7	1320.0	678.9	1577.6	123.9	121.8	71.6	79.5	48.1
801-1200m n=2	293.1	2.6	4.4	2.2	67.9	1.0	973.5	1.1	98.7	16.8	102.4	1.6	2.0	1.0	3.6	0.0
1201-1600m n=5	1016.2	64.0	437.5	71.1	322.3	48.5	2775.6	329.2	343.1	114.6	799.6	140.6	51.5	19.3	2.4	1.5
>1600m n=2	126.3	21.1	56.3	28.1	419.6	38.7	1826.7	98.0	387.5	57.2	96.5	14.6	3.6	1.8	13.7	6.8

Notes: a = sum of squares
b = deviation of sum of squares

Table 7.17: Assemblage composition in relation to distance from the river

	Density			%retouch			%primary			%tertiary			%cores			%blades			%scrapers			%c-t		
	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se	min	max	se
Zone																								
1 n=13	16.8	110.6	8.6	0.4	6.8	0.5	1.3	12.4	0.8	18.0	26.3	0.8	0.0	2.6	0.2	4.9	12.0	0.6	0.0	2.6	0.2	0.0	5.3	0.4
2 n=14	4.0	32.9	2.2	0.0	18.0	1.4	2.3	18.2	1.2	7.6	36.4	2.1	0.0	18.2	1.4	3.7	21.6	1.2	0.0	6.6	0.6	0.0	5.0	0.4
3 n=12	3.5	66.0	4.9	0.0	14.3	1.3	4.8	15.8	1.1	4.8	25.0	2.1	3.5	23.8	1.8	0.0	15.6	1.2	0.0	5.6	0.6	0.0	6.5	0.6

Note: se = standard error of the means

Table 7.18: Assemblage composition relating to the three ecological zones

	Density		%retouch		%primary		%tertiary		%cores		%blades		%scrapers		%c-t	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Zone																
1 n=13	43525.6	11553.5	169.1	33.4	789.2	96.4	6089.7	97.7	26.2	8.1	959.2	53.7	26.2	8.1	56.0	26.2
2 n=14	4431.3	879.2	1604.0	372.6	1414.9	279.1	6922.6	819.8	1124.8	347.7	1528.5	251.7	141.1	66.1	56.4	35.5
3 n=12	5170.4	3170.9	1038.1	232.9	973.9	145.6	4535.6	571.6	1545.1	404.3	1105.7	199.1	75.2	45.4	54.2	40.1

Notes: a = sum of squares
b = deviation of sum of squares

Table 7.19: Assemblage composition in relation to the three ecological zones

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 6 .FLINT

LABEL: FREQUENCY DISTRIBUTION: DENSITY PER HECTARE

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	10.00	9	23.08	9	23.08
10.00	<	20.00	14	35.90	23	58.97
20.00	<	30.00	5	12.82	28	71.79
30.00	<	40.00	4	10.26	32	82.05
40.00	<	50.00	2	5.13	34	87.18
50.00	<	60.00	0	0.00	34	87.18
60.00	<	70.00	2	5.13	36	92.31
70.00	<	80.00	0	0.00	36	92.31
80.00	<	90.00	1	2.56	37	94.87
90.00	<	100.00	1	2.56	38	97.44
100.00	<	110.00	0	0.00	38	97.44
110.00	<	120.00	1	2.56	39	100.00
		TOTAL	39	100.00		

VARIABLE: 6 . FLINT

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	10.00	9	==========
10.00	<	20.00	14	==========
20.00	<	30.00	5	==========
30.00	<	40.00	4	========
40.00	<	50.00	2	====
50.00	<	60.00	0	
60.00	<	70.00	2	====
70.00	<	80.00	0	
80.00	<	90.00	1	==
90.00	<	100.00	1	==
100.00	<	110.00	0	
110.00	<	120.00	1	==

Table 7.20

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 7 . %RET

LABEL: FREQUENCY DISTRIBUTION: % RETOUCH PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00 <		2.00	5	12.82	5	12.82
2.00 <		4.00	10	25.64	15	38.46
4.00 <		6.00	3	7.69	18	46.15
6.00 <		8.00	6	15.38	24	61.54
8.00 <		10.00	5	12.82	29	74.36
10.00 <		12.00	4	10.26	33	84.62
12.00 <		14.00	1	2.56	34	87.18
14.00 <		16.00	2	5.13	36	92.31
16.00 <		18.00	2	5.13	38	97.44
18.00 <		20.00	1	2.56	39	100.00
	TOTAL		39	100.00		

VARIABLE: 7 . %RET

=====CLASS LIMITS====			FREQUENCY	.....
0.00 <		2.00	5	==========
2.00 <		4.00	10	==========
4.00 <		6.00	3	========
6.00 <		8.00	6	==========
8.00 <		10.00	5	==========
10.00 <		12.00	4	==========
12.00 <		14.00	1	==
14.00 <		16.00	2	=====
16.00 <		18.00	2	=====
18.00 <		20.00	1	==

Table 7.21

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 8 . %P

LABEL: FREQUENCY DISTRIBUTION: % PRIMARY WASTE PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00 <		2.00	1	2.56	1	2.56
2.00 <		4.00	1	2.56	2	5.13
4.00 <		6.00	10	25.64	12	30.77
6.00 <		8.00	7	17.95	19	48.72
8.00 <		10.00	11	28.21	30	76.92
10.00 <		12.00	4	10.26	34	87.18
12.00 <		14.00	2	5.13	36	92.31
14.00 <		16.00	1	2.56	37	94.87
16.00 <		18.00	1	2.56	38	97.44
18.00 <		20.00	1	2.56	39	100.00
	TOTAL		39	100.00		

VARIABLE: 8 . %P

=====CLASS LIMITS====			FREQUENCY	.....
0.00 <		2.00	1	==
2.00 <		4.00	1	==
4.00 <		6.00	10	==========
6.00 <		8.00	7	=======
8.00 <		10.00	11	===========
10.00 <		12.00	4	==========
12.00 <		14.00	2	=====
14.00 <		16.00	1	==
16.00 <		18.00	1	==
18.00 <		20.00	1	==

Table 7.22

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 9 . %T

LABEL: FREQUENCY DISTRIBUTION: % TERTIARY WASTE PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	3.00	0	0.00	0	0.00
3.00	<	6.00	2	5.13	2	5.13
6.00	<	9.00	1	2.56	3	7.69
9.00	<	12.00	2	5.13	5	12.82
12.00	<	15.00	2	5.13	7	17.95
15.00	<	18.00	1	2.56	8	20.51
18.00	<	21.00	10	25.64	18	46.15
21.00	<	24.00	12	30.77	30	76.92
24.00	<	27.00	7	17.95	37	94.87
27.00	<	30.00	0	0.00	37	94.87
30.00	<	33.00	1	2.56	38	97.44
33.00	<	36.00	0	0.00	38	97.44
36.00	<	39.00	1	2.56	39	100.00
		TOTAL	39	100.00		

VARIABLE: 9 . %T

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	3.00	0	
3.00	<	6.00	2	====
6.00	<	9.00	1	==
9.00	<	12.00	2	====
12.00	<	15.00	2	====
15.00	<	18.00	1	==
18.00	<	21.00	10	==========
21.00	<	24.00	12	==========
24.00	<	27.00	7	==========
27.00	<	30.00	0	
30.00	<	33.00	1	==
33.00	<	36.00	0	
36.00	<	39.00	1	==

Table 7.23

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 10 .%CORE

LABEL: FREQUENCY DISTRIBUTION: % CORES PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00	<	2.00	12	30.77	12	30.77
2.00	<	4.00	5	12.82	17	43.59
4.00	<	6.00	5	12.82	22	56.41
6.00	<	8.00	6	15.38	28	71.79
8.00	<	10.00	3	7.69	31	79.49
10.00	<	12.00	1	2.56	32	82.05
12.00	<	14.00	2	5.13	34	87.18
14.00	<	16.00	3	7.69	37	94.87
16.00	<	18.00	0	0.00	37	94.87
18.00	<	20.00	1	2.56	38	97.44
20.00	<	22.00	0	0.00	38	97.44
22.00	<	24.00	1	2.56	39	100.00
		TOTAL	39	100.00		

VARIABLE: 10 . %CORE

=====CLASS LIMITS====			FREQUENCY	.....
0.00	<	2.00	12	==========
2.00	<	4.00	5	==========
4.00	<	6.00	5	==========
6.00	<	8.00	6	==========
8.00	<	10.00	3	=======
10.00	<	12.00	1	==
12.00	<	14.00	2	====
14.00	<	16.00	3	=======
16.00	<	18.00	0	
18.00	<	20.00	1	==
20.00	<	22.00	0	
22.00	<	24.00	1	==

Table 7.24

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 12 .%BLAD

LABEL: FREQUENCY DISTRIBUTION: % BLADES PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00 <		2.00	1	2.56	1	2.56
2.00 <		4.00	1	2.56	2	5.13
4.00 <		6.00	4	10.26	6	15.38
6.00 <		8.00	10	25.64	16	41.03
8.00 <		10.00	11	28.21	27	69.23
10.00 <		12.00	7	17.95	34	87.18
12.00 <		14.00	1	2.56	35	89.74
14.00 <		16.00	3	7.69	38	97.44
16.00 <		18.00	0	0.00	38	97.44
18.00 <		20.00	0	0.00	38	97.44
20.00 <		22.00	1	2.56	39	100.00
	TOTAL		39	100.00		

VARIABLE: 12 . %BLAD

=====CLASS LIMITS====			FREQUENCY	.....
0.00 <		2.00	1	==
2.00 <		4.00	1	==
4.00 <		6.00	4	==========
6.00 <		8.00	10	==========
8.00 <		10.00	11	==========
10.00 <		12.00	7	==========
12.00 <		14.00	1	==
14.00 <		16.00	3	=======
16.00 <		18.00	0	
18.00 <		20.00	0	
20.00 <		22.00	1	==

Table 7.25

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 11 .%SCRA

LABEL: FREQUENCY DISTRIBUTION: % SCRAPERS PER FIELD

=====CLASS LIMITS====		FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00 <	0.50	14	35.90	14	35.90
0.50 <	1.00	5	12.82	19	48.72
1.00 <	1.50	5	12.82	24	61.54
1.50 <	2.00	3	7.69	27	69.23
2.00 <	2.50	1	2.56	28	71.79
2.50 <	3.00	3	7.69	31	79.49
3.00 <	3.50	1	2.56	32	82.05
3.50 <	4.00	1	2.56	33	84.62
4.00 <	4.50	2	5.13	35	89.74
4.50 <	5.00	0	0.00	35	89.74
5.00 <	5.50	2	5.13	37	94.87
5.50 <	6.00	1	2.56	38	97.44
6.00 <	6.50	0	0.00	38	97.44
6.50 <	7.00	1	2.56	39	100.00
	TOTAL	39	100.00		

VARIABLE: 11 . %SCRA

=====CLASS LIMITS====		FREQUENCY	.....
0.00 <	0.50	14	==========
0.50 <	1.00	5	==========
1.00 <	1.50	5	==========
1.50 <	2.00	3	======
2.00 <	2.50	1	==
2.50 <	3.00	3	======
3.00 <	3.50	1	==
3.50 <	4.00	1	==
4.00 <	4.50	2	====
4.50 <	5.00	0	
5.00 <	5.50	2	====
5.50 <	6.00	1	==
6.00 <	6.50	0	
6.50 <	7.00	1	==

Table 7.26

HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

VARIABLE: 13 . %CT

LABEL: FREQUENCY DISTRIBUTION: % CORE TRIMMING FLAKES PER FIELD

=====CLASS LIMITS====			FREQUENCY	PERCENT	....CUMULATIVE.... FREQUENCY	PERCENT
0.00 <	0.50		16	41.03	16	41.03
0.50 <	1.00		5	12.82	21	53.85
1.00 <	1.50		8	20.51	29	74.36
1.50 <	2.00		2	5.13	31	79.49
2.00 <	2.50		1	2.56	32	82.05
2.50 <	3.00		1	2.56	33	84.62
3.00 <	3.50		1	2.56	34	87.18
3.50 <	4.00		2	5.13	36	92.31
4.00 <	4.50		0	0.00	36	92.31
4.50 <	5.00		0	0.00	36	92.31
5.00 <	5.50		2	5.13	38	97.44
5.50 <	6.00		0	0.00	38	97.44
6.00 <	6.50		0	0.00	38	97.44
6.50 <	7.00		1	2.56	39	100.00
		TOTAL	39	100.00		

VARIABLE: 13 . %CT

=====CLASS LIMITS====			FREQUENCY	.....
0.00 <	0.50		16	================================
0.50 <	1.00		5	==========
1.00 <	1.50		8	================
1.50 <	2.00		2	===
2.00 <	2.50		1	=
2.50 <	3.00		1	=
3.00 <	3.50		1	=
3.50 <	4.00		2	===
4.00 <	4.50		0	
4.50 <	5.00		0	
5.00 <	5.50		2	===
5.50 <	6.00		0	
6.00 <	6.50		0	
6.50 <	7.00		1	=

Table 7.27

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	12.300	11
2	40.124	17
3	23.363	8
4	6.100	3

GRAND MEAN 26.221

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: DENSITY vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	6697.435	3	2232.478	3.983
WITHIN	19616.710	35	560.478	
TOTAL	26314.150	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	7.964	11
2	4.553	17
3	10.888	8
4	6.500	3

GRAND MEAN 6.964

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % RETOUCH vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	233.613	3	77.871	3.972
WITHIN	686.097	35	19.603	
TOTAL	919.710	38		

Table 7.28: 1: 342a; 2: 343h; 3: 511d; 4: 581d.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.882	11
2	7.782	17
3	8.650	8
4	7.167	3

GRAND MEAN 8.223

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	12.881	3	4.294	0.285
WITHIN	527.988	35	15.085	
TOTAL	540.869	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	21.991	11
2	20.865	17
3	17.725	8
4	17.033	3

GRAND MEAN 20.244

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	121.806	3	40.602	0.984
WITHIN	1443.849	35	41.253	
TOTAL	1565.656	38		

Table 7.29. Key as for Table 7.28.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.173	11
2	3.359	17
3	6.438	8
4	12.700	3

GRAND MEAN 6.067

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORES vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	306.545	3	102.182	3.749
WITHIN	954.042	35	27.258	
TOTAL	1260.587	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	10.100	11
2	7.894	17
3	8.587	8
4	10.833	3

GRAND MEAN 8.885

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % BLADES vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	45.026	3	15.009	1.118
WITHIN	469.865	35	13.425	
TOTAL	514.891	38		

Table 7.30. Key as for Table 7.28.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.936	11
2	1.071	17
3	2.250	8
4	1.667	3

GRAND MEAN 1.603

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % SCRAPERS vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	9.402	3	3.134	0.906
WITHIN	121.067	35	3.459	
TOTAL	130.470	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	0.673	11
2	1.406	17
3	2.150	8
4	0.433	3

GRAND MEAN 1.277

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs SOIL

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	12.531	3	4.177	1.616
WITHIN	90.478	35	2.585	
TOTAL	103.009	38		

Table 7.31. Key as for Table 7.28.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	41.550	14
2	29.171	7
3	10.131	13
4	9.750	4

GRAND MEAN 25.174

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: DENSITY vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	7759.768	3	2586.589	5.194
WITHIN	16930.320	34	497.951	
TOTAL	24690.090	37		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	7.379	14
2	4.600	7
3	7.762	13
4	7.825	4

GRAND MEAN 7.045

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % RETOUCH vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	52.512	3	17.504	0.694
WITHIN	857.562	34	25.222	
TOTAL	910.074	37		

Table 7.32. 1: less than 70m; 2: 71-100m; 3: 101-130m; 4: 131-160m.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	9.157	14
2	5.814	7
3	8.915	13
4	6.900	4

GRAND MEAN 8.221

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	66.063	3	22.021	1.577
WITHIN	474.800	34	13.965	
TOTAL	540.863	37		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	18.957	14
2	23.529	7
3	18.746	13
4	23.350	4

GRAND MEAN 20.189

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	166.345	3	55.448	1.351
WITHIN	1394.971	34	41.029	
TOTAL	1561.316	37		

Table 7.33. Key as for Table 7.32.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	3.943	14
2	1.371	7
3	10.931	13
4	5.850	4

GRAND MEAN 6.061

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORES vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	525.225	3	175.075	8.095
WITHIN	735.306	34	21.627	
TOTAL	1260.531	37		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.421	14
2	9.443	7
3	7.738	13
4	12.925	4

GRAND MEAN 8.850

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % BLADES vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	87.516	3	29.172	2.330
WITHIN	425.599	34	12.518	
TOTAL	513.115	37		

Table 7.34. Key as for Table 7.32.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.571	14
2	0.800	7
3	1.892	13
4	2.200	4

GRAND MEAN 1.605

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % SCRAPERS vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	7.041	3	2.347	0.647
WITHIN	123.418	34	3.630	
TOTAL	130.459	37		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.286	14
2	1.857	7
3	1.369	13
4	0.125	4

GRAND MEAN 1.297

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs TOPOGRAPHY

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	7.760	3	2.587	0.929
WITHIN	94.629	34	2.783	
TOTAL	102.390	37		

Table 7.35. Key as for Table 7.32.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	43.785	13
2	20.341	17
3	13.800	5

GRAND MEAN 28.114

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: DENSITY vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	5243.925	2	2621.963	4.238
WITHIN	19799.560	32	618.736	
TOTAL	25043.490	34		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	5.608	13
2	2.512	17
3	0.000	5

GRAND MEAN 3.303

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % RETOUCH vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	134.243	2	67.121	2.784
WITHIN	771.507	32	24.110	
TOTAL	905.750	34		

Table 7.36. 1: less than 400m; 2: 401-800m; 3: 1201-1600m.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.577	13
2	7.829	17
3	7.400	5

GRAND MEAN 8.046

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	6.548	2	3.274	0.251
WITHIN	418.258	32	13.071	
TOTAL	424.807	34		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	19.762	13
2	18.771	17
3	22.120	5

GRAND MEAN 19.617

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	43.776	2	21.888	0.567
WITHIN	1234.814	32	38.588	
TOTAL	1278.590	34		

Table 7.37. Key as for Table 7.36.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	4.608	13
2	6.141	17
3	6.760	5

GRAND MEAN 5.660

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORES vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	24.382	2	12.191	0.367
WITHIN	1064.102	32	33.253	
TOTAL	1088.484	34		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.069	13
2	9.247	17
3	11.480	5

GRAND MEAN 9.129

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % BLADES vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	42.473	2	21.237	1.561
WITHIN	435.418	32	13.607	
TOTAL	477.891	34		

Table 7.38. Key as for Table 7.36.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.600	13
2	1.512	17
3	2.540	5

GRAND MEAN 1.691

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % SCRAPERS vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	4.258	2	2.129	0.565
WITHIN	120.670	32	3.771	
TOTAL	124.927	34		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.392	13
2	1.359	17
3	0.440	5

GRAND MEAN 1.240

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES vs RIVER

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	3.742	2	1.871	0.653
WITHIN	91.702	32	2.866	
TOTAL	95.444	34		

Table 7.39. Key as for Table 7.36.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	49.592	13
2	15.929	14
3	12.908	12

GRAND MEAN 26.221

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: DENSITY VARIATION BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	10710.640	2	5355.318	12.356
WITHIN	15603.510	36	433.431	
TOTAL	26314.150	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	3.231	13
2	9.379	14
3	8.192	12

GRAND MEAN 6.964

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % RETOUCH BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	280.889	2	140.445	7.915
WITHIN	638.820	36	17.745	
TOTAL	919.710	38		

Table 7.40. Numbers refer to the 3 zones in Figure 7.6.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	7.300	13
2	9.007	14
3	8.308	12

GRAND MEAN 8.223

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % PRIMARY WASTE BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	19.771	2	9.885	0.683
WITHIN	521.099	36	14.475	
TOTAL	540.869	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	21.469	13
2	20.879	14
3	18.175	12

GRAND MEAN 20.244

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % TERTIARY WASTE BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	76.522	2	38.261	0.925
WITHIN	1489.134	36	41.365	
TOTAL	1565.656	38		

Table 7.41. Key as for Table 7.40.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.177	13
2	7.450	14
3	9.750	12

GRAND MEAN 6.067

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORES BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	500.419	2	250.209	11.849
WITHIN	760.168	36	21.116	
TOTAL	1260.587	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	8.346	13
2	9.550	14
3	8.692	12

GRAND MEAN 8.885

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % BLADES BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	10.414	2	5.207	0.372
WITHIN	504.476	36	14.013	
TOTAL	514.891	38		

Table 7.42. Key as for Table 7.40.

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	0.862	13
2	2.314	14
3	1.575	12

GRAND MEAN 1.603

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % SCRAPERS BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	14.239	2	7.120	2.205
WITHIN	116.230	36	3.229	
TOTAL	130.470	38		

---------- ANALYSIS OF VARIANCE ----------
ONE-WAY ANOVA

GROUP	MEAN	N
1	1.515	13
2	1.221	14
3	1.083	12

GRAND MEAN 1.277

---------- ANALYSIS OF VARIANCE ----------
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16
ONE-WAY ANOVA

LABEL: % CORE TRIMMING FLAKES BETWEEN ZONES

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO
BETWEEN	1.232	2	0.616	0.218
WITHIN	101.777	36	2.827	
TOTAL	103.009	38		

Table 7.43. Key as for Table 7.40.

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: DENSITY (>1SD above mean) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	2	9.10	0.1429	0.6500
2	12	4.90	0.8571	0.3500
TOTALS	14	14.00	1.0000	1.0000

CHI-SQUARE= 15.827 D.F.= 1

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 1

D MAX = 0.5071

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % RETOUCH (>1SD above mean) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	9	5.90	1.0000	0.6556
2	0	3.10	0.0000	0.3444
TOTALS	9	9.00	1.0000	1.0000

CHI-SQUARE= 4.729 D.F.= 1

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 1

D MAX = 0.3444

Table 7.44. 1: lower chalk; 2: upper chalk.

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % PRIMARY WASTE (>1SD above mean) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	6	5.20	0.7500	0.6500
2	2	2.80	0.2500	0.3500
TOTALS	8	8.00	1.0000	1.0000

CHI-SQUARE= 0.352 D.F.= 1

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 1

D MAX = 0.1000

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % TERTIARY WASTE (>1SD above mean) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	12	14.00	0.5455	0.6364
2	10	8.00	0.4545	0.3636
TOTALS	22	22.00	1.0000	1.0000

CHI-SQUARE= 0.786 D.F.= 1

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 1

D MAX = 0.0909

Table 7.45. Key as for Table 7.44.

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % CORES (>1SD above mean) vs GEOLOGY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	12	7.80	1.0000	0.6500
2	0	4.20	0.0000	0.3500
TOTALS	12	12.00	1.0000	1.0000

CHI-SQUARE= 6.462 D.F.= 1

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 1

D MAX = 0.3500

Table 7.46. Key as for Table 7.44.

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: DENSITY (>1SD above mean) vs TOPOGRAPHY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	5	1.90	0.3571	0.1357
2	8	4.50	0.5714	0.3214
3	0	5.10	0.0000	0.3643
4	0	1.90	0.0000	0.1357
5	1	0.60	0.0714	0.0429
TOTALS	14	14.00	1.0000	1.0000

CHI-SQUARE= 15.047 D.F.=4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 2

D MAX = 0.4714

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % RETOUCH (>1SD above mean) vs TOPOGRAPHY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	1	1.20	0.1111	0.1333
2	2	2.90	0.2222	0.3222
3	4	3.30	0.4444	0.3667
4	2	1.20	0.2222	0.1333
5	0	0.40	0.0000	0.0444
TOTALS	9	9.00	1.0000	1.0000

CHI-SQUARE= 1.394 D.F.=4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 2

D MAX = 0.1222

Table 7.47. 1: less than 70m; 2: 71-100m; 3: 101-130m; 4: 131-160m; 5: greater than 160m.

---------- CROSSTABS / CHI-SQUARE ----------

GOODNESS OF FIT TEST

LABEL: % CORES (>1SD above mean) vs TOPOGRAPHY

	FREQUENCIES		PROPORTIONS	
CLASS	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	1	1.60	0.0833	0.1333
2	1	3.80	0.0833	0.3167
3	7	4.50	0.5833	0.3750
4	3	1.60	0.2500	0.1333
5	0	0.50	0.0000	0.0417
TOTALS	12	12.00	1.0000	1.0000

CHI-SQUARE= 5.402 D.F.=4

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFERENCE: 2

D MAX = 0.2833

Table 7.48. Key as for Table 7.47.

```
HEADER DATA FOR: B:MEONALL    LABEL: 39
NUMBER OF CASES:  39          NUMBER OF VARIABLES:  16

     DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

          LABEL: DENSITY vs GEOLOGY

     GROUP 1                        GROUP 2

      MEAN =      49.5923            14.5346
STD. DEV. =       31.0288            12.8203
        N =       13                 26
    CASES = 1 TO 13                  14 TO 39

              DIFFERENCE =    35.0577
STD. ERROR OF DIFFERENCE =     6.9888

T =    5.0163      (D.F.  =   37)    VARIABLE: FLINT
```

```
HEADER DATA FOR: B:MEONALL    LABEL: 39
NUMBER OF CASES:  39          NUMBER OF VARIABLES:  16

     DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

          LABEL: % RETOUCH vs GEOLOGY

     GROUP 1                        GROUP 2

      MEAN =       3.2308             8.8308
STD. DEV. =        1.6675             4.9580
        N =       13                 26
    CASES = 1 TO 13                  14 TO 39

              DIFFERENCE =    -5.6000
STD. ERROR OF DIFFERENCE =     1.4215

T =   -3.9396      (D.F.  =   37)    VARIABLE:  %RET
```

Table 7.49. 1: upper chalk; 2: lower chalk.

```
HEADER DATA FOR: B:MEONALL    LABEL: 39
NUMBER OF CASES:  39          NUMBER OF VARIABLES:  16

     DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

          LABEL: % PRIMARY WASTE vs GEOLOGY

        GROUP 1                          GROUP 2

         MEAN =       7.3000              8.6846
    STD. DEV. =       2.8346              4.1368
            N =     13                   26
        CASES = 1 TO 13                  14 TO 39

                  DIFFERENCE =    -1.3846
    STD. ERROR OF DIFFERENCE =     1.2786

    T =   -1.0829      (D.F.  =   37)     VARIABLE:     %P
```

```
HEADER DATA FOR: B:MEONALL    LABEL: 39
NUMBER OF CASES:  39          NUMBER OF VARIABLES:  16

     DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

          LABEL: % TERTIARY WASTE vs GEOLOGY

        GROUP 1                          GROUP 2

         MEAN =      21.4692             19.6308
    STD. DEV. =       2.8535              7.5859
            N =     13                   26
        CASES = 1 TO 13                  14 TO 39

                  DIFFERENCE =     1.8385
    STD. ERROR OF DIFFERENCE =     2.1889

    T =    0.8399      (D.F.  =   37)     VARIABLE:     %T
```

Table 7.50. Key as for Table 7.49.

```
HEADER DATA FOR: B:MEONALL    LABEL: 39
NUMBER OF CASES:  39          NUMBER OF VARIABLES:  16

     DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

              LABEL: % CORES vs GEOLOGY

        GROUP 1                        GROUP 2

         MEAN =       1.1769              8.5115
    STD. DEV. =       0.8238              5.6079
            N =     13                    26
        CASES = 1 TO 13                   14 TO 39

                  DIFFERENCE =    -7.3346
    STD. ERROR OF DIFFERENCE =     1.5739

    T =   -4.6601      (D.F.  =   37)     VARIABLE: %CORE
```

```
HEADER DATA FOR: B:MEONALL    LABEL: 39
NUMBER OF CASES:  39          NUMBER OF VARIABLES:  16

     DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

              LABEL: % BLADES vs GEOLOGY

        GROUP 1                        GROUP 2

         MEAN =       8.3462              9.1538
    STD. DEV. =       2.1145              4.2689
            N =     13                    26
        CASES = 1 TO 13                   14 TO 39

                  DIFFERENCE =    -0.8077
    STD. ERROR OF DIFFERENCE =     1.2602

    T =   -0.6409      (D.F.  =   37)     VARIABLE: %BLAD
```

Table 7.51. Key as for Table 7.49.

HEADER DATA FOR: B:MEONALL LABEL: 39
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

LABEL: % SCRAPERS vs GEOLOGY

	GROUP 1	GROUP 2
MEAN =	0.8615	1.9731
STD. DEV. =	0.6252	2.1454
N =	13	26
CASES =	1 TO 13	14 TO 39

DIFFERENCE = -1.1115
STD. ERROR OF DIFFERENCE = 0.6111

T = -1.8188 (D.F. = 37) VARIABLE: %SCRA

HEADER DATA FOR: B:MEONALL LABEL: 39
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

DIFFERENCE BETWEEN TWO GROUP MEANS: SMALL SAMPLE

LABEL: % CORE TRIMMING FLAKES vs GEOLOGY

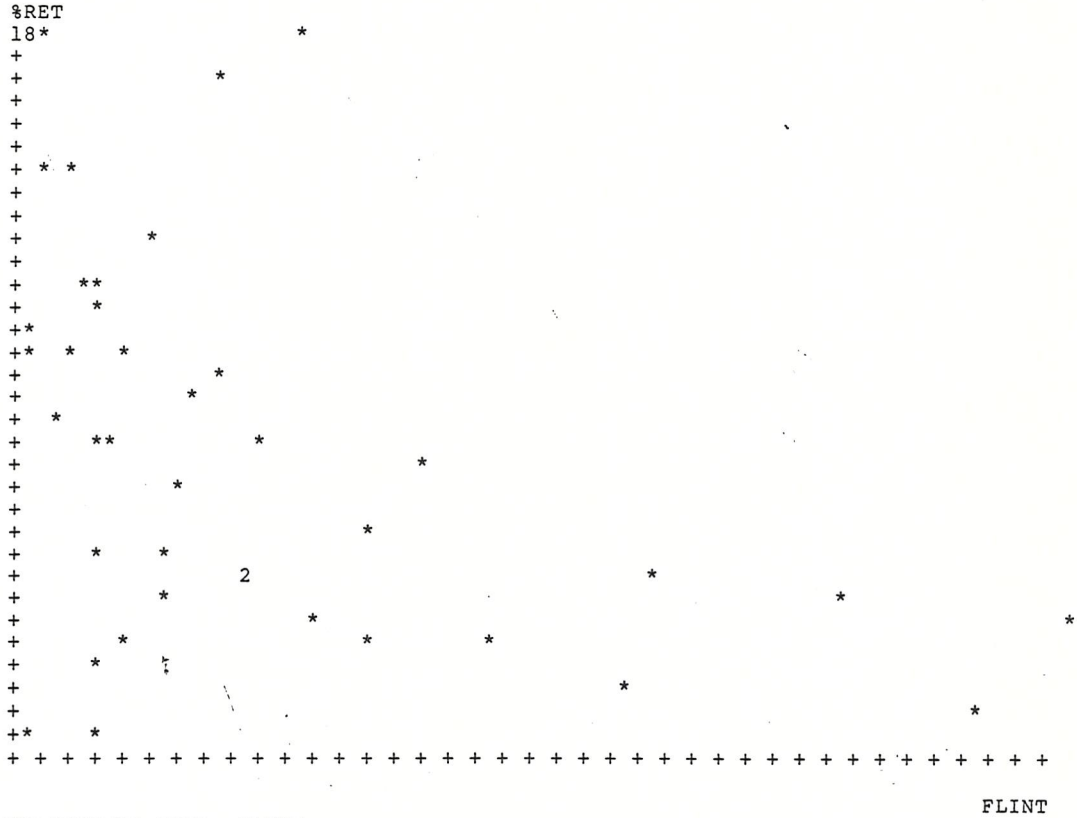
	GROUP 1	GROUP 2
MEAN =	1.5154	1.1577
STD. DEV. =	1.4764	1.7406
N =	13	26
CASES =	1 TO 13	14 TO 39

DIFFERENCE = 0.3577
STD. ERROR OF DIFFERENCE = 0.5637

T = 0.6345 (D.F. = 37) VARIABLE: %CT

Table 7.52. Key as for Table 7.49.

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND %RET
ON THE Y



HORIZONTAL AXIS: FLINT
LEFT ENDPOINT: 3.5 RIGHT ENDPOINT: 110.6

VERTICAL AXIS: %RET
LOWER ENDPOINT: 0 UPPER ENDPOINT: 18
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.26

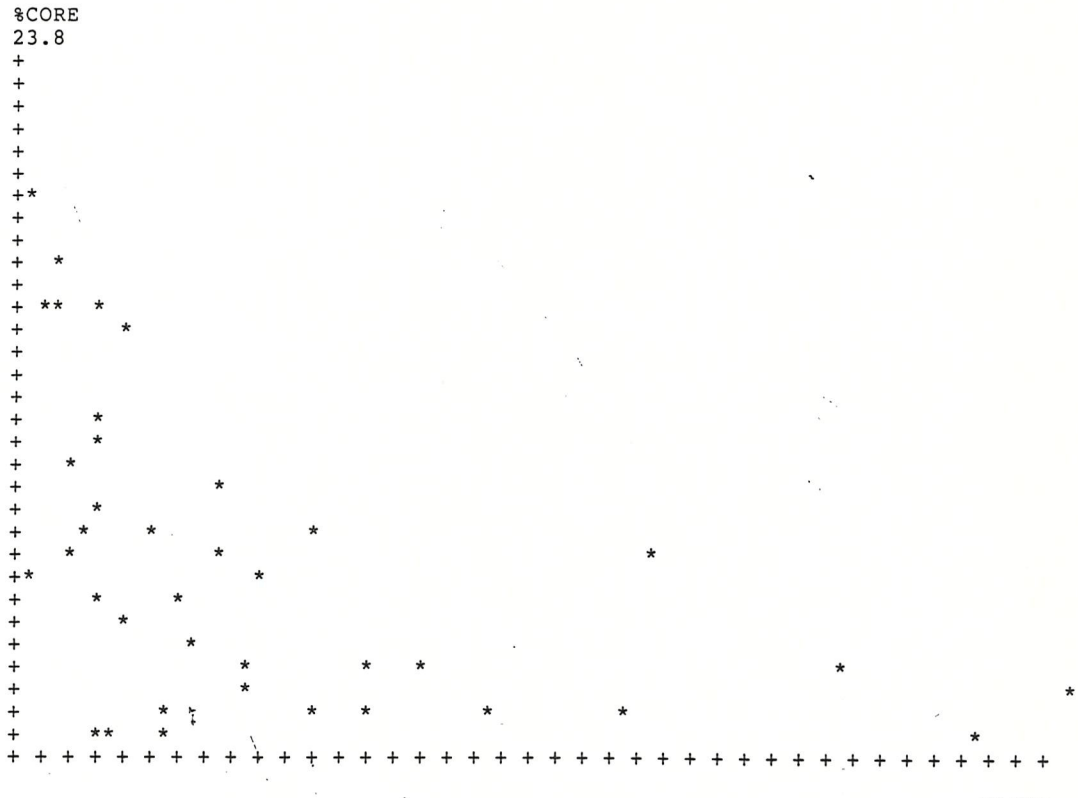
```
SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND    %P
 ON THE Y

%P
18.2  *
+
+
+
+  *
+
+
+
+    *
+
+                *
+
+     *
+     *              *
+
+*            *      *
+     * * * *
+     *                    *                              *                *
+                                                  *
+                                            *
+                    *
+     *    *                 *
+               *                                                  *
+   2         *
+**     *   *
+               *                    *
+  *
+
+
+     *
+
+               *
+ + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + +
           ↕                                                              FLINT

HORIZONTAL AXIS: FLINT
 LEFT ENDPOINT:   3.5        RIGHT ENDPOINT:  110.6

VERTICAL AXIS:    %P
 LOWER ENDPOINT:  1.3        UPPER ENDPOINT:  18.2
HEADER DATA FOR: B:MEONALL   LABEL: ALL DATA
NUMBER OF CASES:  39         NUMBER OF VARIABLES:  16
```

Figure 7.27

```
SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND     %T
 ON THE Y

%T
36.4
+
+
+
+             *
+
+
+
+
+     *           *                          *
+                  *
+*     *                     *
+          *
+    2** *                           *               *
+      **    *                              *
+          *                     *
+      2                                                    *
+                  *    2                                                  *
+             *                                                    *
+
+
+
+                *
+                *
+
+
+   *
+   *
+
+         *
+
+
+**
+ + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + +
                                                                        FLINT

HORIZONTAL AXIS: FLINT
 LEFT ENDPOINT:   3.5          RIGHT ENDPOINT:  110.6

VERTICAL AXIS:    %T
 LOWER ENDPOINT:  4.8          UPPER ENDPOINT:  36.4
HEADER DATA FOR: B:MEONALL     LABEL: ALL DATA
NUMBER OF CASES:  39           NUMBER OF VARIABLES:  16
```

Figure 7.28

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND %CORE
ON THE Y

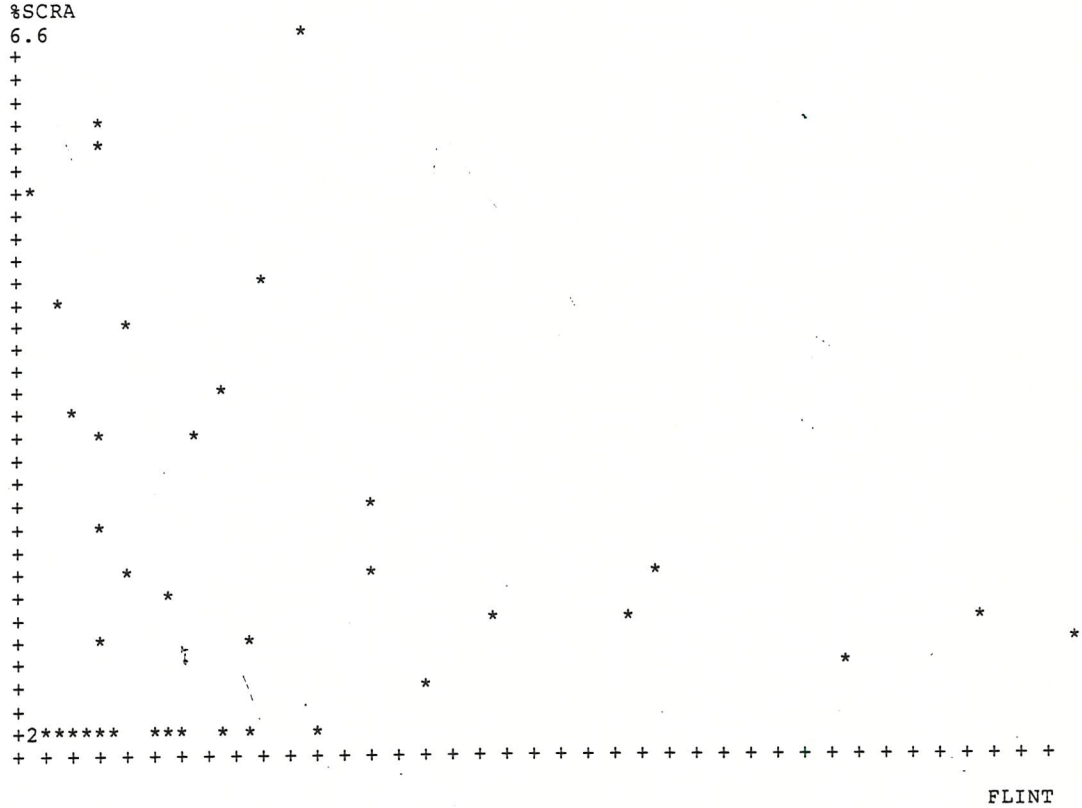


HORIZONTAL AXIS: FLINT
LEFT ENDPOINT: 3.5 RIGHT ENDPOINT: 110.6

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 23.8
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.29

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND %SCRA
ON THE Y

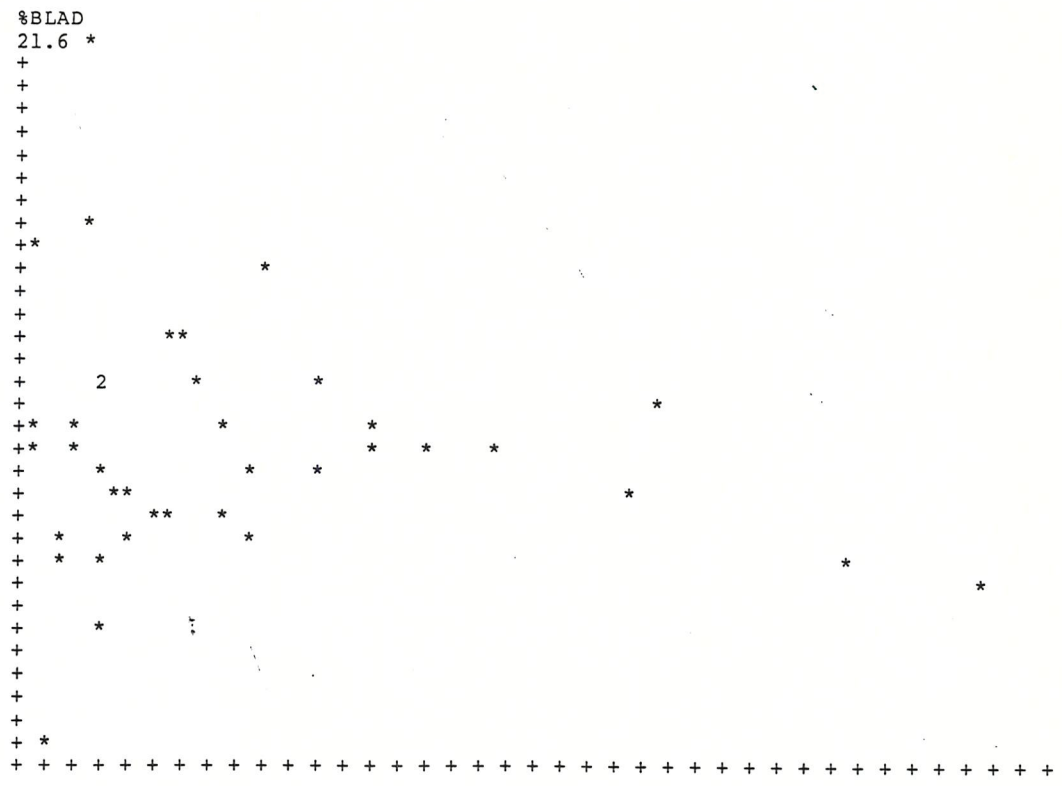


HORIZONTAL AXIS: FLINT
LEFT ENDPOINT: 3.5 RIGHT ENDPOINT: 110.6

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.30

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND %BLAD
ON THE Y



HORIZONTAL AXIS: FLINT
LEFT ENDPOINT: 3.5 RIGHT ENDPOINT: 110.6

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 21.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.31

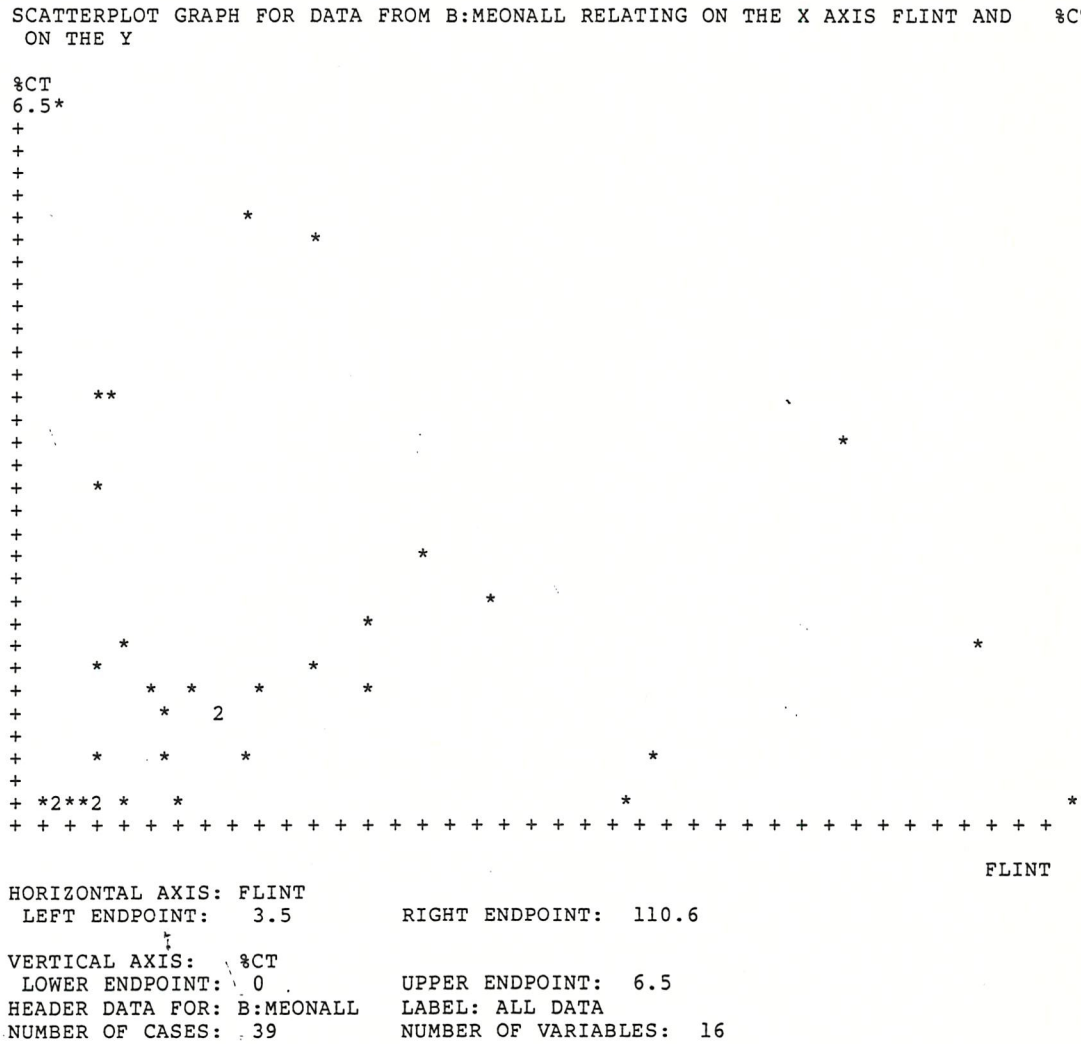
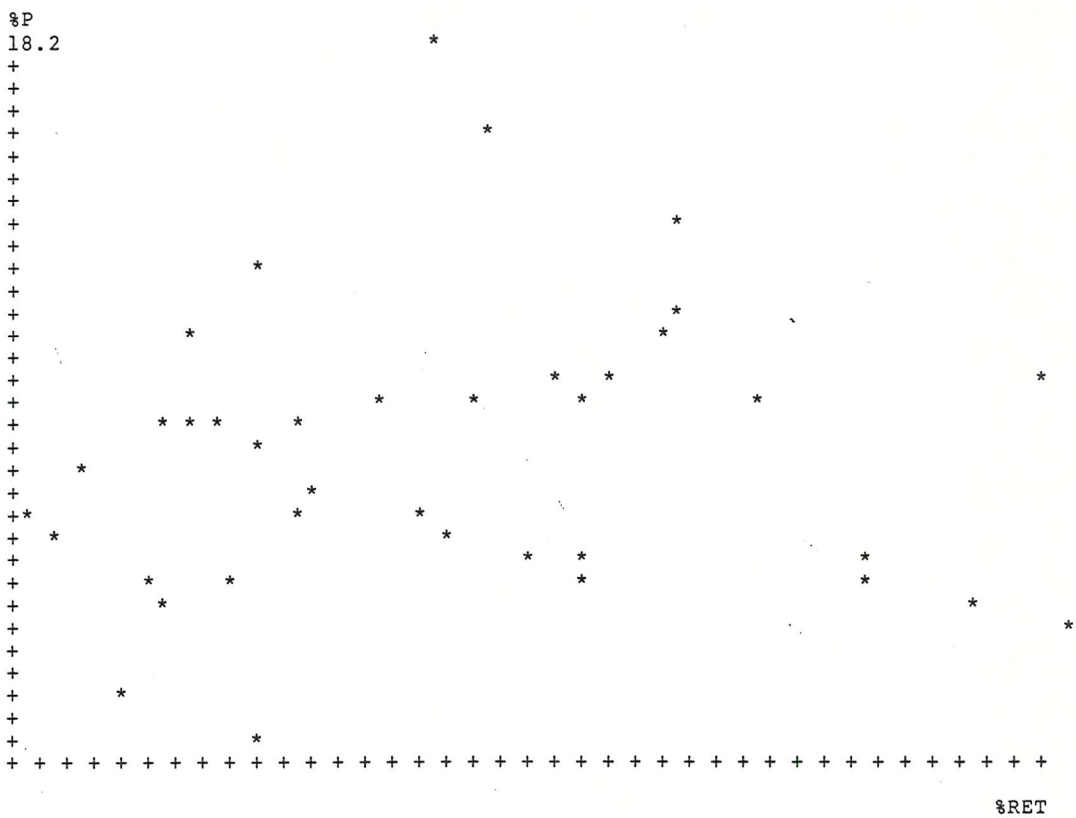

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS FLINT AND %CT ON THE Y
%CT
6.5*
FLINT
HORIZONTAL AXIS: FLINT
LEFT ENDPOINT: 3.5
RIGHT ENDPOINT: 110.6
VERTICAL AXIS: %CT
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.5
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.32

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %RET AND %P
ON THE Y



HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 18

VERTICAL AXIS: %P
LOWER ENDPOINT: 1.3 UPPER ENDPOINT: 18.2
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.33

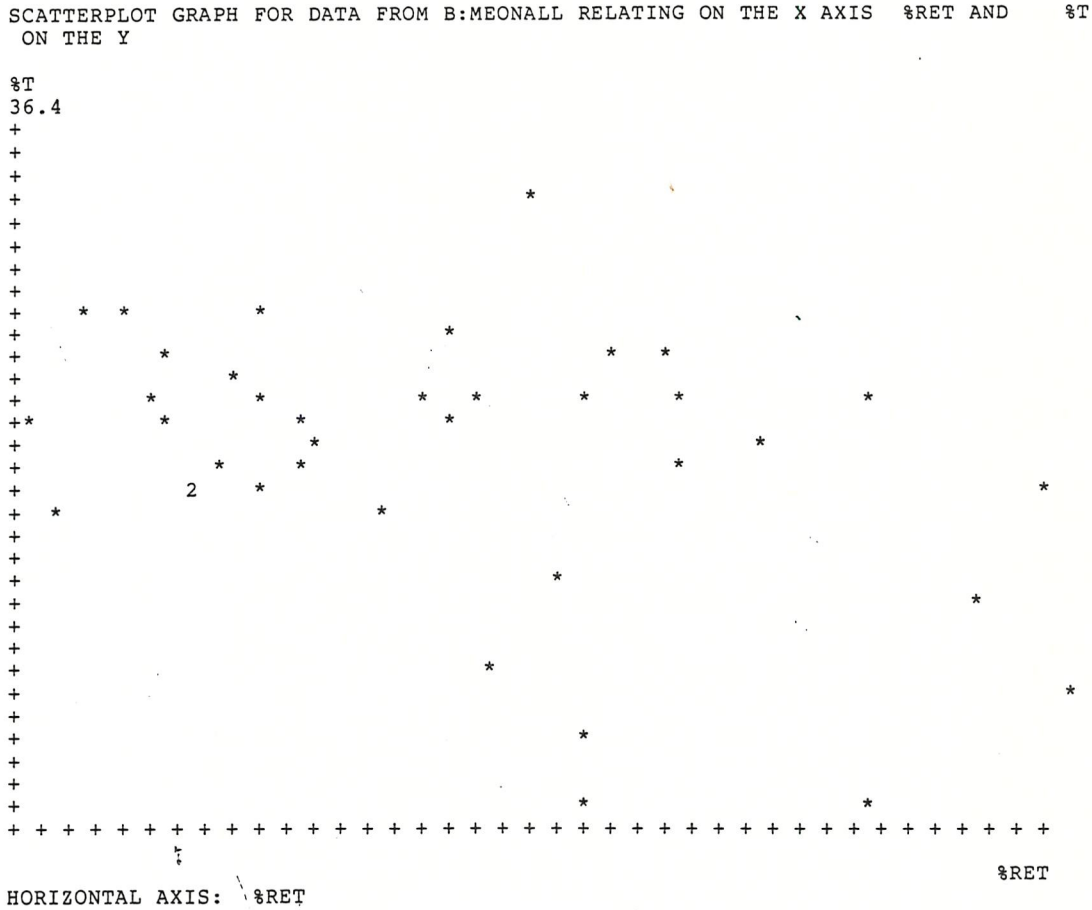
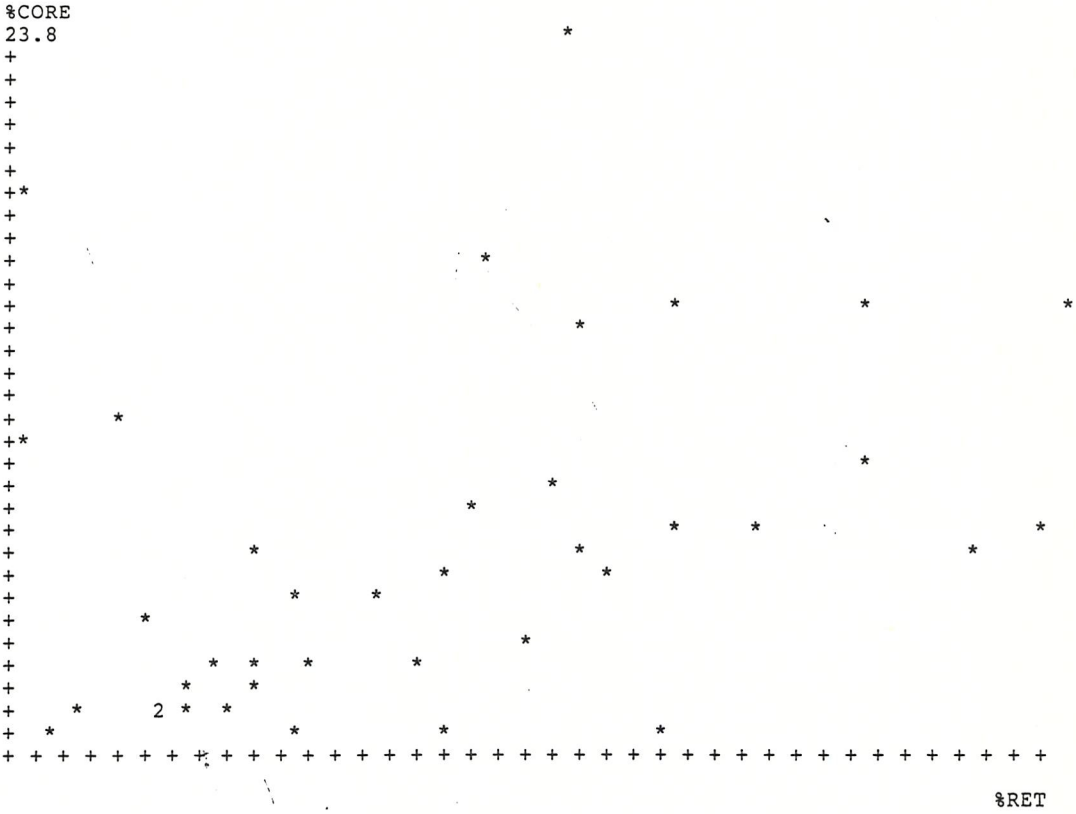

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %RET AND %T
ON THE Y
%T
36.4
2
%RET
HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 18
VERTICAL AXIS: %T
LOWER ENDPOINT: 4.8 UPPER ENDPOINT: 36.4
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.34

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %RET AND %CORE
ON THE Y



HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 18

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 23.8
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.35

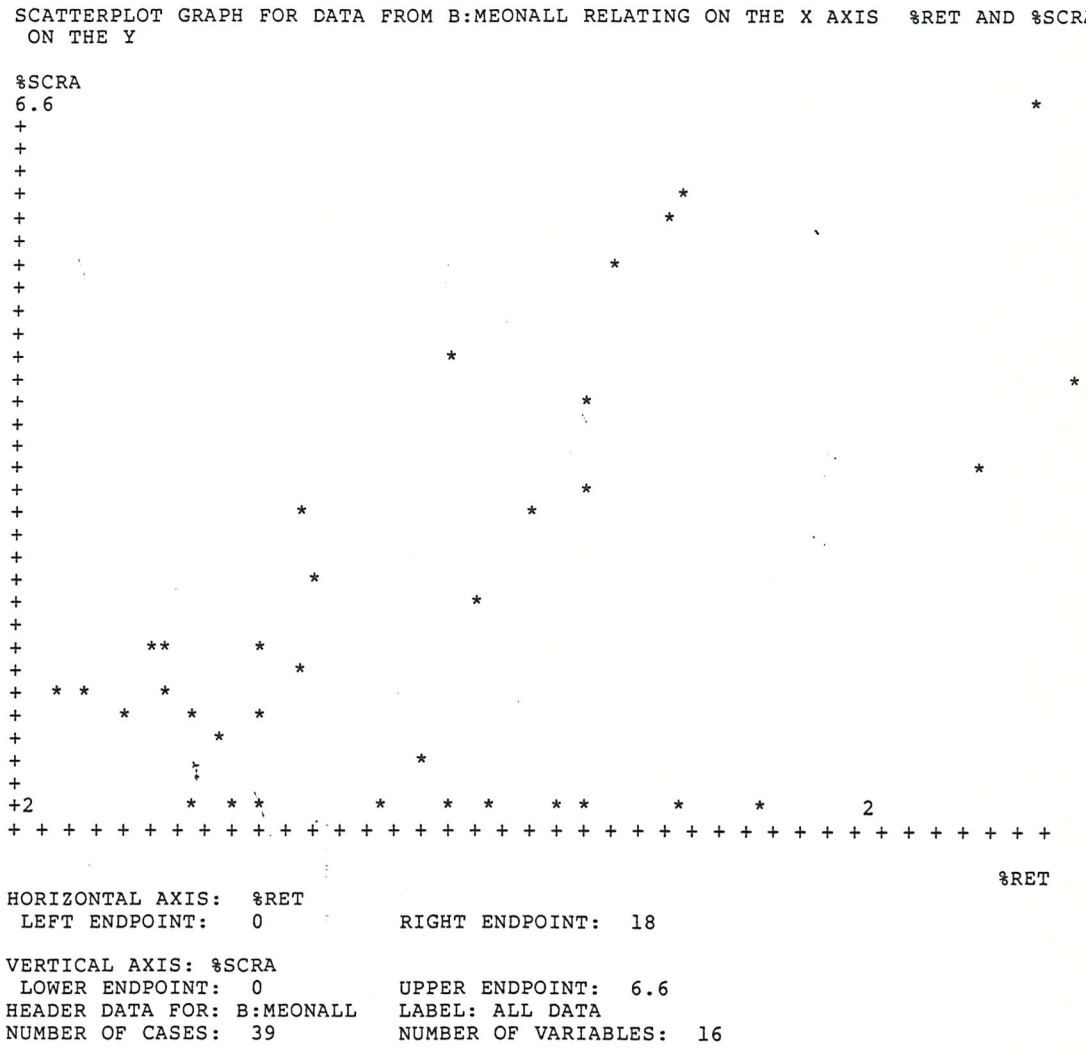

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %RET AND %SCRA ON THE Y
%SCRA
6.6
%RET
HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 18
VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.6
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.36

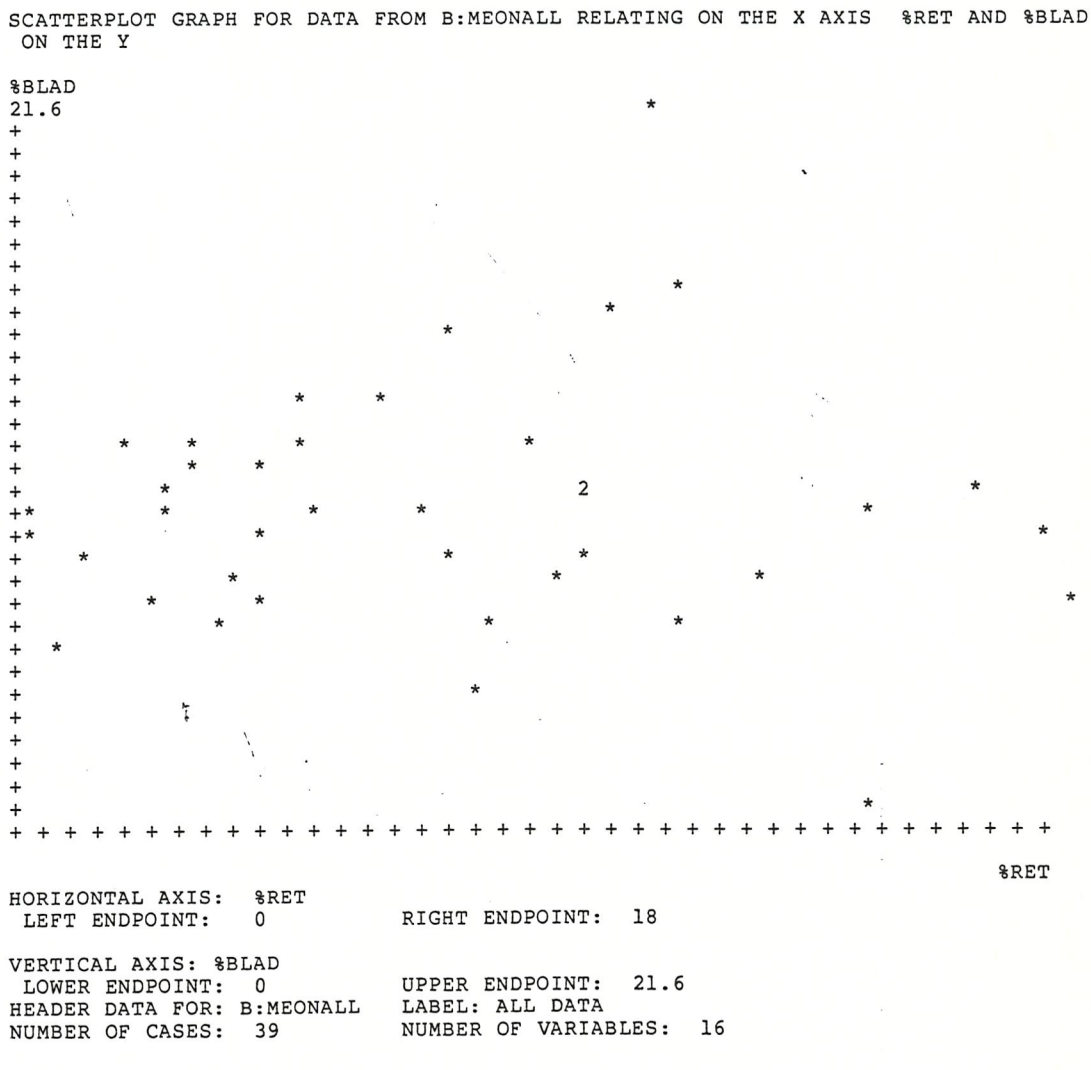
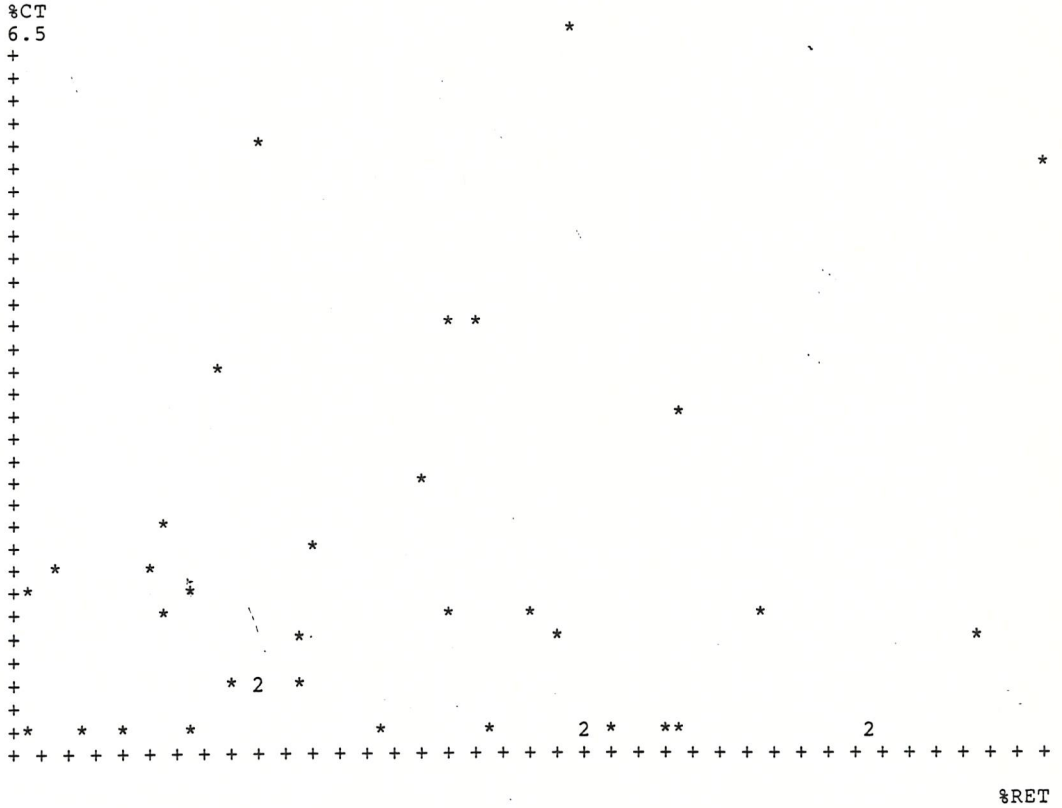

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %RET AND %BLAD
ON THE Y
%BLAD
21.6
%RET
HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 18
VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0
UPPER ENDPOINT: 21.6
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.37

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %RET AND %CT ON THE Y



HORIZONTAL AXIS: %RET
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 18

VERTICAL AXIS: %CT
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.5
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.38

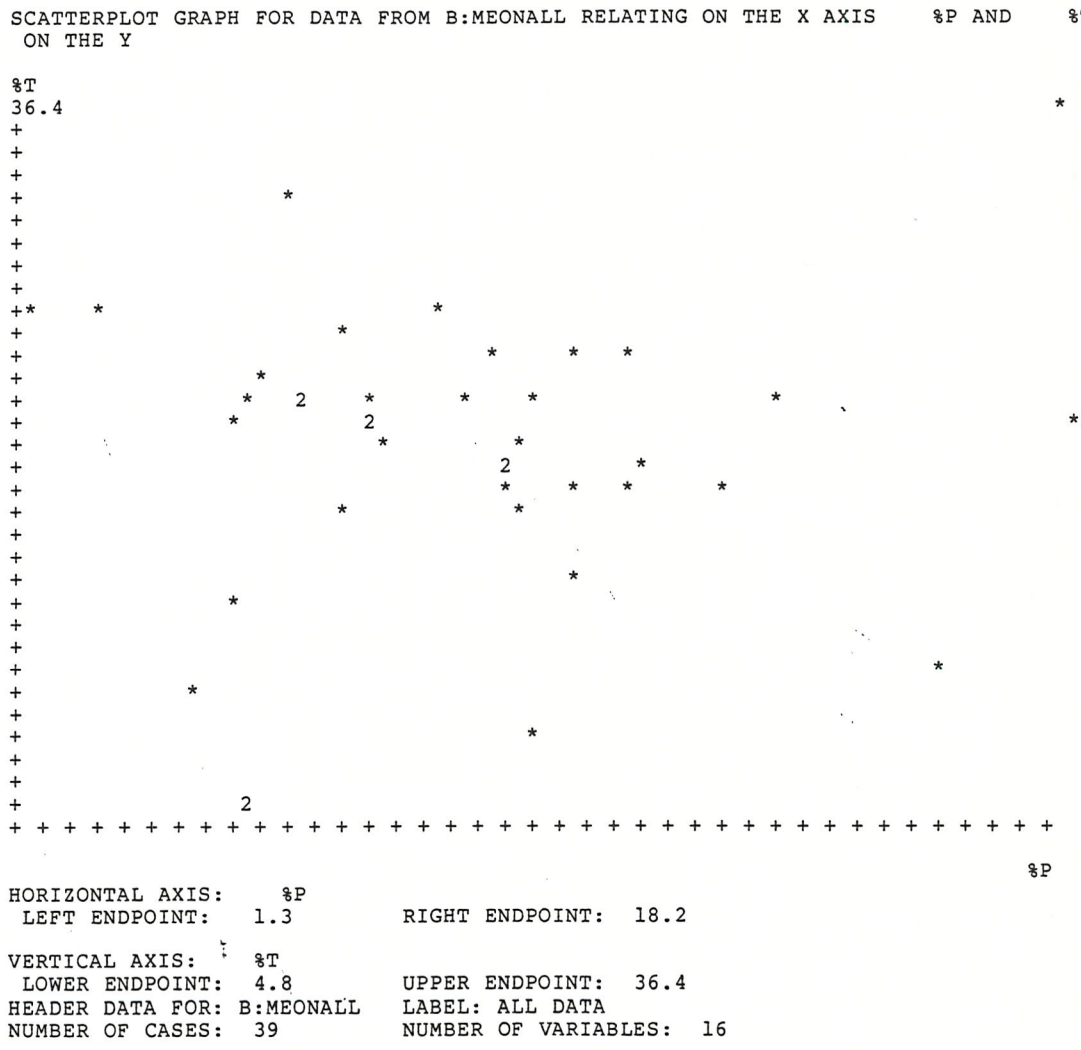

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %P AND %T
ON THE Y
%T
36.4
%P
HORIZONTAL AXIS: %P
LEFT ENDPOINT: 1.3 RIGHT ENDPOINT: 18.2
VERTICAL AXIS: %T
LOWER ENDPOINT: 4.8 UPPER ENDPOINT: 36.4
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.39

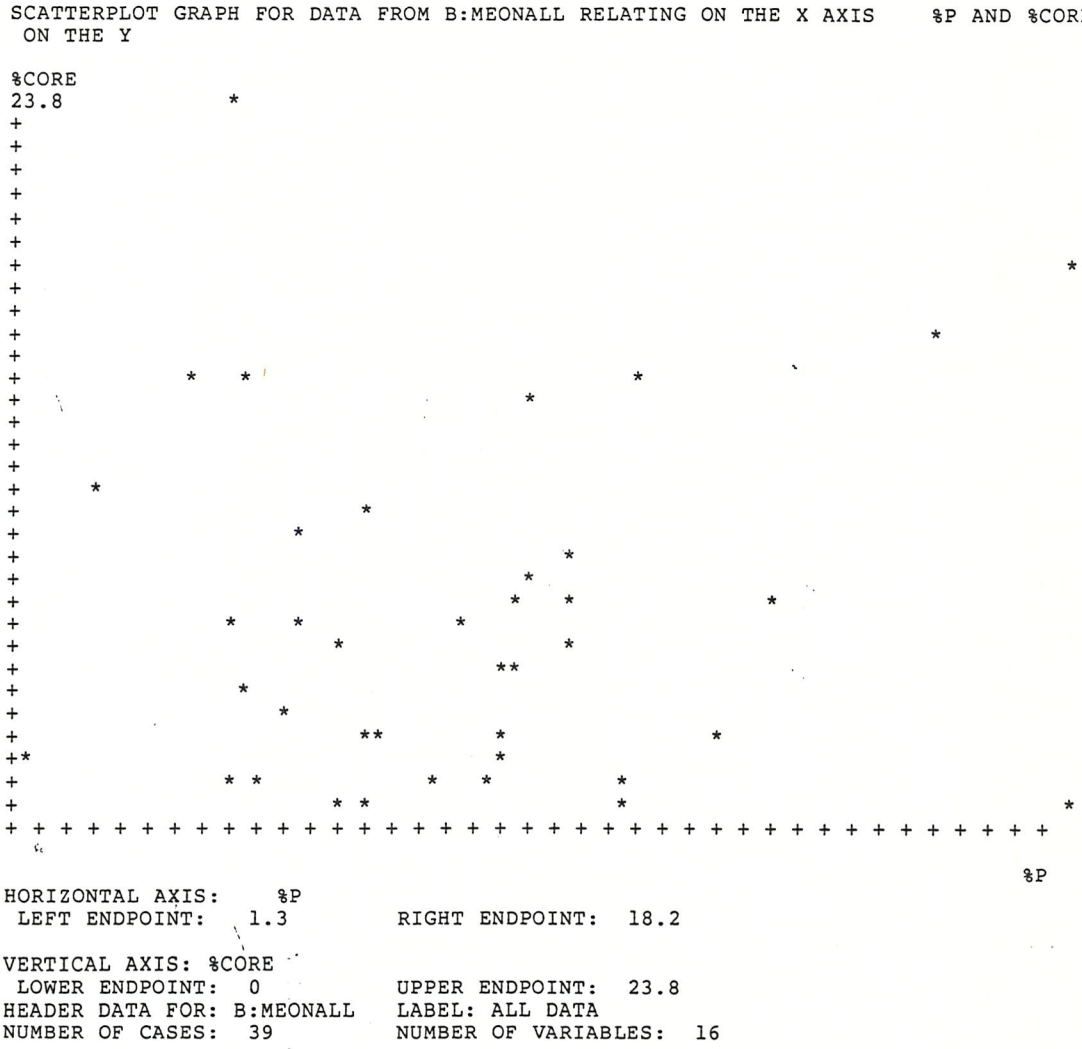
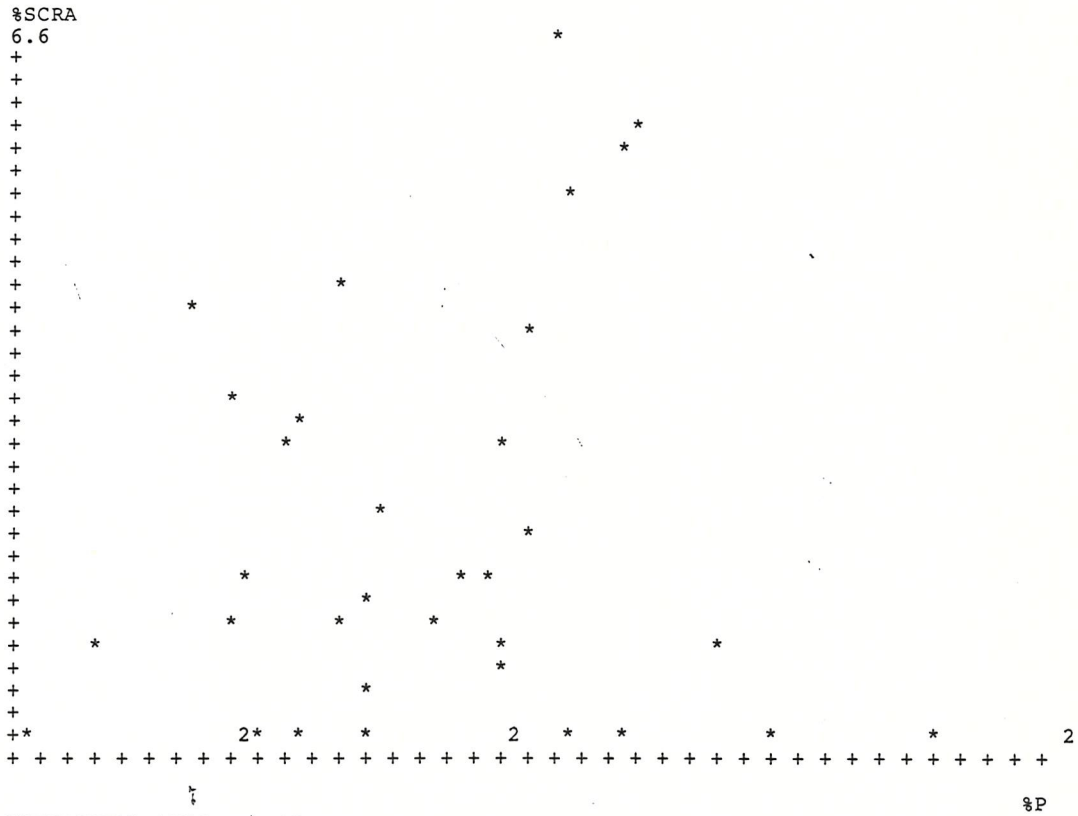

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %P AND %CORE
ON THE Y
%CORE
23.8
%P
HORIZONTAL AXIS: %P
LEFT ENDPOINT: 1.3 RIGHT ENDPOINT: 18.2
VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 23.8
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.40

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %P AND %SCRA
ON THE Y

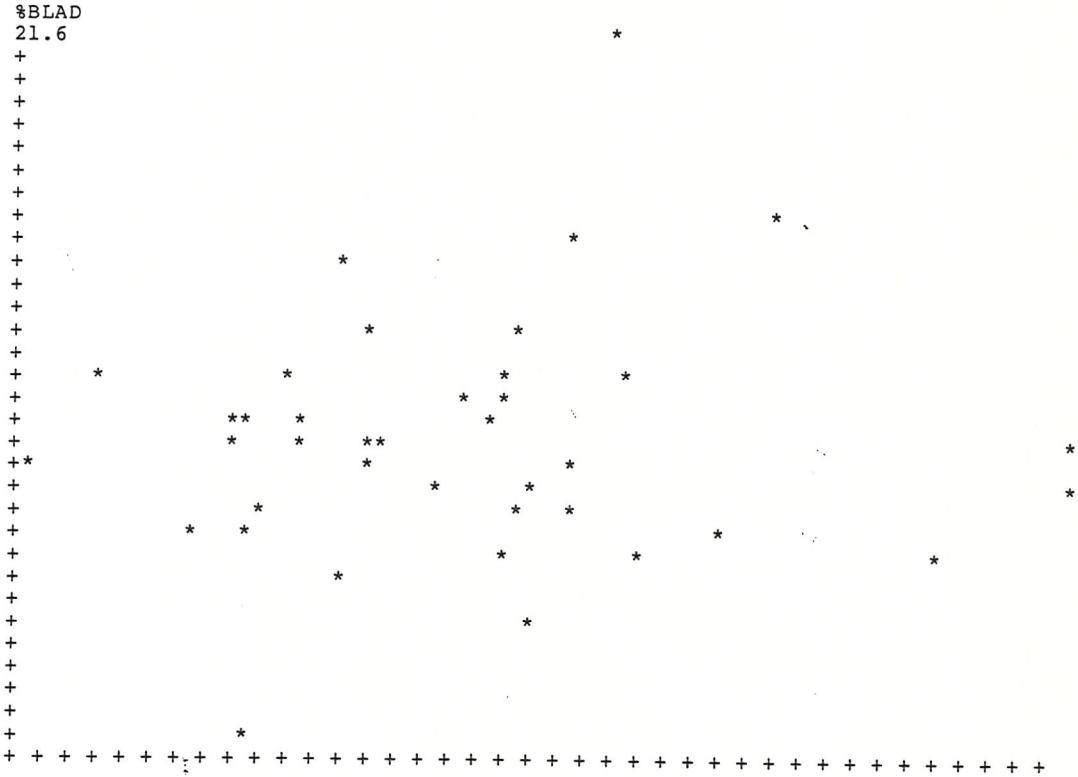


HORIZONTAL AXIS: %P
LEFT ENDPOINT: 1.3 RIGHT ENDPOINT: 18.2

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.41

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %P AND %BLAD
ON THE Y



HORIZONTAL AXIS: %P
LEFT ENDPOINT: 1.3 RIGHT ENDPOINT: 18.2

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 21.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.42

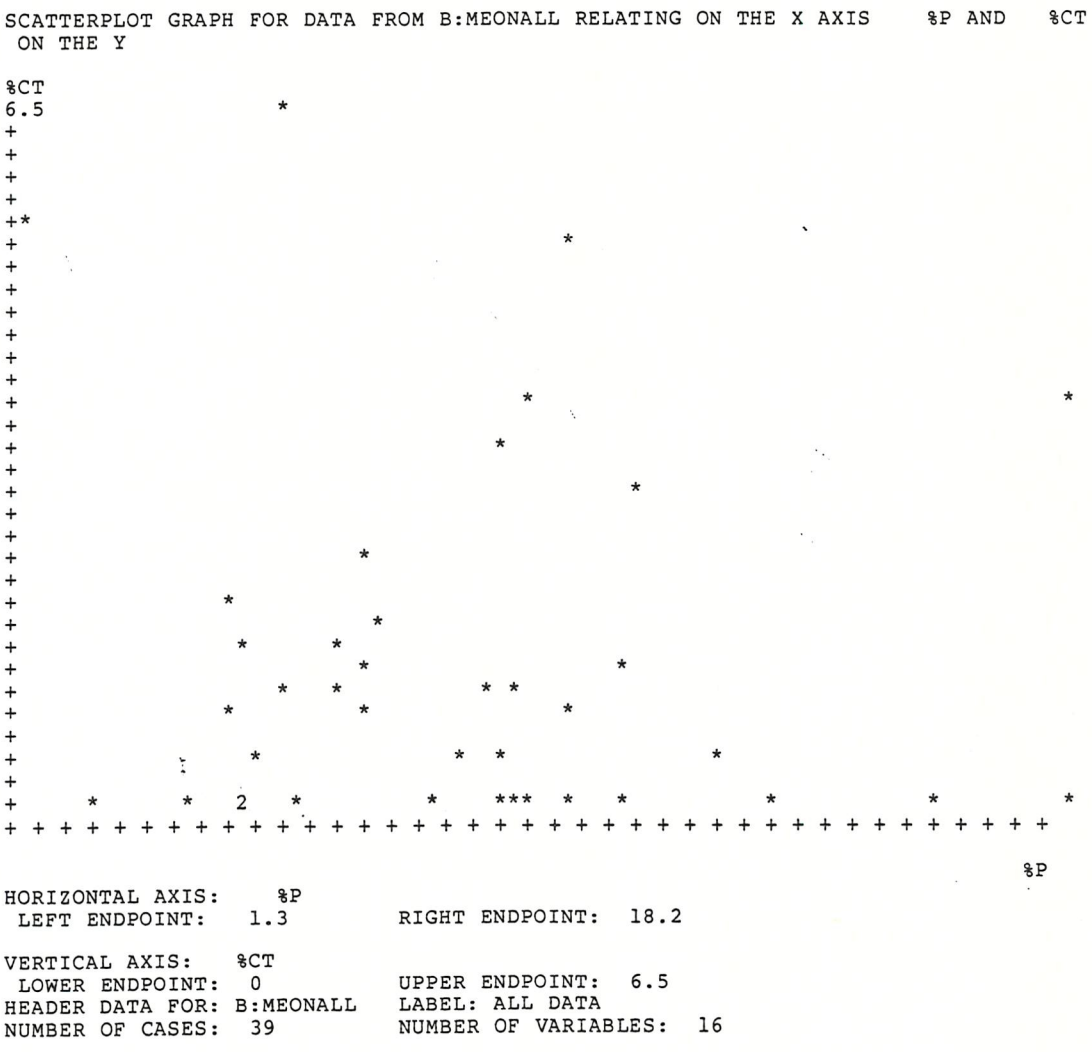
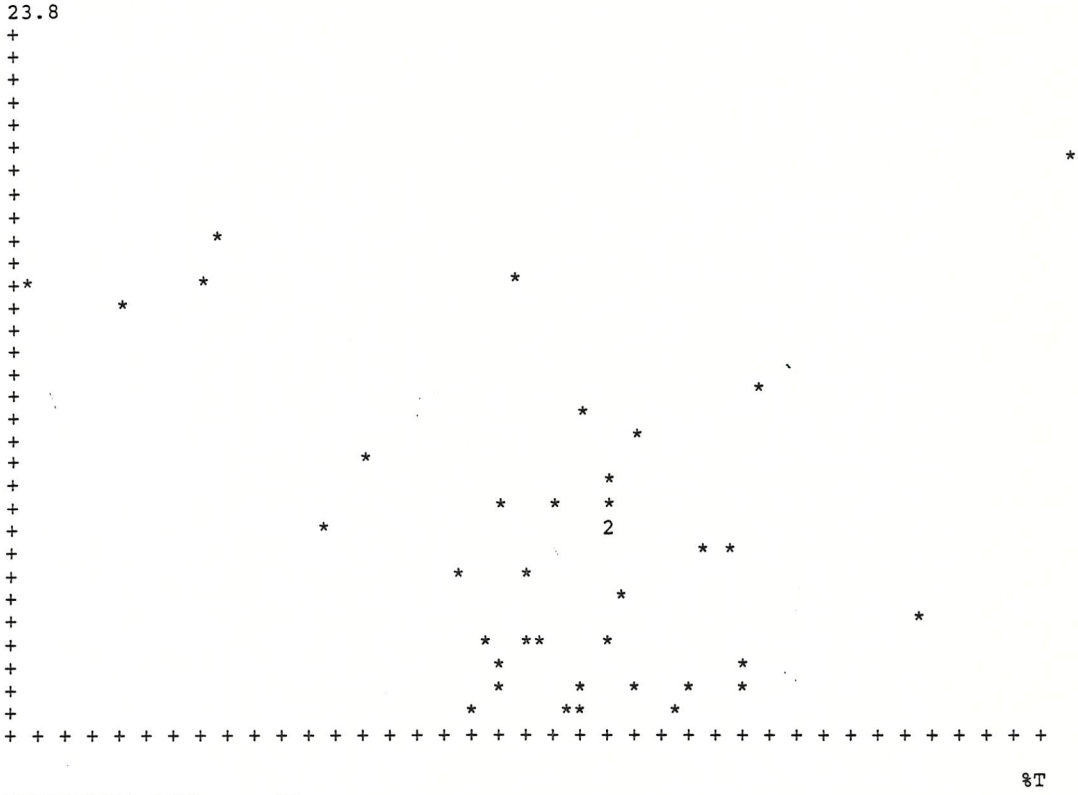

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %P AND %CT
ON THE Y
%CT
6.5
%P
HORIZONTAL AXIS: %P
LEFT ENDPOINT: 1.3
RIGHT ENDPOINT: 18.2
VERTICAL AXIS: %CT
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.5
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.43

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %T AND %CORE
ON THE Y



HORIZONTAL AXIS: %T
LEFT ENDPOINT: 4.8 RIGHT ENDPOINT: 36.4

VERTICAL AXIS: %CORE
LOWER ENDPOINT: 0 UPPER ENDPOINT: 23.8
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.44

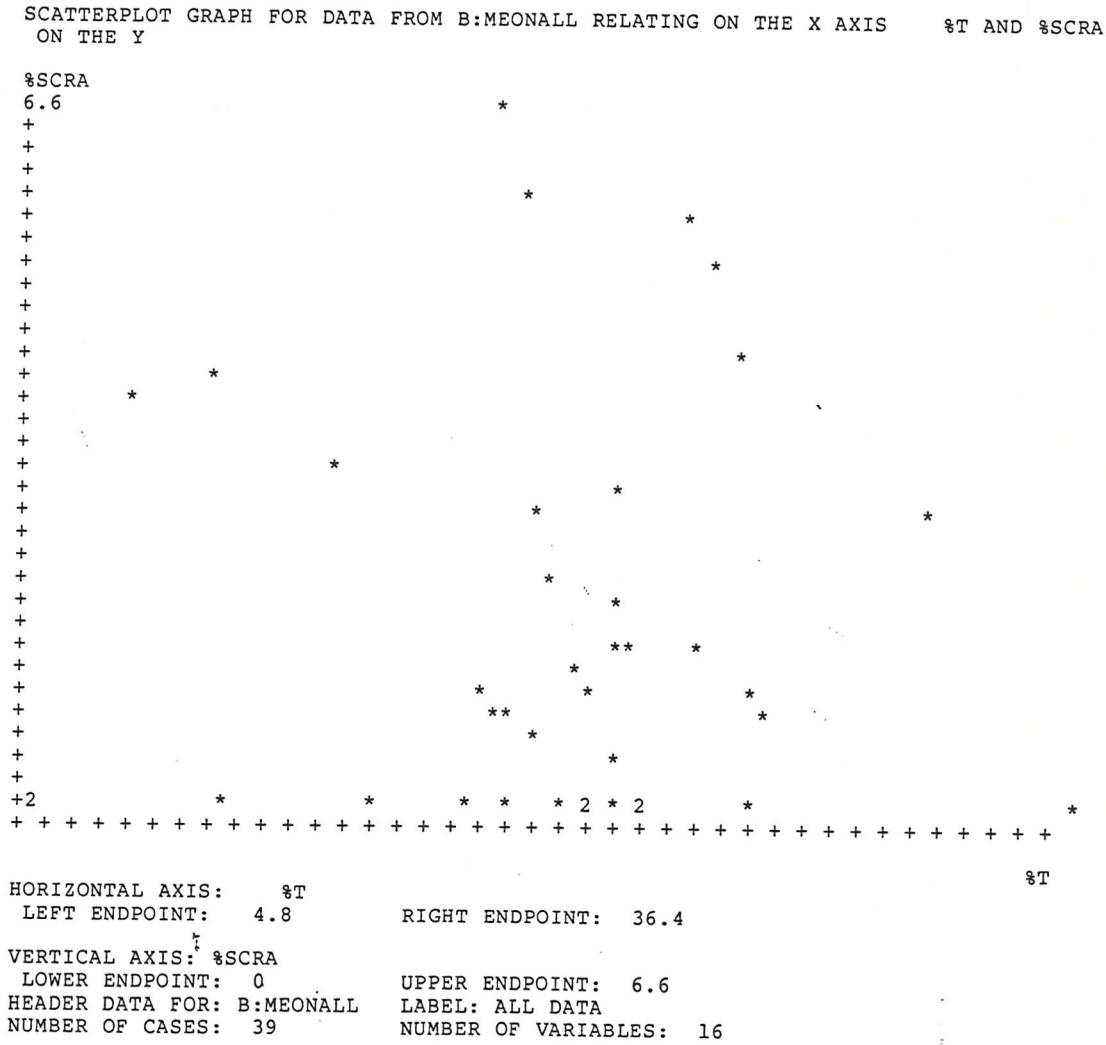
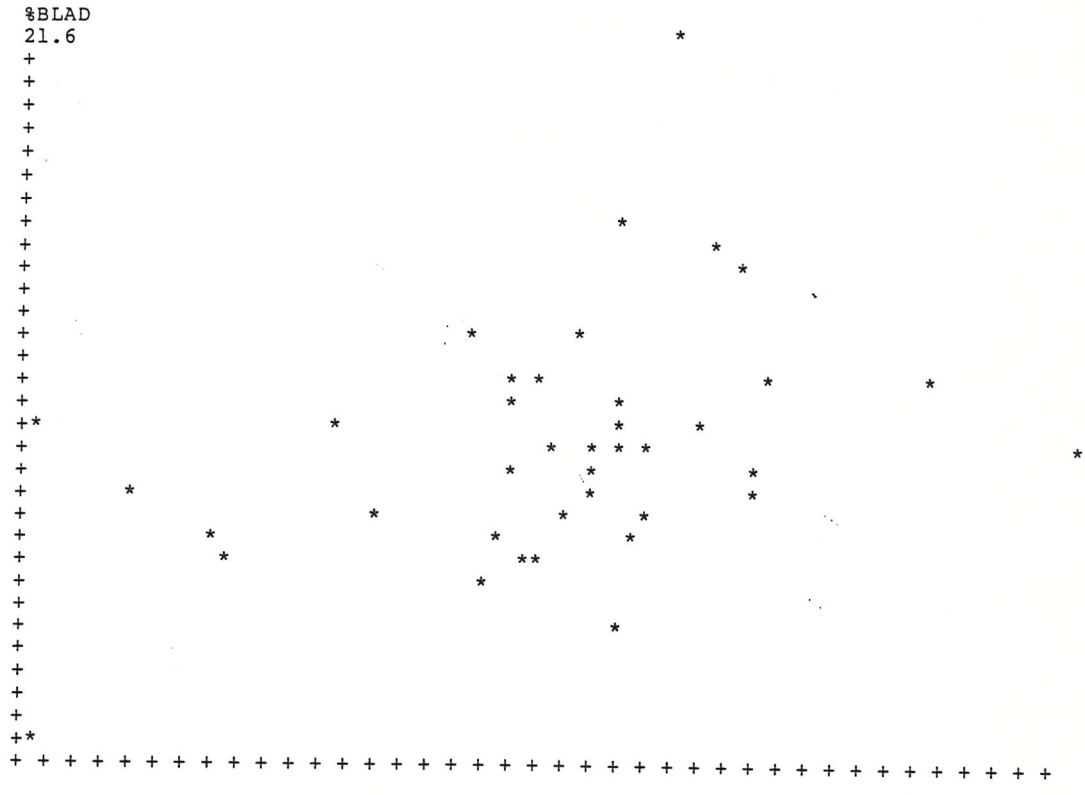

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %T AND %SCRA
ON THE Y
%SCRA
6.6
%T
HORIZONTAL AXIS: %T
LEFT ENDPOINT: 4.8 RIGHT ENDPOINT: 36.4
VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.45

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %T AND %BLAD
ON THE Y



HORIZONTAL AXIS: %T
LEFT ENDPOINT: 4.8 RIGHT ENDPOINT: 36.4

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 21.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.46

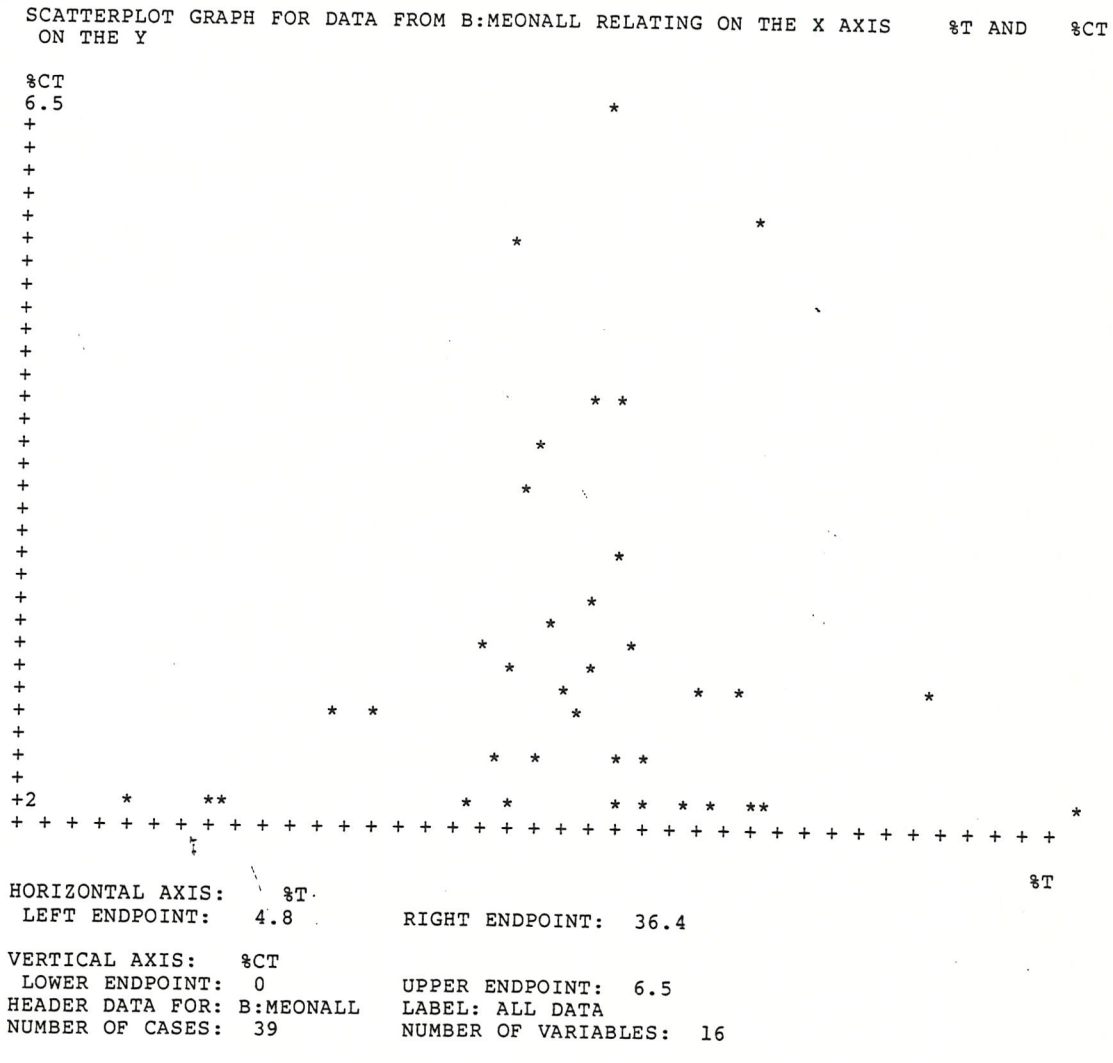
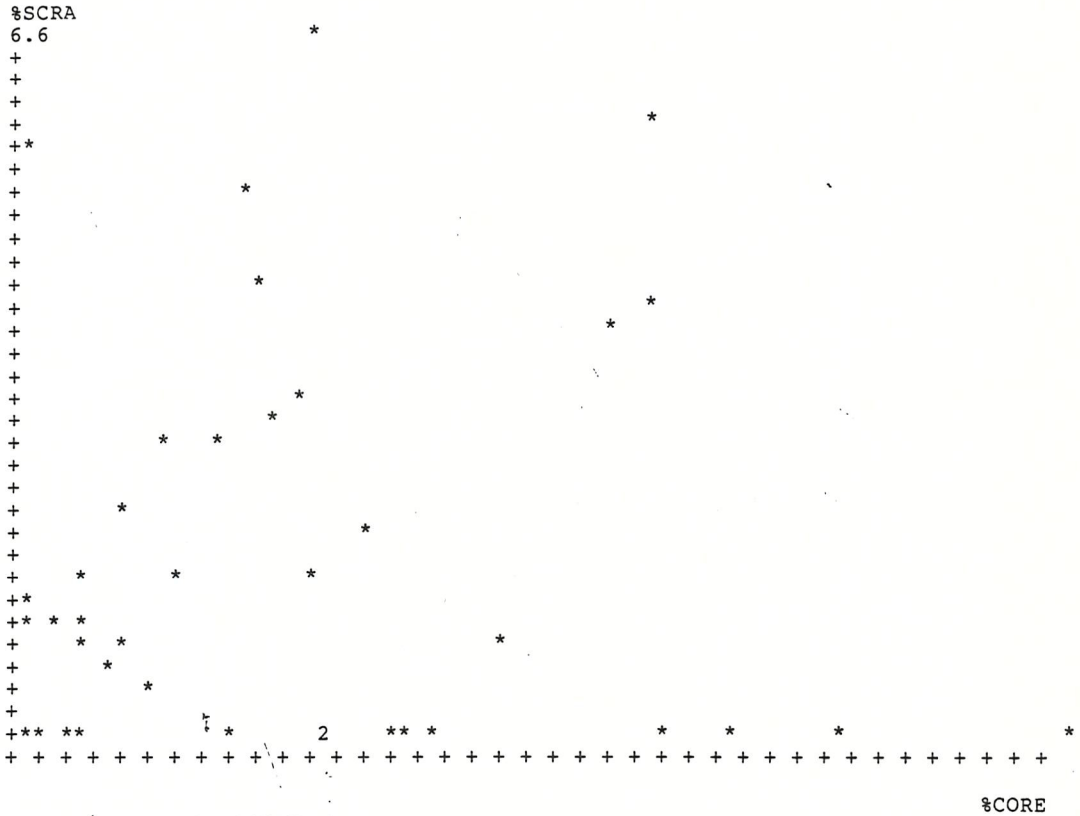

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %T AND %CT
ON THE Y
%CT
6.5
+2
%T
HORIZONTAL AXIS: %T
LEFT ENDPOINT: 4.8
RIGHT ENDPOINT: 36.4
VERTICAL AXIS: %CT
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.5
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.47

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %CORE AND %SCRA
ON THE Y

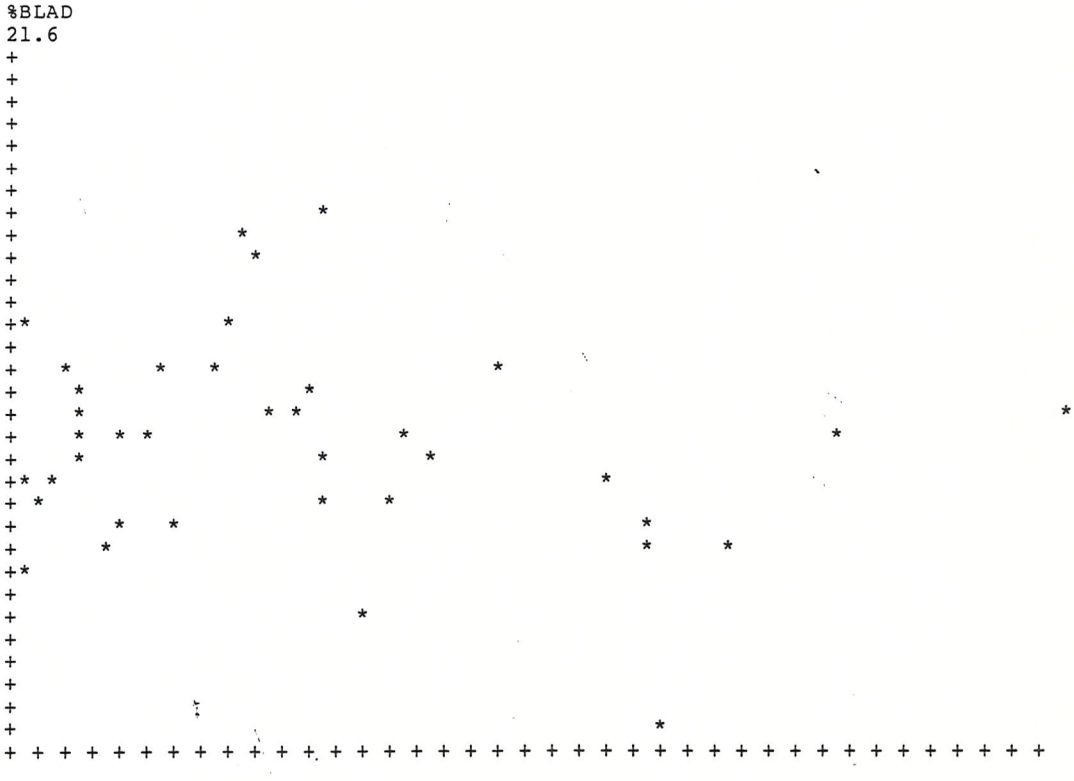


HORIZONTAL AXIS: %CORE
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 23.8

VERTICAL AXIS: %SCRA
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.48

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %CORE AND %BLAD
ON THE Y



HORIZONTAL AXIS: %CORE
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 23.8

VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0 UPPER ENDPOINT: 21.6
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.49

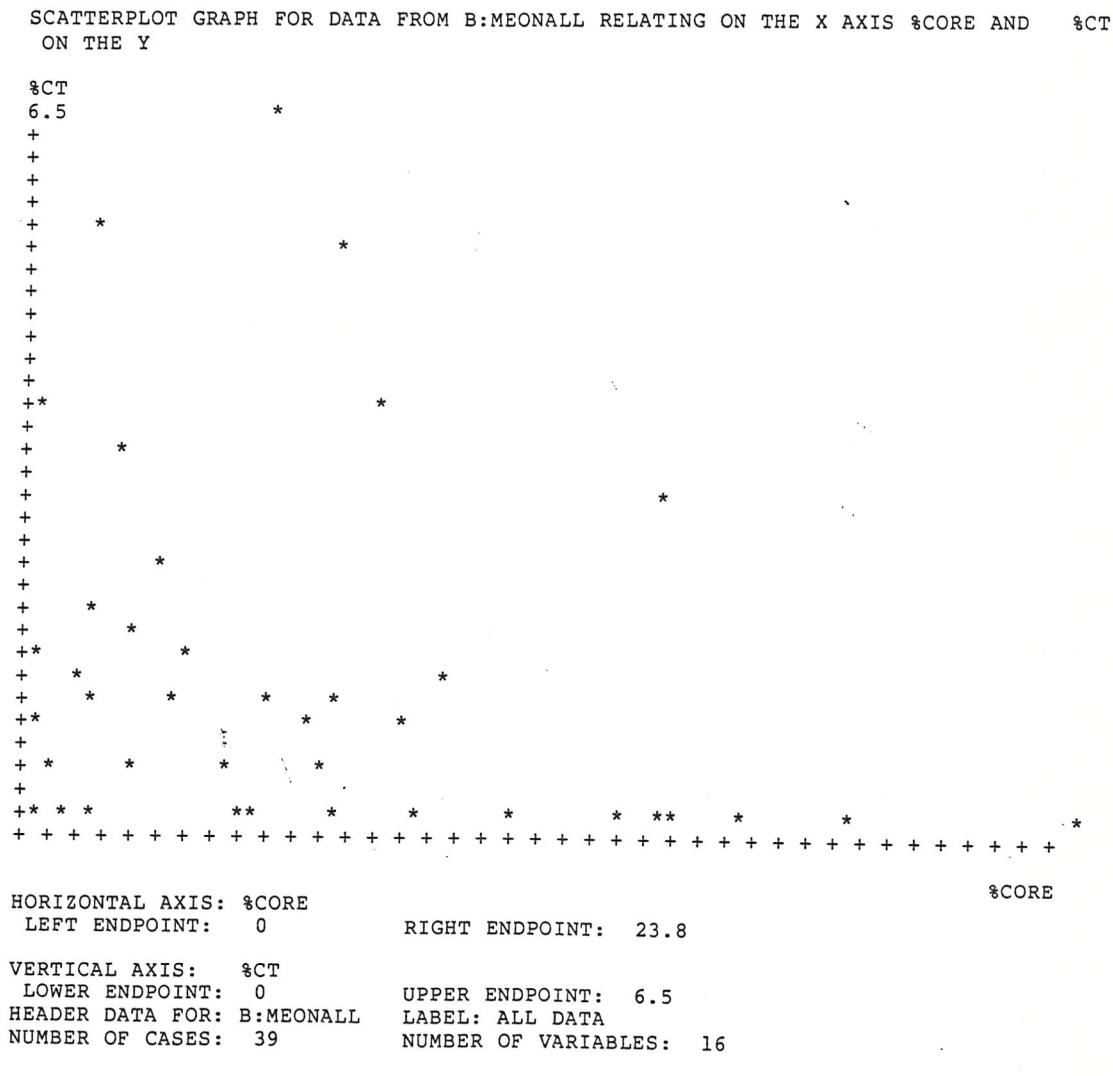

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %CORE AND %CT ON THE Y
%CT
6.5
%CORE
HORIZONTAL AXIS: %CORE
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 23.8
VERTICAL AXIS: %CT
LOWER ENDPOINT: 0
UPPER ENDPOINT: 6.5
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.50

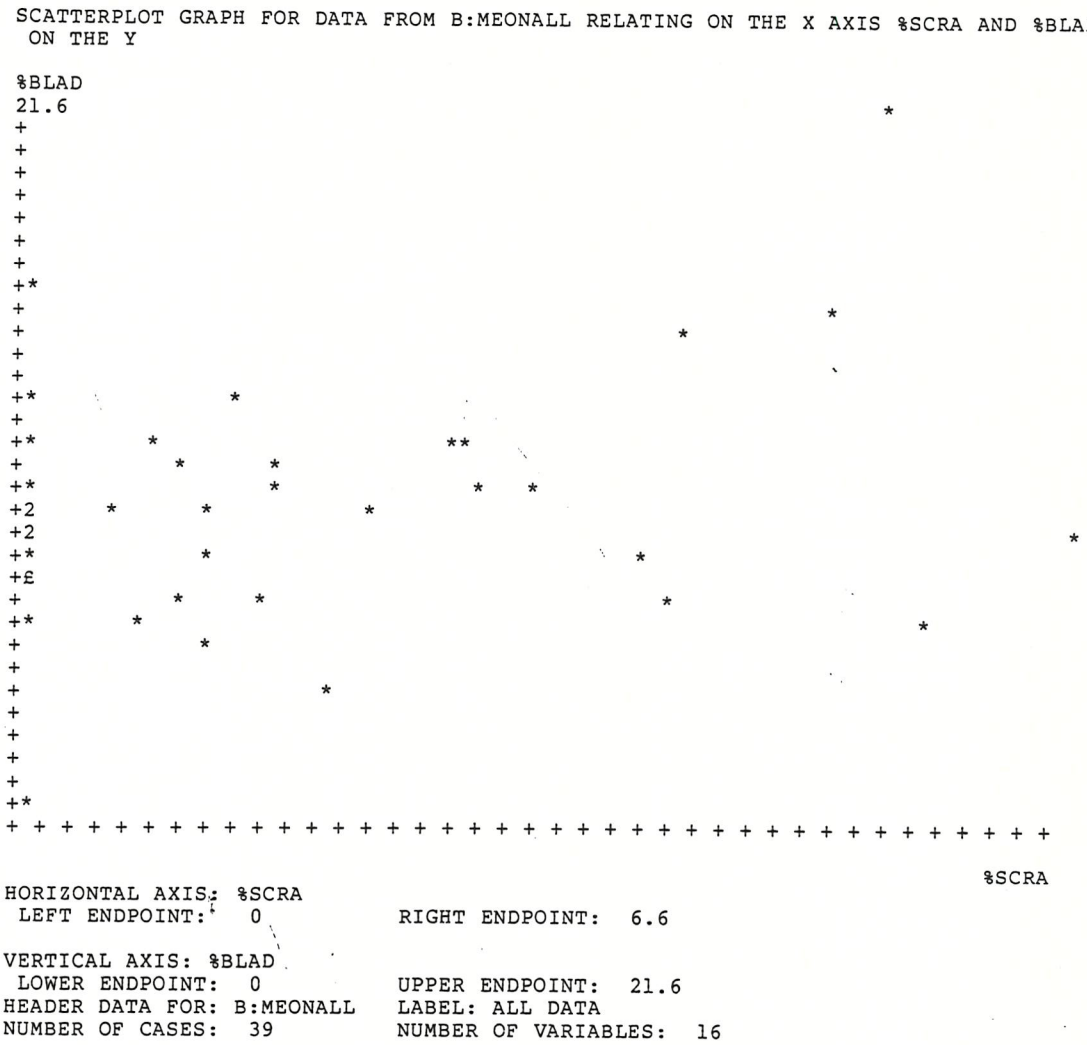
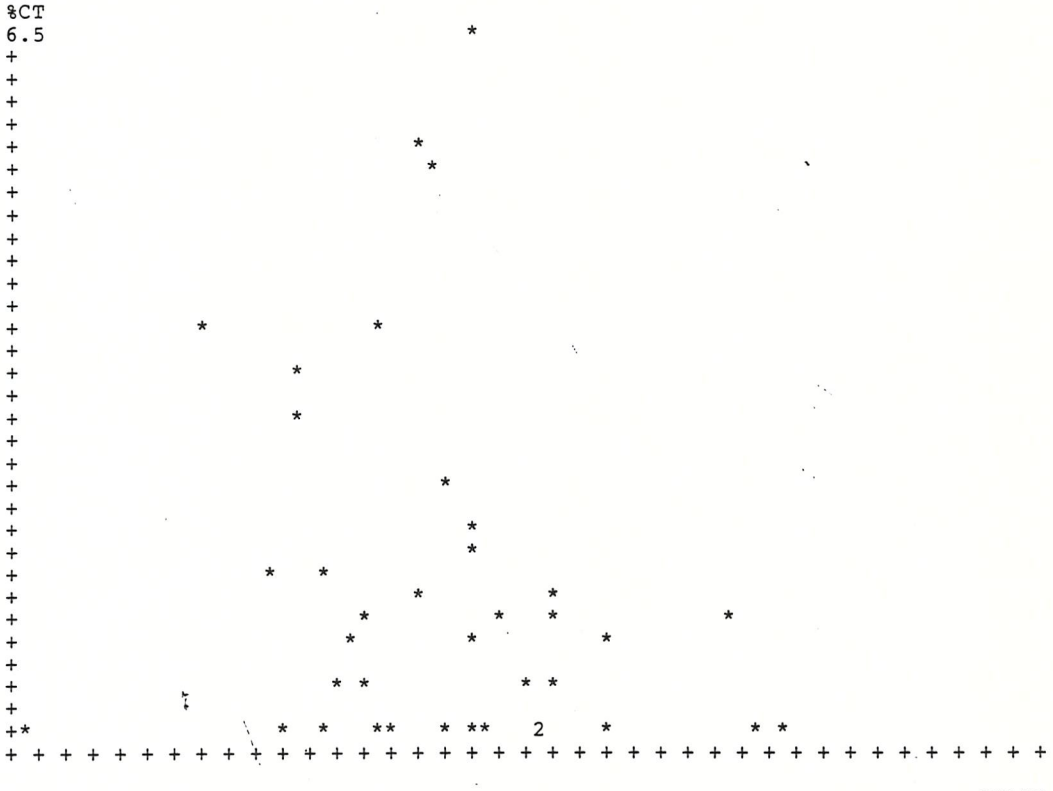

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %SCRA AND %BLAD
ON THE Y
%BLAD
21.6
%SCRA
HORIZONTAL AXIS: %SCRA
LEFT ENDPOINT: 0
RIGHT ENDPOINT: 6.6
VERTICAL AXIS: %BLAD
LOWER ENDPOINT: 0
UPPER ENDPOINT: 21.6
HEADER DATA FOR: B:MEONALL
LABEL: ALL DATA
NUMBER OF CASES: 39
NUMBER OF VARIABLES: 16

Figure 7.51

```
SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %SCRA AND   %CT
 ON THE Y

%CT
6.5                                *
+
+
+
+
+*                                                                        *
+
+
+
+
+
+
+
+*                    *
+
+         *
+
+                                                                *
+
+
+
+       *
+
+               *
+                          *
+               *   *
+2
+*                   *              *               *
+*                *                      *
+
+*           *       *             *
+
+          * * *                                  * *           *    *
+ + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + + +

                                                                        %SCRA

HORIZONTAL AXIS: %SCRA
 LEFT ENDPOINT:   0          RIGHT ENDPOINT:  6.6

VERTICAL AXIS:   %CT
 LOWER ENDPOINT:  0          UPPER ENDPOINT:  6.5
HEADER DATA FOR: B:MEONALL   LABEL: ALL DATA
NUMBER OF CASES:  39         NUMBER OF VARIABLES:  16
```

Figure 7.52

SCATTERPLOT GRAPH FOR DATA FROM B:MEONALL RELATING ON THE X AXIS %BLAD AND %CT
ON THE Y



HORIZONTAL AXIS: %BLAD
LEFT ENDPOINT: 0 RIGHT ENDPOINT: 21.6

VERTICAL AXIS: %CT
LOWER ENDPOINT: 0 UPPER ENDPOINT: 6.5
HEADER DATA FOR: B:MEONALL LABEL: ALL DATA
NUMBER OF CASES: 39 NUMBER OF VARIABLES: 16

Figure 7.53

Chapter 8

The Avon and Meon valleys compared: a question of scale?

In this chapter, evidence from the Avon and Meon valley surveys will be compared, and suggestions put forward as to the reasons for variation, both in the density and composition of lithic collections. The merit of the two models - chronological and technological - will be compared and discussed with relation to the results presented in the previous two chapters.

8.1 Variations in time

The main temporal distinction between human adaptation in the Meon and Avon valleys appears to be one between the Mesolithic/early Neolithic on the one hand, and the late Neolithic/Bronze Age periods on the other. Figure 8.1 presents the ubiquity indices for each of the two study areas and this distinction between periods is clearly apparent. The question we must therefore ask is to what extent the distinction is environmentally determined or to what extent it may be a cultural phenomenon. Certainly the physical structure of the two areas is very different. In the Avon valley the topography displays little diversity except to the extreme north and west of the survey area, the geology is largely comprised of river gravels and alluvium while the Avon itself was sufficient to act as a major food source as well as a passage for communication between north and south. The Meon on the other hand displays diverse topography in the north. In the south the upper chalk downland forms a 'naturally monotonous' upland zone. The river itself was smaller and therefore both less productive and less effective as a communication link.

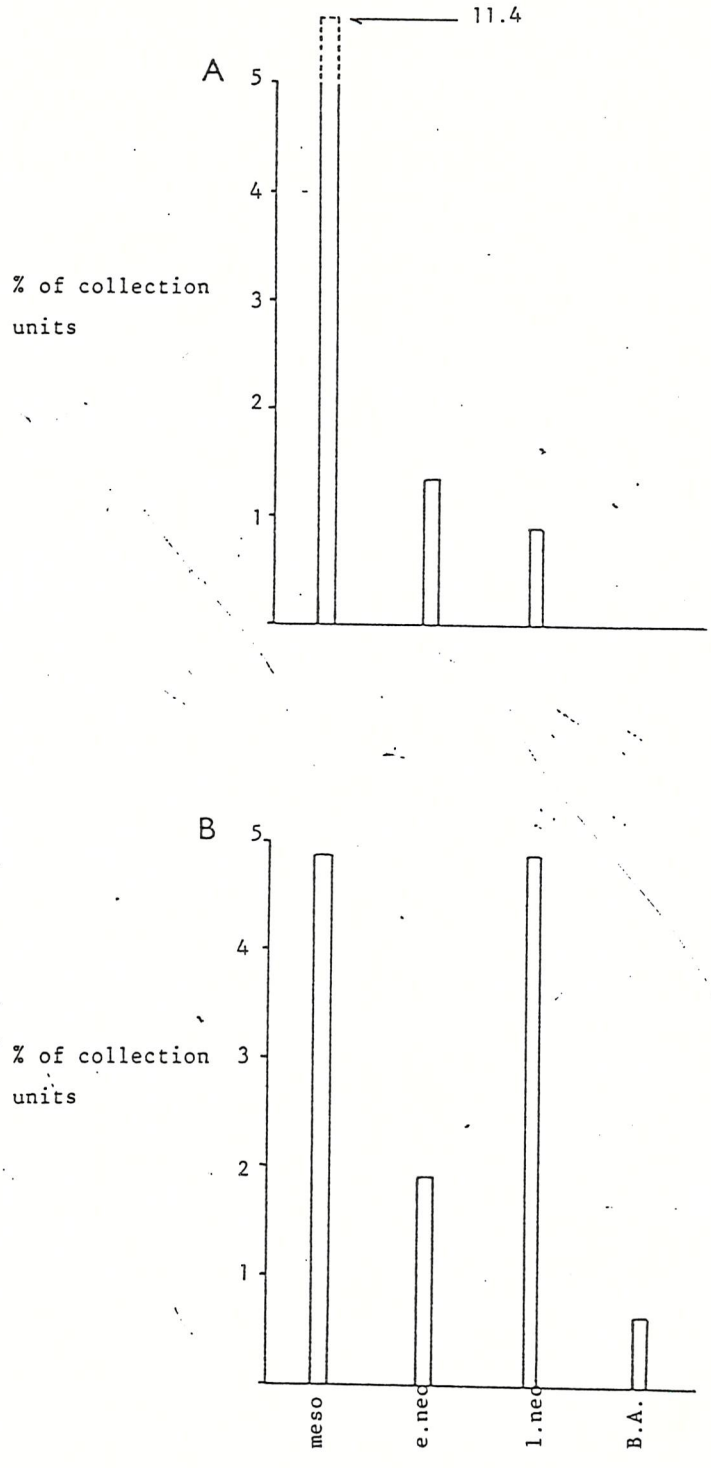


Figure 8.1: Ubiquity indices for the upper Meon (A) and middle Avon valleys (B). Figures represent %age of collection units maintaining diagnostic artefacts.

It was apparent from Chapters 6 and 7 that Mesolithic activity was predominant in areas of more diverse topography. Whether or not we are dealing with early or late Mesolithic activity is unclear and is beyond the resolution of regional surface collection strategies where diagnostic 'tool-types' are considered the only measure of cultural affinity. This was discussed in chapter 5. Myers has argued however that earlier Mesolithic hunting strategies tended to select favourable points in the landscape in order to intercept animals, while towards the beginning of the Neolithic, the hunting strategy changed in character to one organised around small task groups who were actively searching for their prey, thereby pursuing an encounter strategy (Myers 1987,145). It may be therefore, that what we are seeing in the Meon valley is evidence for an intercept hunting strategy in the form of monitoring stations, characterised by specialist assemblages in locations such as area 3 as well as Salt Hill and Old Winchester Hill. In area 1 of the Meon valley and over much of the Avon valley survey area the strategy may be one of encountering resources. Microliths appear in both cases as a scatter extending beyond the confines of the home-range on to either the upper chalk or river gravels. Such an encounter strategy - as well as the earlier intercept strategy in the Meon valley - may have been connected with winter occupation and associated with the abundance of small deer herds which would have spent the winter months in the river valleys (chapter 6). Such behaviour would appear on a small-scale although the repeated use of some locations would produce an accumulation of archaeological debris through time.

Early Neolithic activity as suggested by the ubiquity indices, is present in the Meon valley survey area but is only limited in the Avon. What this may suggest is a degree of variation in the 'favourability' attached to those two

areas by early farming communities, a variation highlighted by the distinction between early and later Neolithic activity. The later Neolithic appears to be virtually absent in the Meon valley survey area and appears with greater frequency in the Avon in the form of both excavations at Downton (Rahtz 1962) and the isolated scatter of a few later Neolithic artefact types. One explanation for this concentration may lie in the closer proximity of the Avon valley survey area to the 'complex ritual' landscape which existed in the late Neolithic of Wessex. Within 15km of the study area there appear a variety of large scale monuments, including henges, which required the input of large amounts of labour, and may be regarded as ceremonial centres for what was almost certainly a dispersed population (Shennan 1986,144).

One example of the potential importance of henge monuments to the late Neolithic communities in Wessex stems from the excavations at Durrington Walls (Wainwright and Longworth 1971) and the reanalysis by Richards and Thomas (1984). Richards and Thomas suggest that this was a particularly important site in terms of the Wessex landscape and analysis of the faunal remains suggests feasting on a large scale, an activity generally regarded as important in renewing or reinforcing social relations and obligations.

It may be no surprise therefore to find an intensity of late Neolithic activity in an area in such close proximity to the 'organised ritual' landscape of south-east Dorset and north Wiltshire. Indeed if Thomas's suggestion that the differing patterns of monument building and land-use in the two areas express the very different relations between elements of the societies which created them (1984,174), then the area of the middle Avon valley takes on renewed significance as an interface between two clearly defined polities within the core area of Wessex as a whole. It is perhaps this difference in social structure and political organisation between SE and SW Hampshire that explains the

diversity of settlement evidence between the two regions.

8.2 Variations in space

There are points of both similarity and distinction between aspects of location and distribution in the two survey areas, both of which tend to suggest a general set of locational requirements operating between the Mesolithic and Bronze Age periods. For the Mesolithic a number of points were made concerning optimal location (chapter 5). If we follow a model of site location based upon optimality criteria, then the model suggested by, for example Jochim (1976) is appropriate. In the Avon valley the projected home-range, characterised by lower density and high proportions of retouch, was located in an area displaying locally diverse topography on the valley side of a tributary stream running ESE into the Avon. All necessary resources were locally available while the distinction between microlith and blade distribution appears to suggest a division of behaviour between hunting and foraging.

In the Meon valley a similar location was exploited, again central to a variety of resource patches and within a locally diverse topography. Home-range locations were again situated on terraces to the east and west of the river. On the upper chalk further to the south, there appears a distinct contrast from the domestic activity in the north, with an apparent emphasis on extractive/industrial activity in the south. From surface collection a totally different set of artefacts were recovered. Tranchet axes and microliths appear in far greater numbers than in the north with particular concentrations appearing on hill-tops such as Salt Hill and Old Winchester Hill. Such locations may reflect the distribution of special-purpose monitoring stations used as integral parts of an intercept hunting strategy in the earlier postglacial (above).

From the ubiquity indices it was suggested that early and

later Neolithic activity was predominant in the Meon and Avon valleys respectively. Certainly there are fewer diagnostic items for the earlier period in the Avon valley. If we assume however that fields with blade frequencies of greater than 1 standard deviation above the mean combined with low density and high retouch as reflecting early Neolithic home-range locations, then a number of similarities are apparent. First that in both cases locations appear again in areas of the most diverse topography, an aspect of location which may reflect the need for natural protection, for example from prevailing winds, or that hunting was still an integral part of the subsistence economy, as suggested by Grigson (1981) and Hillman (1981). Second, that location does not appear to concentrate on one particular side of the river, aspect and direction varying enormously between individual locations. We have noted in chapter 5 that certain locations and aspects are favourable for crop growth and if this were a primary consideration then we should expect location to be uniform. Indeed the catchment in each case is so variable in topography that it must be suggested that other factors were of greater importance.

A third similarity is both behavioural and locational. In the two most clearly defined early Neolithic home-range locations, areas of localised high density and high retouch - which may suggest repeated visits in the seasonal round - are in close proximity to areas of low density and high scraper frequency. That this boundary between two types of behaviour is relatively clear-cut does suggest that 'blurring' was minimal and that locational determinants for one period were not necessarily those of another.

Indeed it is for the later Neolithic that a clear distinction between the two study areas is most apparent, the possible reasons being the subject of some discussion in the previous section. What is clear from the Avon valley is that the the river terraces took on renewed significance

at this time. Grigson (1981) and Richards and Thomas (1984) have both pointed to the important role of pig husbandry in the later Neolithic of Wessex while palaeoecological records suggest that while the chalk downs remained wooded, the valleys appeared to be undergoing regeneration. Terrace locations would have been ideal if this were the case, with small pockets of arable on the terrace and floodplain and the facility for pig husbandry in the primary woodland on the chalk. The Meon valley almost certainly provided the latter but possibly not the former. It may be for this reason as well as that described in the previous section that the Meon valley remained largely unoccupied in the later Neolithic.

Evidence for settlement in the Bronze Age tends to confirm the suggestions made by Ellison (1981), that small family-sized units were predominant, exploiting valley systems and areas of downland as part of a system of nomadic pastoralism. It may be that sites such as Westbury, and the lower density scatters at Harbridge and Warnford represent aspects of that system, possibly special purpose locations or 'grazing stops'. Both are located adjacent to the floodplain as close to the river as is possible without liability to flooding and situated on river gravels. This situation is reflected in the Kennet valley where Bradley et.al. (1980) indeed suggest that such areas were prime locations during the Bronze Age period. One contrast between the two areas which suggests that the comparison is rather more complex than first appears was discussed briefly in chapters 2 and 6. The point made by Bradley was that the coastal and heathland zones and the chalkland provided two very contrasting burial records. The Avon valley is located at the interface of the two zones while the Meon valley is firmly established within the latter. If this distinction extends to the settlement record then we should perhaps expect something richer and more substantial within the Meon valley, perhaps on a par with the 'Chilbolton treasure' discovered in the Test valley (Russel

1986). Yet it was the Avon and other 'core areas' that saw a greater intensity of activity in the later Neolithic and which first saw the emergence of individual burials in the content of grave goods, known as the 'Bell Beaker phenomenon' (Shennan 1986,145).

There is no doubt that the Deverel-Rimbury culture saw a marked concentration on the river valleys in southern England, a concentration which continued through from the Mesolithic to at least the end of the Bronze Age. This can be identified both at a macro-scale from the two survey areas and on the Kennet gravels (Bradley et.al. 1980), and at a micro-scale in the Avon valley at Downton (Rahtz 1962), where settlement shift upslope was almost certainly related to an increasing water level during the postglacial. After an apparent concentration in the Avon valley and central Wessex during the late Neolithic, settlement appears to have dispersed taking the form of a wide scatter of isolated units. It is the remnants of such a dispersal - with some clear distinctions between the chalk and coastal zones - which we are seeing in the two study areas.

8.3 Variations in form

A number of clear distinctions appear to exist between the two study areas, distinctions which may be either time- or technology-related. We should now consider which of these best explains the observed patterning in the surface distribution of artefacts.

8.3.1 Density

Table 8.1 clearly demonstrates the broad distinction between the two study areas in terms of artefact density, which it must be argued represents the accumulation of debris between the Mesolithic and Bronze Age resulting from repeated use and occupation. For the Meon valley both mean

	Meon valley		Avon valley	
	$\bar{x}$	s.d.	$\bar{x}$	s.d.
Density per hectare	26.2	25.9	18.7	12.8
%primary	8.2	3.7	13.8	7.7
%tertiary	20.7	5.7	25.7	9.1
%retouch	7.0	4.9	20.1	9.2
%cores	5.9	5.8	4.2	3.1
%blades	8.9	3.6	8.6	4.2

Table 8.1. aspects of assemblage composition: a comparison between the Avon and Meon valleys.

density and the standard deviation are high in comparison to the Avon, the latter relating to considerable internal variation between lower and upper chalk. On the upper chalk density is four-times that of the lower chalk while for the former standard deviation is half that of the mean; in the Avon valley on the other hand, both mean and standard deviation are virtually identical.

In the Avon valley the density is greater than on the lower chalk in the Meon valley but less than that of the upper chalk. What this appears to suggest is that in the Avon valley density was variable but that variation was only limited in comparison to that of the lower chalk in the Meon valley. That higher density combined with a lesser degree of variation appears to suggest a degree of continuity - whether spatial or temporal - within the valley. For the Meon no such continuity is apparent, with considerable variation between the lower and upper chalk combined with high variability within the former. Much of the density on the upper chalk is accounted for by the presence of industrial activity. Concentrating as it does on the upper chalk terrace, a clear division may be observed between the distribution of primary and tertiary waste, undoubtedly representing behavioural zones within a more general industrial domain. The sheer density, the clarity of division between these zones and the low standard deviation score in relation to the mean, all suggest that activity in this area was intensive and possibly continued over a long period of time. The occurrence of microliths, arrowheads and axes gives support to this idea of long-term use while the absence of maintenance items implies that area 1 in the Meon valley was never occupied as a home-range.

In summary therefore, a comparison between the density of areas 2 and 3 in the Meon valley and the Avon valley suggests less intensive domestic activity in the former and a greater degree of continuity in the latter. In area 1 of

the Meon valley, a predominance of industrial activity clearly generated vast quantities of waste and was utilised on a large scale at some stage during the earlier postglacial.

8.3.2 Retouch

The suggestion that the Avon valley saw a greater intensity and continuity of domestic activity throughout the earlier postglacial is reflected in the density/standard deviation figures in comparison to those on the lower chalk in the Meon valley. Indeed this contrast is further highlighted by the distinction between the two areas in the frequency of retouched artefacts and its relationship to density. In the Meon valley, mean proportions of retouch stand at 7.0% of the total collection with the negative correlation score of -0.4250 being largely the result of industrial activity concentrated in area 1. Indeed the correlation between density and scrapers (-0.0863) and between scrapers and retouch (0.4507) appear to confirm this.

In the Avon valley the proportion of retouch is virtually three-times that in the Meon valley, with a mean score of 20.5%. In this case the correlation between density and retouch of -0.2724 is less than that from the Meon valley, while that between density and scrapers (0.1322) and between scrapers and retouch (0.6624) both suggest far stronger relationships. Four main points emerge from this analysis:

1. That there is a far higher proportion of retouched artefacts in the Avon valley than in the Meon valley.

2. That there is a stronger negative correlation between density and retouched artefacts in the Meon valley.

3. That there is a stronger negative correlation between density and scrapers in the Meon valley.

4. That there is a stronger positive correlation between scrapers and retouched artefacts in the Meon valley.

The Avon valley therefore played a more important role as a domestic context through time with some emphasis towards transient, small-scale occupation of which the excavations at Downton are a case in point. The strong negative correlation between density and retouched artefacts in the Meon valley however - displaying a percentage level of explanation of 18.07% - suggests that small-scale occupation - as witnessed by excavations at Westbury (Lewis and Walker 1977) and Corhampton (Grigson and Smith 1985) - was of even greater significance. It was here after all that the ubiquity index appeared to suggest an emphasis on Mesolithic/early Neolithic activity (or at least an absence of later Neolithic and Bronze Age activity) and with a concentration of later activity concentrated in the Avon valley.

The final two points only serve to confirm those general observations and to reinforce the idea that scrapers and the frequency of retouched artefacts are more accurate indicators of domestic activity than is density.

8.3.3 Technology

Variations in technology can be divided into two broad categories: Those that are primarily behavioural and those that are related to the nature of raw material being exploited, although these are not necessarily exclusive.

As a first point it may be observed that in the Meon valley there is both a higher mean frequency and a higher standard deviation for cores than is the case for the Avon valley, while both primary and tertiary waste exhibit higher scores in the latter. Certainly the variation in core frequency from the Meon valley suggests a highly localised

distribution and is indeed the result of a broad distinction between upper and lower chalk, with far higher numbers occurring within the industrial zone to the south of the study area. Nevertheless it is surprising to find a higher proportion of waste characteristic of industrial activity in an area which saw a greater predominance of domestic home-range behaviour.

The only explanation for this dichotomy is one based on both the location of industrial activity and on the type of raw material being exploited. In the Meon valley for example, all the artefacts recovered by surface collection - both from this project and in the past (Draper 1955) - were locally derived, coming from the upper chalk to the south of the study area. Knapping appears to have taken the form of primary reduction at source (area 1) with subsequent core-reduction and discard occurring within the home-range further to the north. This is confirmed both by the high proportion of cores in areas 2 and 3, their virtual absence from area 1 and the strong positive correlation between retouch and cores (0.362 and a percentage level of explanation of 13.1%) and the negative correlation between density and cores (-0.489 and a percentage level of explanation of 23.9%).

In the Avon valley two separate core-reduction strategies appear to have been pursued. Within the Mesolithic home-range, material appears to have been obtained and reduced on-site with no import or export (Mode 1 production, after Schick 1986). In the north a very different system may well represent the temporal division, possibly between short-term activity taking whatever is available to a more logistical procurement strategy. Indeed area 1 - the projected Neolithic home-range situated on valley gravels - and area 3 - a primarily industrial area situated on upper chalk - appear to represent two parts of a single system by which cores were reduced on the upper chalk before being transferred to the home-range for further

reduction and tool manufacture (Mode 3 production, after Schick 1986). Mode 2 production is not represented in the survey area.

With individual systems operating within the study area, the clear relationships observed for the Meon valley will not be apparent. Indeed the relationship between cores and other variables demonstrated little correlation.

A final point really confirms the extent of variation within the Avon valley as well as highlighting the point already made elsewhere (Ford 1987, Schofield 1986), that the type of raw material will influence flake morphology. In the Meon valley the mean flake length and breadth vary little between the three zones, which is hardly surprising when we consider that chalk-flint was the only source being exploited. Greater variation appears to exist in the Avon valley where the distinction between large and small corresponds to that between chalk- and gravel-derived flint. In areas 1 and 3 for example, chalk-derived flint formed a larger proportion of the assemblage than elsewhere - 22.5 and 30.1% respectively - while mean flake size was greater than over the remainder of the survey area. Where flake size was at a minimum on the other hand, gravel flint made up a larger proportion of the assemblage. It must be suggested therefore that in regional surveys, technology is a vital factor in contributing to our understanding of changing land-use strategies, yet variation may occur as the result of both behavioural and geological factors. This was a point described in some detail in chapter 4.

8.4 Explaining the pattern: technology vs chronology

In chapters 4 and 5 it was suggested that while a chronological interpretation can succeed in putting 'dots-on-maps', it gives no indication of the nature or intensity of settlement and land-use. For both the Meon and Avon valleys this was certainly the case, and the following

conclusions can now be made:

1. In both case studies, areas were identified as characteristic of specific types of activity, whether domestic or industrial, and that by analogy with evidence from excavation and palaeoenvironmental studies, variations in location and the scale of activity could provide broad estimates as to the period of exploitation.

2. By examining variations in the proportion of debitage and retouched artefacts between areas, stages of the core-reduction sequence could be identified and 'matched-up' with home-range and extra home-range contexts. Again the scale of activity and the relationship between domestic and industrial provided a clue as to the period of use.

3. It became clear that certain areas were favoured throughout the prehistoric period for specific types of activity. Valleys for example were valued as home-range locations between the early post-glacial and Bronze Age periods; areas of undifferentiated downland appeared to take on the role of extra home-range, with areas of industrial activity on exposed chalkland.

4. The most significant point concerns the value of the off-site approach adopted for this thesis. A traditional chronological interpretation, based on diagnostic artefacts, would have provided none of the information concerning scale of activity and continued use of specific portions of the landscape. For the Meon valley, high density scatters combined with very few diagnostic items, would have reinforced the view of upland exploitation, while for the Avon valley, areas of extra home-range activity would have been recognised as period-specific at the expense of a clearly defined home-range, from which no diagnostic artefacts came. Although such cultural items should of course not be ignored, their value should be limited to demonstrating presence of activity during a

specific period. Anything further is making the very assumptions which this thesis has sought to dispel.

8.5 Summary: a question of scale?

In conclusion, we may suggest that human adaptation in the river valleys of southern England was not governed by a standard set of rules, establishing where, when and to what extent settlement should be located. Indeed it appears likely that the various river valleys were ranked according to their resource-potential and that that rank-order changed with time. It is argued that the Meon valley was favoured more by hunter-gatherers and early farmers than by later communities, although that does not necessarily mean that it was ranked higher than the Avon valley at this time. What is clear is that when domestic activity did become established in the Avon valley, it was to a level of continuity and intensity never reached in the Meon valley. Occupation is certainly evident in the Mesolithic and early Neolithic periods but it may be argued that the level of intensity was attained during more permanent occupation at a later date. Whether this concentration on the Avon was primarily the result of social or ecological constraints was the subject of some debate in previous sections.

Our concern should now extend to beyond the individual surveys to examine the wider implications and regional context for those statements and observations made in the previous sections. To what extent does the distinction between coarse- and fine-grained adaptation apply in the wider context of southern England? Were specific locations really arranged in rank-order according to the requirements of a particular culture?

Chapter 9

Coarse- and fine-grained adaptation between the Mesolithic and Bronze Age: towards a regional context.

> 'The concept of grain is best interpreted as a behavioural response to an environmental mosaic' (Wiens 1976,85).

> 'Habitat selection may result from individuals exercising a choice among compared alternatives...or from some external agent imposing a differential distribution of individuals among patch types upon the population' (Wiens 1976,91).

This chapter will present the data from numerous survey projects carried out in southern England over the past decade with the aim of establishing a context within which results from the two case studies may be more fully understood. The emphasis will be towards comparison and that, in most cases, will involve discussing results in similar terms to those from the Meon and Avon valley surveys. To highlight the distinction between valley and non-valley contexts, the survey results will be divided into two sections: Those from valleys which may be expected to produce evidence for a coarse-grained response, and those from non-valley contexts which may indicate fine-grained adaptation. These results may now be presented.

9.1 Coarse-grained adaptation

9.1.1 The upper Thames valley

Evidence for prehistoric activity in the upper Thames valley has been well documented in recent years (Bradley and Holgate 1984, Ford 1987) and provides a detailed picture of settlement and land-use continuity between the Mesolithic and Bronze Age periods. Indeed the suggestion by

Bradley and Holgate is one of clear contradiction between continuous activity in the Thames valley focused on a series of river terraces, and a discontinuous pattern of settlement on the chalk and limestone uplands (1984,107), for example the Berkshire Downs (Richards 1978) and Cotswolds (Marshall 1985), both of which will be discussed in section 9.2, below.

Within the Thames valley, intensive surface collection conducted around Abingdon (Holgate 1985) and North Stoke (Ford 1987), both demonstrate the clear distribution of both high and low density scatters. For the later Mesolithic, Bradley and Holgate suggest the location of three domestic sites, all situated on the edge of the first terrace adjacent to the river Thames (1984,112), similar locations to those suggested in the previous chapters. For the early Neolithic the characteristics are similar to those described above, namely small flint scatters again on the edge of gravel terraces overlooking the valley floor, again suggesting the presence of short-lived and/or shifting settlement locations.

With the later Neolithic there appears a dramatic increase in the extent of domestic activity. Locations are now characterised more by extensive flint scatters as well as an abundance of pits containing domestic refuse. Animal bones and cereal remains from Barton Court Farm for example appear to suggest a mixed farming economy with settlements permanently occupied (Miles 1978,106). In addition to - and perhaps as a result of - increased permanency of occupation, the later Neolithic also witnessed an expansion of settlement beyond the confines of the valley corridor and into areas which had previously been unoccupied. It is unlikely that purely ecological reasons would explain such a shift in emphasis and a more likely cause may have reflected the emergence of 'core areas' and 'complex ritual landscapes' which began to emerge at this time. It is therefore interesting to note that in the case of the

Thames valley, previously unoccupied areas became a focus for the construction of monuments at around the same time. A similar argument was proposed for the Avon valley and will also be discussed in the context of Cranborne Chase (below).

A detailed picture of settlement and land-use on a micro-scale is provided by Ford (1987) from two survey areas in the upper Thames valley. The first is at North Stoke and consists of an area of 6x4km located on the east side of the valley running from the Thames up to the edge of the Chilterns. The geology of the area is dominated by lower and middle chalk with an expanse of river gravels, while the topography is divided evenly between the valley and a number of hills, ridges and undulating downland. The East Berkshire survey area consists of a 4x25km transect running from the Thames in the north, crossing all the major geologies of East Berkshire - London clay, Reading beds, upper chalk - to the river Blackwater in the south. The main topographical features in this case are the narrow and steep-sided Thames valley, hill-tops, steep slopes and ridges.

What the results from both surveys appear to suggest is a pattern of changing land-use strategies with time. In both cases the Mesolithic was characterised by the exploitation of all available habitats. In East Berkshire for example, blades and blade cores appear widespread throughout the area with the concentration of blade cores on the lower chalk perhaps suggesting an emphasis on industrial activity. In the North Stoke area a similarly widespread distribution is apparent, although in this case blade cores appear to be gravel- rather than chalk-based and appear to suggest a greater emphasis on lower land than was the case in East Berkshire. That this distinction may be one between domestic and industrial is perhaps supported by the greater frequency of cutting flakes in the North Stoke area (1987,108).

In both cases the higher density of artefacts probably represents later activity, and in North Stoke these higher density scatters appear to concentrate on hill-tops relatively close to the river. The early Neolithic appears to display continuity from the later Mesolithic but in the late Neolithic there is an expansion both in the number of scatters yielding late Neolithic material, and in the areas exploited, a trend which continues throughout the Bronze Age (Ford 1987,121). In East Berkshire the major Mesolithic scatters appear on the gravel terraces adjacent to the river Loddon, and this conforms to the view already expressed, that larger 'base-camps' were located adjacent to the major rivers with other areas being exploited from smaller camps, occupied perhaps at different times of the year. Little evidence is available to suggest that East Berkshire was exploited in the early Neolithic, while in the late Neolithic and Bronze Age large parts of the survey areas - especially the Reading beds and upper chalk - were exploited, at least in part for hunting as represented by the distribution of stray arrowheads across the area.

In conclusion therefore, both areas were exploited but at varying levels of intensity (Table 9.1), for varying purposes and at different times. Certainly continuity appears to have existed in the valleys but with an expansion outwards from the later Neolithic, with a particular emphasis on upper chalk and Reading beds. The continuity and density of material certainly would appear to suggest disproportionate exploitation, and hence the presence of a coarse-grained adaptation can be argued.

9.1.2 Kennet valley

The discussion in this session is based largely on the results presented by Froom (1972) and Bradley et.al. (1980). Although both projects were concerned with specific periods, the combined results once more present a picture

Survey Project	% sampled (per field)	corrected density (100%)		
		min.	max.	mean
East Hampshire	13	0.0	544.4	61.2
Avon valley	13	3.8	475.9	144.0
Meon valley	13	0.0	851.6	201.7
Maddle farm	8	0.0	+1387.5	256.3
North Stoke	5	0.0	+500.0	?
East Berkshire	5	0.0	+187.5	?
Vale of the White Horse	8	?	?	15.6
North Cotswolds	54	-6.7	+33.3	-33.3
Cuckmere valley zone 1	6.7	?	?	610.5
Cuckmere valley zone 2	6.7	?	?	324.0
Cuckmere valley zone 5	6.7	?	?	18.0

Table 9.1: Comparable density figures from survey projects in southern England.

of continuity and the disproportionate exploitation of resource patches. This point is highlighted in the context of Froom's investigation of Mesolithic settlement along a 6km stretch of river frontage. Indeed the density of occupation may increase still further if the search were extended beyond the arable adjoining the floodplain with which Froom was primarily concerned. Beyond the distribution of findspots presented by Froom, Smith (1985,115) has attempted to investigate in more detail, the pattern of settlement as it appears within the valley as a whole. On the basis that a higher frequency of axes and microliths should represent extractive activity and that scrapers and cores may be indicative of home-range locations, a distribution map of the four artefact 'types' was presented (Figure 9.1). It is clear from the diagram that a distinction appears to exist between the 'home-range' locations concentrated in the west of the study area in a zone displaying a wide variety of niche habitats and a more diverse topography, and extra home-range activity in the east of the valley where the environmental constraints were less suited to occupation. This was a distinction also noted for the Avon and Meon valleys. Another point made in the previous chapters - that of repeated (perhaps seasonal) occupation - is also suggested by evidence from the Kennet valley. At Wawcott 1 for example (Froom 1972) the presence of Dorset chert and the suggestion that the site was probably reoccupied several times, both point to the nature of the seasonal round with the clear distinction between coastal and inland/riverine again apparent.

Froom's (1972) investigations, although primarily concerned with the Mesolithic, did also produce evidence for occupation extending well into the 4th millennium bc. Wawcott XX111 and 1 produced dates of around 3910 and 3310bc respectively, neither of which appear to relate to the end of occupation, while Wawcott 111 produced a date of 4170bc approximately half-way through the occupation episode. Indeed the general picture at this time appears to

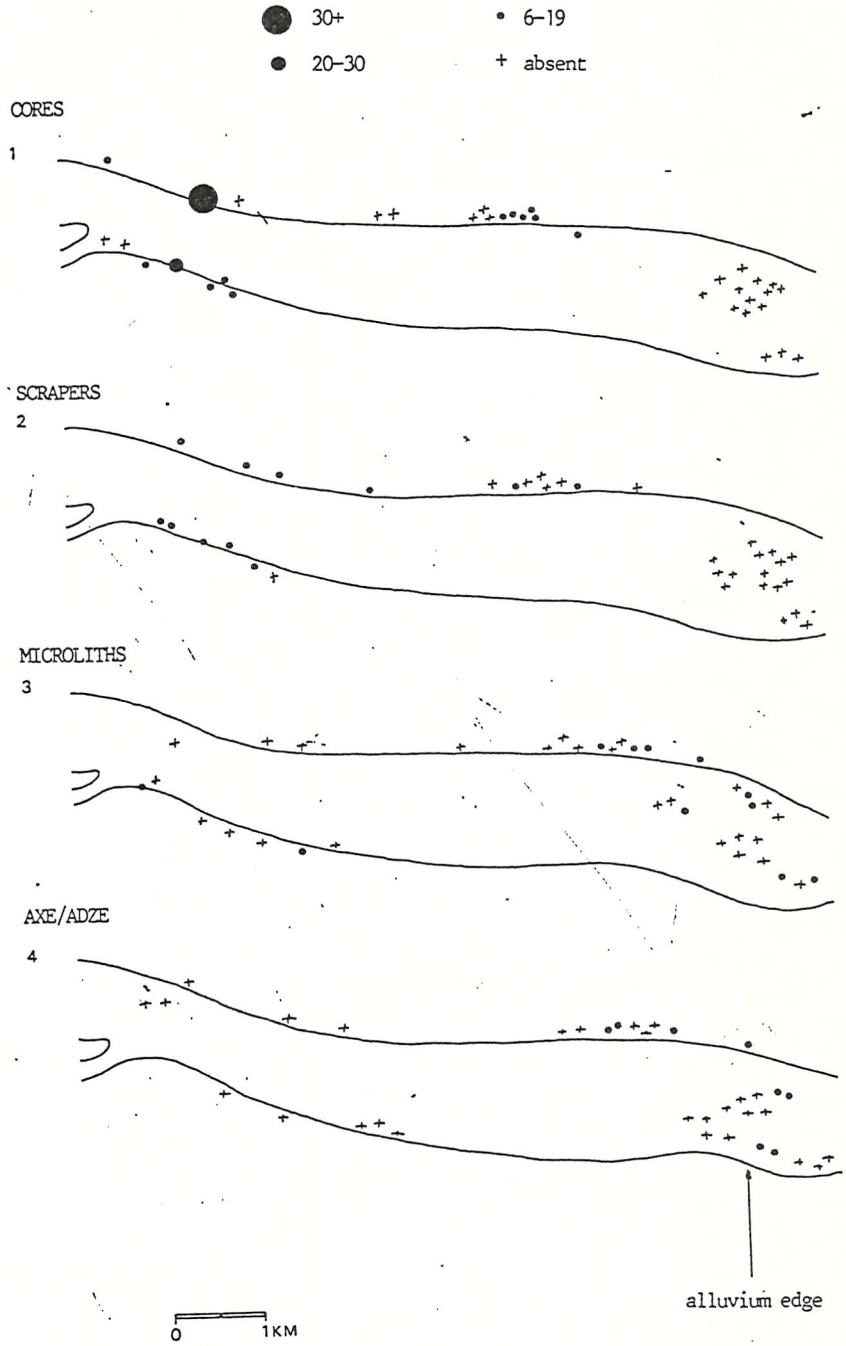


Figure 9.1: Artefact patterns in the Kennet valley, Berkshire (from Froom 1972, Wymer 1977, and after Smith 1985). Key to figures 2–4: circle – present; cross – absent.

be one of continued occupation within the valley, combined with an expansion - possibly attributable to the late Neolithic - onto the surrounding chalk downland (section 9.2, below).

For the Bronze Age the picture is again one of intensive and continuous settlement between the middle and later periods, with a particular emphasis on the valley gravels (Bradley 1980,286); indeed radiocarbon dates from Knights Farm suggest continuous occupation between the 13th and 6th century bc. In the late Bronze Age, occupation at Aldermaston overlaps with occupation at Knights Farm, Pingewood and Theale with few gaps appearing in the continuum. Locational characteristics of the various sites appear to have been determined largely by the distribution of land prone to flooding and that of poorly drained soils. Indeed all but one of the sites are in well-drained positions, lying close to areas which are either water-logged or flooded in winter. The Deverel-Rimbury sites at Brimpton and Corporation Farm both occupy raised 'promontories' above poorly drained soils, while Knights Farm and Sheffield Bottom both occupy islands which provide drier ground during the winter months (Bradley et.al. 1980,286).

Settlement in the Bronze Age therefore appears to have concentrated on specific locations within the general distribution of valley gravels. Continuity appears to have been the norm with henge enclosures yielding Beaker pottery - for example at Aldermaston Wharf, Ballast Hole and Knights Farm - lying within close proximity of 'Deverel-Rimbury farmsteads'. This degree of continuity almost certainly reflects the distribution of zones ideal for both occupation and agriculture, a distribution which clearly corresponds to the characteristics described in chapter 3 as belonging to a coarse-grained adaptation. While the relative absence of Neolithic activity may be the result of a lower ranking at this time - for example in relation to

the upper Thames and Avebury regions (below), it may equally be the result of research emphasis. This situation may be clarified by further work in the area.

9.1.3 The Avebury region

The Avebury region at the head of the Kennet valley is another which provides a complete picture of settlement and land-use, in this case concentrating on the Mesolithic and Neolithic periods (Smith 1984,1985). Indeed as Smith has observed, the work of Dimbleby and Evans (1974) has provided a wealth of information regarding both Neolithic adaptation and environmental conditions (1984,99). In chapter 3 it was suggested that on the Wiltshire chalklands - of which this area is but a part - clearance phases could be identified as early as the late Mesolithic and early Neolithic, especially at Horslip and South Street where the molluscan record appears to suggest early clearance apparently associated with arable farming. Another interesting contrast, related to the topographical distinction between valley and upland, concerns the environmental evidence from Windmill Hill, Horslip and South Street - hilltop, hillside and valley floor locations respectively. The evidence provided by faunal remains suggests a clear distinction with the predominance of sheep in lowland settings - especially at South Street and particularly in the late Neolithic - in an area apparently open from the early Neolithic, and a predominance of pig on the upland sites and particularly Windmill Hill where woodland and scrub were more common. Indeed throughout the Neolithic this upland area - with the exception of one disturbance phase associated with the construction of the causewayed enclosure - appears to have been a 'wild and marginal land resource' (Smith 1984,104).

A similar argument can be suggested for the Beckhampton Road/Hemp Knoll area. At Beckhampton Road the molluscan evidence suggests limited clearance in the middle Neolithic

with open conditions appearing towards the end of the Neolithic at Hemp Knoll. The faunal evidence suggests some concentration on wild resources while the settlement evidence from Hemp Knoll clearly demonstrates the extent of the upland/valley dichotomy. The evidence presented by Smith (1984) shows a clear continuity between the areas exploited by hunter-gatherers with evidence for woodland disturbance and those areas occupied throughout the Neolithic. Within the valley there was an intensity of settlement and land-use not repeated on the neighbouring uplands. Smiths (1984,106) suggestion that settlement units were 'small in size and closely spaced' conforms to the general picture of valley adaptation in southern England (Schofield 1987 and chapter 5) as does the lack of any significant breaks in their occupational history. If the evidence from Hemp Knoll (Robertson Mackay 1980) is typical of upland settlement, then the suggestion that these may represent 'special purpose locations' or 'grazing stops' cannot be ruled out. At Hemp Knoll, Robertson Mackay identified five oval pits which yielded varying quantities of early Neolithic pottery, struck flint, animal bones and hazel nuts all of which appeared to suggest a mixed economy. The hazel nuts did not necessarily indicate autumn occupation as they had apparently been stored for some time (1980,136). The flint and pottery assemblages vary enormously between the pits and there is no evidence to suggest that all five were occupied at once. The suggestion could be therefore that this represents successive seasonal visits or repeated visits to some special-purpose location outside the home-range which was centred on the Avebury/upper Kennet region.

In terms of a reconstruction therefore, Smith (1984) makes a number of points which are worth considering in the light of the home-range model described in chapter 5. For the Mesolithic there was a concentration of activity associated, at least in the valley, with some degree of local clearance. This valley concentration continued into

the early Neolithic with Mesolithic occupation debris never appearing more than 200m away from known foci of early farming activity. Indeed as Smith points out, if permanent clearings had already been created it is logical that early farmers would exploit them (1984,113). The early Neolithic sees a marked diversity both in terms of environmental conditions and in the organisation of land-use strategies. What is clearly apparent however is that the majority of both settlement and subsistence activity fell upon the valley corridor. At South Street for example we may envisage an area comprising numerous small parcels of land each experiencing alternate episodes of arable and long fallow tied to the maintenance of a balanced stock population.

Snail and pollen evidence suggest that during the middle Neolithic there was a continued, yet still uneven opening up of the region. Small clearings, peripheral to the valley corridor were opened up, possibly to increase pastoral resources although some were used for arable for the first time. Within the valley corridor itself there are signs of regeneration, for example at South Street and Horslip, while Avebury and Silbury were opened up for the first time and saw some cultivation. This 'opening up' continued into the late Neolithic; indeed late Neolithic pollen sequences indicate a paucity of woodland especially in the valley. A final point concerning the late Neolithic relates to the social background of these developments and may be particularly significant in relation to other valley systems in Wessex at this time. As Smith suggests, 'the late Neolithic was undeniably a time of dramatic social development. That the economy was able to support it is ample testimony to the success of economic adaptation to what was manifestly a difficult farming environment' (1984,118).

The main point regarding the upper Kennet in the Bronze Age concerns the way in which settlement and subsistence were

'revitalised' following the mid to late Neolithic recession, a process which Smith believes was connected with the late Neolithic phase of monument construction which appears to commence with Silbury at around 2200bc. Revitalisation is manifested in the palaeoecological record in terms of selective reclamation, working upwards and outwards from the valley corridor. Smith notes for example how ard marks associated with Beaker scrub clearance at South Street overlie and are similarly oriented to those of early Neolithic date, 'as if the old valley field layout remained both intact and viable' (Smith 1985,213), while a degree of continuity is also suggested by the tendency for Beaker barrows to overlie early Neolithic occupation sites, for example at Hemp Knoll.

In the Avebury region therefore, there appears to be a clear distinction between on the one hand valley and upland settlement and land-use strategies, and on the other between the nature and intensity of land-use through time. The distinction between what was happening in the valley and at Beckhampton Road, Windmill Hill and Hemp Knoll can be understood clearly in terms of both the coarse-grained/fine-grained dichotomy and between the home-range/extra home-range environments. In the valley there are few gaps in the occupational history while in the upland zone settlement is distinctly intermittent. This is supported by the evidence from surface collection. Holgate (1987,260) suggests a continuous low density scatter of flint all around Avebury, although a distinct fall-off does appear to exist above the first river terrace. This situation is analogous to that occurring in the Thames and middle Kennet valleys with the added dimension of social/'ritual' complexity emerging in the middle Neolithic and coming to a head in the late Neolithic. It may be more accurate therefore to distinguish between two types of coarse-grained response, one that is governed by the distribution of resource patches and the other determined by social formation and the emergence of 'core areas' in

the landscape as a whole.

9.1.4 The Ouse and Cuckmere valleys

The Ouse and especially the Cuckmere valley in Sussex provides a pattern of adaptation totally in conflict to that of the previous sections. Rather than a correlation between archaeological and palaeoenvironmental evidence - such as was the case in the Avebury region - the evidence from this region appears to conflict. In chapter 3 it was suggested that in the Ouse and Cuckmere valleys, the evidence pointed to valley side forest clearance, perhaps as early as the later Mesolithic (Scaife and Burrin 1983). At Chiddingly in the upper Cuckmere valley (Scaife and Burrin 1985), the base of a pollen sample provides evidence for agricultural activity in the form of clearance and cereal pollen grains with valley sedimentation inland developing as a consequence of human activity.

This therefore fits the proposed 'valley adaptation' model with a distinct contrast between what was taking place in the valleys and on the downs. Thorley (1981) for example suggested that the South Downs in the Lewes area were still wooded in the Neolithic with primary clearance not occurring until the middle Bronze Age. Drewett (1978) on the other hand produced evidence for local clearance from Neolithic sites at Alfriston in the Cuckmere valley catchment and at Offham and Bishopstone in the Ouse.

It is surprising therefore to find that the results of surface collection in the Cuckmere valley (Garwood 1985), while confirming a concentration on the river valley suggest an emphasis, not inland where the wider floodplain and lower terraces were apparently cleared of primary woodland in the late Mesolithic/early Neolithic, but on the coastal strip where the corrected density figure is 20x that where clearance activity is registered (Table 9.1). It is worth therefore considering the results of the Cuckmere

valley survey in more detail to establish whether this dichotomy can be explained by either cultural or functional variables.

Regarding overall density, one major trend is immediately apparent and that concerns the decreasing density of flint per hectare with distance from the coast. The highest density appears in that zone adjacent to the coast and on an area of chalk downland flanking Cuckmere Haven. It may be suggested that, as in the Meon valley, much of this density is accounted for by intensive industrial activity although this is a question not raised by the survey report. High density also occurs on the chalk 4km inland and may be for much the same reason, although in both areas scatters of late Neolithic/early Bronze Age date situated on the floodplain and low on slopes may represent domestic activity.

A particularly interesting pattern appears to emerge once beyond the chalk. Density is considerably lower and the emphasis is towards Mesolithic rather than later flintwork, located in various zones with a concentration on land slightly above the floodplain. The highest density of flint in the three inland zones - almost all of which is recorded as Mesolithic (Garwood 1985,63-4) - appears in similar settings to those Mesolithic concentrations observed in the Meon, Avon and Kennet valleys, central to the widest variety of resource patches. The geology is a mixture of Weald clay, alluvium, gault clay and lower greensand with chalk only 1-2km distant and the coast about 8km distant. One particular concentration which may tentatively be assigned home-range status is situated on top of a rise above the Cuckmere floodplain adjacent to lower greensand. In areas 4 and 5 further inland, density is remarkably low but those scatters which were located were all apparently Mesolithic and again situated in areas of the most diverse topography, often adjacent to tributary streams.

The distinction described by Garwood (1985) is therefore apparently a temporal one with limited Mesolithic activity in the area which Scaife and Burrin (1983,1985) suggest was the subject of early clearance and more intensive Neolithic/Bronze Age activity in the south. Garwoods (1985,Figs. 3-8) distribution maps also appear to suggest a tendency towards upland settings with time. In the Mesolithic, settlement was apparently concentrated in the valley corridor while Neolithic/Bronze Age activity further south was spread widely across the valley profile, although the distinction between domestic and industrial is not clear from the report.

What is most clearly apparent is the extent of upland shift in the later Neolithic and Bronze Age periods. Excavations at both Itford Hill and Black Patch (Drewett 1982a) in the Ouse/Cuckmere catchment demonstrate clearly the nature of adaptation in that period. Drewett (1982a,397) noted that from Black Patch and other similar settlements in the region it would be possible to utilise all required resources on a daily basis although a 'seasonal calendar of activities' was perhaps more likely. As was suggested in a previous chapter however, this expansion onto the chalk and a tendency to exploit upland settings did not necessitate the abandonment of valley ecosystems. As Drewett points out, the location of middle Bronze Age settlements at Selmeston on the greensand, Cross in Hand in a river valley and Kingston Buci on the coastal plain, clearly suggests that all ecosystems were utilised (1982a,399).

In the Cuckmere valley therefore, while a coarse-grained adaptation may once again be argued, there appears some conflict in the evidence provided by archaeology and palaeoecology. The high density on the chalk may be largely the result of intensive industrial activity while the lower densities inland suggest that the Cuckmere maintained a relatively low rank on the favourability scale.

9.2 Fine-grained adaptation

9.2.1 Cranborne Chase

The evidence from the chalk uplands of Cranborne Chase appear at first to conform to the distinction between intensive/continuous occupation occurring in the valleys and a later expansion onto the chalklands at a later Neolithic or even Bronze Age date. Bradley et.al. (1984) have suggested first, that leaf arrowheads appear to concentrate both on areas of clay-with-flint and on upper chalk near the Dorset cursus, and second that these provide virtually the only evidence for domestic activity within the region. It has been suggested (for example by Healy 1983) that early Neolithic material may be masked in the ploughsoil by the sheer quantity of later artefacts, although if this were the case it contrasts with high quantities of early Neolithic flintwork both on the Sussex Downs and in the Hampshire Basin. The alternative to Healy's argument is that both Mesolithic and early Neolithic domestic activity - with the exception of clay-with-flints - was light in the area of Cranborne Chase, at least away from the low lying and sheltered valley and tributary streams. This displays a marked contrast with the evidence for non-domestic activity; indeed the density and variety of field monuments in this area of Wessex is quite substantial. This situation is therefore the direct opposite to that which appears, not only in the middle Avon valley (above), but also in the Stour valley where early clearance episodes and the presence of early Neolithic domestic activity at Pamphill suggest a home-range context. The distribution of both monuments and arrowheads combined with the absence of domestic activity appears to conform to what was described in chapter 5 as the extra home-range - at least for the early Neolithic - and again confirms the concentration of settlement in the valleys at this early stage.

The later Neolithic in contrast is marked by an abundance of surface finds which appear to concentrate in two specific areas approximately 4km apart: One on high ground and in an area of clay-with-flint, and the other in the vicinity of the Dorset cursus. In the former, artefact scatters are dense displaying a wide range of implement types, while in the latter, scatters contain fewer items and a smaller range of implements. It may be argued that the latter are characteristic - in size at least - of specialist work camps while the former may represent more intensively occupied industrial locations where a specific range of tool types were manufactured and utilised. This is confirmed both by the larger size of artefacts and their suitability for extracting nodules from an area where flint is naturally outcropping (Bradley et.al. 1984).

Whatever the function of the various zones of activity, that they were distinct is clearly apparent. The most important point in the light of the survey results presented here however, is that the area saw an increase in activity at the beginning of the later Neolithic. That its importance did not increase at the expense of the Avon valley is not surprising as we are dealing with expansion rather than shift, and also because this region as a whole was taking on renewed significance as either the centre or periphery of a 'core area' in which monument construction occurred on a massive scale.

That settlement continued into the Bronze Age is clearly illustrated by numerous excavations (for example at South Lodge Camp, Martin Down) while the suggestion that they were largely self-sufficient and small-scale communities is suggested by Barrett et.al. (1978) and was the subject of some discussion in chapter 6. We may suggest therefore that although exploitation was continuous, the nature and intensity of that exploitation was subject to considerable variation.

The notion of a fine-grained adaptation therefore appears relevant but only for the Mesolithic, early Neolithic and Bronze Age periods. The massive investment in monument construction and the emergence of core areas in the landscape appears to produce a variable which clearly distorts what was primarily intended as an ecological measure of variation. This distinction was not clearly apparent in the Avebury region where both social and environmental constraints tended to produce a similar distribution.

9.2.2 East Hampshire

Like the Avon and Meon valley surveys, the East Hampshire survey (Shennan 1985) was concentrated in an area away from the 'monument zones' characteristic of many parts of Wessex. Although density variation between individual zones was not presented, an overall density figure of 7.95 flints per hectare (corrected to 61.2) provides a striking contrast to the density of artefacts in both the Avon, Meon and lower Cuckmere valleys (Table 9.1).

For the Mesolithic the pattern is one of dispersal rather than concentration, with sites occurring widely on the Downs and especially on clay-with-flint on or close to the plateau edge. This contrasts with the dense accumulations of Mesolithic flintwork on the adjacent lower greensand - for example at Oakhanger Vll - raising the possibility of such areas being characteristic home-range locations in this part of Hampshire. The concentration of extra home-range activity on clay-with-flint is a trend also noted on Bullock Down, East Sussex (Drewett 1982b,42). Indeed Drewett suggests that this may reflect the water retentive properties of this deposit while another suggestion may be an emphasis on industrial activity, with the primary reduction of nodules occurring prior to removal elsewhere. Primary knapping would certainly produce sufficient quantities of waste for this to be the case.

The pattern of Neolithic activity displays a far greater degree of spatial variation. In some areas for example there are smaller quantities of flint while a clear behavioural distinction appears to exist between east and west. In the east of the survey area a series of tributary streams running west to east have produced variable densities of worked flint yet a virtual absence of both axes and arrowheads. In the west on the other hand, an area of downland devoid of surface water produced a widespread scatter of both axes, arrowheads and burial monuments, all characteristic of the extra home-range. Regarding location, clays appear to display a negative correlation with flint density while fields maintaining a south-facing aspect appear to have higher densities of flint. Both points agree, at least in part, with results from both the Avon and Meon valley surveys.

Perhaps the most significant contrast between the survey results from East Hampshire and those from the Avon and Meon valleys, concerns the correlation noted by Gardiner and Shennan (1985,57) between density and retouch. For the Avon and Meon valleys the relationship was both negative and slight while in the East Hampshire survey it appears both positive and strong, the total number of lithic pieces accounting for 36.3% of variation in the number of retouched pieces per field. Negative residuals appear to concentrate in the east of the survey area at the edge of the clay with flint and in an area which was primarily industrial and on an area of greensand where some other form of 'non-base camp activity' is suggested (1985,58). Positive residuals (ie where retouched items appear in high frequency) also display an interesting distribution, in this case with a tendency towards clustering. While not situated in the river valleys, all cases are close to the main scarp running north-south through the survey area. Some are situated on the ridge top while others appear both in the valley and on the sides of dry valleys.

The pattern is therefore different to that observed in south coast river valleys. There is no marked tendency towards continuity or coarse-grained adaptation within a particular area. Mesolithic activity was apparently dispersed with a marked contraction of settlement appearing into the Neolithic and Bronze Age periods. The only area to display any degree of concentration was the clay-with-flint and the larger flake size and greater proportions of cortical waste suggest that this was primarily for industrial reasons. It may be argued therefore that in the East Hampshire survey area we are seeing the signature of a distinctly fine-grained adaptation with both lower density and the absence of land-use continuity pointing to a clear distinction between settlement here and in adjacent valley contexts. It is important to note however that while a fine-grained adaptation can be argued for the area as a whole, variation does appear to exist within it with an apparent distinction between east and west.

9.2.3 The northern Cotswolds

Although the limestone uplands of the northern Cotswolds have produced evidence for settlement from at least the early Neolithic, the overall nature and extent of that settlement prior to intensive survey, was based largely upon excavations at major prehistoric monuments such as Crickley Hill (Dixon 1981) and on the distributional characteristics of burial monuments. With the fertile soils of the limestone region it may be suggested that although an upland area and characteristic of fine-grained adaptation, that distinction may be rather too simplistic. Intensive field survey provided an answer to that question (Marshall 1985).

From the archaeological record prior to the survey, a clear correlation appeared to exist between funerary monuments of the Neolithic and Bronze Age and upland limestone soils of

the inferior and great Oolite series. It was suggested that if fertile soils were a primary location factor, then settlement would display a similar concentration. The alternative view would regard the two types of activity as 'mutually exclusive' with burial monuments sited away from settlement areas on the assumption that such areas were marginal to agriculture or occupation, whether for economic or other reasons. Certainly the pattern is one of continuity whichever explanation is the case. Similar proportions in the various zones suggest that the same forces may have been operating on settlement during the Neolithic and Bronze Age periods (Marshall 1985,26).

The first and perhaps most significant point to note concerns the density of flint across the study area. The corrected maximum density figure is recorded as being >33.3 per hectare while the minimum is <6.6. This is particularly low in comparison with other study areas with a mean score of perhaps only 10 per hectare (Marshall 1985,31). A comparison with East Hampshire shows once again a general correlation between density and retouch in those areas most suited to occupation. Marshall suggests that denser scatters on spurs - areas where settlement might be expected - repeatedly produced high quantities of retouched items, while 'peripheral' scatters on hillslopes showed low values for the proportion of retouch.

In the more specific survey area of the northern Cotswolds, situated between the river Isbourne and the Cotswold scarp, a similar set of relationships appear to exist. The headwater stream valleys of the Isbourne, Windrush and Coln for example, are ringed by a number of potential settlements occupying many of the fertile inferior Oolite spurs. On higher ground far fewer high density scatters were located, even in cases where 'topographically-suitable' spurs exist. The reason is probably connected with water supply as the adjacent spring-line is far less productive than that on lower ground.

Unlike the East Hampshire area, scatters with higher density and larger proportions of retouch are not clustered but display a distinct uniformity, spaced at regular intervals of 1.5 to 2.0km and may, as Marshall suggests, represent more than an environmentally-imposed regularity such as may result from the natural spacing of spurs suitable for settlement. One point of interest, particularly in the context of the home-range model, is the tendency for such occupation-type scatters to be centred on a wider distribution of low density/special purpose scatters. The valley area of the Isbourne/Coln watershed for example may well have formed a single focus for activities around it.

In summary therefore, Neolithic and Bronze Age settlement appears in the Cotswold area to be spur-based with the neighbouring uplands, as in the East Hampshire area exploited extensively and for both industrial purposes and for the construction of funerary monuments. This corresponds also to the situation in the Avon valley/Cranborne Chase and Kennet valley/Berkshire Downs areas where distinctions can be made between coarse- and fine-grained adaptation. The most significant distinction is in terms of density. Both here and in East Hampshire the density is lower overall than in adjacent valley systems, although if density scores were available from individual contexts, variation within the survey areas between tributary and upland settings would probably be equally marked.

9.2.4 Maddle Farm and the Vale of the White Horse

The results of archaeological investigations in the area of the Lambourn valley (Bradley and Ellison 1975, Richards 1978 and below), the area of chalk upland around Maddle Farm and in the Vale of the White Horse (Tingle 1987) again provides a complete picture of prehistoric activity in the

region, highlighting specifically a significant contrast between the nature and intensity of activity between the chalk uplands and the Vale. Topographically the region is diverse reaching heights in excess of 200m on the chalk and with seasonal streams running south-east in the Lambourn valley and north into the Vale of the White Horse.

From the chalkland survey it was apparent that the entire area was covered with flint debitage, denser patches tending to occur on upper slopes and hilltops between dry valleys. The suggestion that this may simply reflect differential visibility was rejected by test-pitting which revealed 'no significant development of colluvium' (Tingle 1987,92). The distribution of implements scattered widely across the area, apparently without regard for high density hilltop scatters - although implements do appear in these contexts - conflicts with the distribution of cores which, in association with high density scatters, does suggest the presence of industrial activity. That this activity was primary and that nodules or primary flakes were taken elsewhere for further reduction is suggested by the distribution of hammerstones which appear away from major concentrations, perhaps indicating the location of secondary and tertiary reduction.

A distinction appears to exist between this apparently industrial focus on the chalk and prehistoric activity in the Vale of the White Horse. Density is significantly different as might be expected between zones of industrial waste and that derived from other types of activity (Torrence 1986). The average density of flakes in the Vale survey area was 15.6 per hectare (corrected density) compared with a corrected density of 256.3 per hectare on the Downs. Although the density of implements was similar from the two areas - and hence a greater proportion in the Vale - worn and broken tools were twice as common in the latter. This may relate back to the 'ASDA Factor' described in chapter 4 and the suggestion that tools were more likely

to be reused and curated with distance from source.

Another distinction between the Vale and the chalk upland concerns the relative proportions of artefact types characteristic of particular behavioural domains. Bradley and Ellison (1975,175) for example noted a clear dichotomy between the frequency of various arrowhead types in the two regions. In the Vale of the White Horse for example, arrowhead frequency is low with the sole exception of barbed and tanged arrowheads which exceed the number found on adjacent chalk downlands. Leaf arrowheads on the other hand display a tendency analogous to that noted for both Cranborne Chase and the East Hampshire regions, with a strong tendency towards upland locations. While museum collections such as those used by Bradley and Ellison (1975) are often unrepresentative of spatial distributions, they do in this case provide an accurate sample of diagnostic items. The proportion of arrowheads from the Downs is similar to the results obtained through fieldwalking while a total of only four leaf arrowheads were recovered from the 420 hectares sampled in the Vale of the White Horse.

Clearly this is characteristic of an extra home-range territory. Activity on the chalk produced vast quantities of waste, most of which is undoubtedly the result of intensive industrial activity. The area was also used as a general hunting territory through from the Neolithic with a shift in emphasis - either cultural or functional - to the Vale of the White Horse at some stage during the Bronze Age. This is clearly indicative of fine-grained adaptation with a distinct contrast between the nature of activity here and in the major valley systems.

9.2.5 Bullock Down

The area of Bullock Down is another which has been the subject of intensive surface collection in recent years

(Drewett 1982b). The geology of the area is dominated by chalk downland although close proximity to the cliffs at Beachy Head may suggest a tendency towards special-purpose activities and particularly those connected with the procurement of flint, both from cliff and clay-with-flint deposits.

For the Mesolithic, the majority of casual finds made prior to intensive survey are of axes while the results of surface collection produced only small quantities of chipped stone artefacts attributable to the period. Much of the collection was manufactured from Bull Head Bed flint which distinguished it from Neolithic material, all of which was apparently derived from other sources (Drewett 1982b,42). As is often the case, much of the Mesolithic material was located on clay-with-flint while a concentration of axes at Beachy Head may indicate an area either of axe manufacture or - perhaps more likely - of axe use. Whichever the case, the pattern which emerges is one of extractive activity and a total absence of anything suggestive of habitation. This contrasts with evidence from the Cuckmere valley, 7km to the east (above), where both archaeological and palaeoenvironmental evidence suggest limited home-range activity involving the localised clearance of primary woodland in the valley corridor.

For the Neolithic, three major concentrations of activity were identified. The first - known as Belle Tout - consisted of an earlier Neolithic flint and pottery assemblage situated on the 200m contour and adjacent to the cliff line. Items which provide clues as to the function of the site include picks, interpreted as quarrying tools (Bradley 1982,64), and the high proportion (75%) of unfinished or broken arrowheads. The suggestion that this early phase at Belle Tout represents a quarrying or manufacturing area is therefore particularly convincing. Settlement area B also appears to suggest an industrial function (Drewett 1982b,45), while the major concentration

of area C produced large quantities of material concentrated on the 175m contour and at the top of a scarp slope. Flint working in this area produced densities of between 0 and 160 flakes per 30m square (a corrected maximum of 5,328 per hectare). In one field, reproduced in detail by Drewett (1982b, Fig.11), a clear behavioural distinction can be observed between separate phases of the core-reduction sequence, similar to those identified in fields in the Meon valley. A distinction is apparent for example between flakes with cortex and those without, while the distribution of cores and hammerstones is similar to that of non-cortical flakes. This tends to agree with the core-reduction model proposed for the industrial zone in the Meon valley. Flint was being extracted and reduced to 'manageable lumps' in one area, with secondary and tertiary reduction adjacent but separate in another.

This extensive use in the Neolithic, primarily it would seem for industrial purposes, continued into the second millennium with dense settlement and activity occurring in the Beaker period, for example in dry valleys at Belle Tout and Kiln Combe. That the area was also utilised as an extractive zone is suggested by the location of both burial monuments and barbed and tanged arrowheads which suggest the continued exploitation of hunting grounds. In the later Bronze Age the area appears to have been abandoned. Both Belle Tout and Kiln Combe were deserted by 1500bc; only one sherd of middle Bronze Age pottery was found during the entire survey while the Beachy Head promontory appears as a blank in the distribution of bronze in the Sussex coastal zone (Drewett 1982b,71).

The area was therefore a focus of industrial activity up until the Beaker period, during which a phase of occupation persisted followed by abandonment in the later Bronze Age. The picture is described by Drewett (1982b,208) as one of, 'intermittent activity with low population density'. This is once more a characteristic of fine-grained adaptation

and contrasts clearly with the nature of activity in river valleys, and inparticular the Ouse and Cuckmere.

9.2.6 Stonehenge environs

The Stonehenge environs is readily acknowledged as one of the more important prehistoric landscapes of northern Europe, with a density and variety of monuments unique to the area. Surface collection in recent years has added further detail to this picture of intensity and continuity with evidence for changing patterns of settlement and land-use throughout the Neolithic and early Bronze Age periods (Richards 1984,1985).

The area is one of gentle topography situated on upper chalk downland with the only distinct break being a major dry valley system orientated on a general north-south axis; the type of environment in other words where we may expect to see a tendency towards fine-grained adaptation. As was the case on Cranborne Chase however, this distinction may be far from straightforward and once again it seems that factors other than the environment may have a bearing on the nature and intensity of human behaviour.

For the early Neolithic the picture is one of communal activity and the dispersed distribution of social groups across the landscape. Communal activity is reflected both in the construction of enclosures at Robin Hoods Ball and possibly phase 1 at Stonehenge while long barrows and cursus monuments add to the general picture of density and diversity. Evidence for domestic activity suggests short-term and dispersed occupation by small groups with an emphasis apparently on Wilsford Down. This is reflected largely in the frequent occurrence of early pottery from beneath barrows in the area, while the suggestion made by Richards is that this concentration may well have been for industrial purposes rather than for habitation (1984,180).

This tendency towards industrial activity appears to have continued into the late Neolithic with a shift away from the early foci such as Stonehenge, where palaeoenvironmental evidence suggests a regeneration of scrub, and the emergence of Durrington Walls as a focus of activity. Surface collection suggests areas of extensive activity in this phase especially on the King Barrow Ridge, where a number of discrete domestic zones were identified. Apparently separated from this by Stonehenge Bottom - from which few surface finds were recovered - was the industrial area on Wilsford Down which continued in use throughout the Neolithic. The suggestion that the two areas were interdependent (Richards 1984) is a possibility with the Durrington zone relying largely on the control of 'ritual' (Richards and Thomas 1984), and that of Wilsford on the control of raw material.

With the Beaker period the picture is similar to that from other areas of downland in southern England. With the emphasis on the individual and prestige goods (Shennan 1986), it is no surprise that the main focus of attention was burial. The period saw renewed interest in Stonehenge as well as the emergence of major bowl barrow cemeteries. No surface indications of settlement were recovered.

Although evidence for domestic activity was forthcoming in the region, especially in the area of King Barrow Ridge, it cannot be described as either intensive or continuous. The main focus of attention was industrial with clear fall-off patterns in flake size suggesting the organised exploitation of known source areas (Richards 1985,32), and 'ritual' with the construction of monuments on a massive scale. As was the case for Cranborne Chase, it would appear that we are dealing in the main with extra home-range activity although the term 'fine-grained' is probably inappropriate in such an exceptional case.

9.2.7 Berkshire Downs

A final example of fine-grained adaptation and one which displays a marked contrast with the adjacent Kennet valley (above) is that of the Berkshire Downs (Richards 1978). The area is one of chalk upland rising from a height of 60-100m OD in the Kennet valley to over 200m OD on the chalk. It is dissected by a series of river valleys (for example the Lambourn) and dry valley tributaries and is capped by clay-with-flint deposits. From casual fieldwalking prior to the survey, a number of artefacts had been recovered and the suggestion from the predominance of cores and hammerstones (Richards 1978,23) must surely be a continuation of the industrial zone identified at Maddle Farm to the west end of the Berkshire Downs (above).

For the Mesolithic, the abundance of activity in the Kennet valley (Froom 1972 and above) is in complete contrast to the virtual absence of material from the uplands. Of the few diagnostic items that were recovered, most came from the valley of the river Lambourn and not on the higher chalk (Richards 1978,29). The Neolithic has also produced only limited evidence. The chalk has no major ceremonial monuments and is indeed peripheral to the main long barrow distribution. Museum collections appear to suggest a distribution of Neolithic domestic activity on the valley gravels while concentrations of likely Neolithic flint scatters appear to represent flint working sites on the clay-with-flint.

For the Bronze Age the pattern of expansion onto the chalk seen elsewhere at this time, appears to be present. The large number of barrows and ring ditches on the chalk was further increased by field survey and aerial reconnaissance, implying the continued use of this area for purposes other than habitation. Indeed settlement evidence for the Bronze Age is conspicuously absent in relation to the large number of burial monuments.

On the Berkshire Downs therefore, as with other areas of southern England, the role of the uplands was largely as an extra home-range environment, exploited through time but extensively and for a variety of functions. It appears that such areas took on renewed significance in the later Neolithic although even this does not appear to have been the case on the Berkshire Downs. What is clearly apparent is the very marked contrast between continuity and intensity here and in the adjacent river valleys. This case highlights the various points made in this section and demonstrates the very clear valley/upland dichotomy which this thesis has sought to illustrate.

9.3 Summary

The opening quotations both illustrate the underlying principles upon which this chapter is based, the ideas of habitat selection and behavioural response. What the results suggest is that both are valid units for investigating human adaptation in the prehistoric period, and that a distinction between fine- and coarse-grained adaptation, based on the home-range model and aspects of lithic reduction, is a useful measure of such variability.

Variation occurs however, not only in space - as is often the case in biological investigations - but also in time, and this is a point which is apparent in the case studies presented. Certain types of environment were preferred by hunter-gatherer and early farming communities and it was largely the distribution and nature of resource patches which determined their distribution ('true habitat selection', after Wiens 1976,91). In later periods, the social landscape became more important with 'core areas' emerging within the Wessex landscape as a whole, adding a further set of locational constraints on the population ('habitat correlation', after Wiens 1976,91).

This chapter has provided a context for the results of the

Avon and Meon valley surveys and demonstrated the considerable diversity - both spatial and temporal - of adaptation across southern England. Although the distinction between fine- and coarse-grained is a valid one and provides a useful set of working assumptions, it masks considerable variation between individual valley and downland systems. Not every valley will be a 'middle Kennet', just as not every area of downland will be a 'Stonehenge environs'.

Chapter 10

Conclusions

In the introduction it was stated that this thesis had two main aims: First, to establish a methodology by which surface lithic collections could be used to reconstruct regional patterns of settlement and land-use, and second, to examine the nature of those patterns outside the 'monument zone' of central Wessex. These points may now be discussed in the light of the evidence which this thesis has presented.:

10.1 Is 'thinking Mesolithic' a good idea?

It was suggested in the introduction that to 'think Mesolithic' was simply a means by which surface collections could be interpreted, adopting models such as that presented by Foley (1981) and applying them not only to the Mesolithic, but to all periods under investigation. In other words the notion of a home-range should not be unique to a forager population, but should be equally valid for farming communities, whether mobile or sedentary. The difference will not merely be one of scale but also one of kind. To distinguish between Mesolithic and Neolithic on the basis of density or scatter size is not sufficient. Clear distinctions are only possible where density and scatter composition are considered together.

These points were investigated by means of two case studies, the upper Meon valley and middle Avon valley in SE and SW Hampshire respectively. In both cases the areas covered by surface collection displayed a continuous scatter of flint artefacts, with distinct variations in density and composition. By adopting the collection unit (the hectare) as a framework, comparisons and contrasts could be drawn across the region as a whole without the need of resorting to subjective decisions regarding the

presence or absence of 'sites'.

The results demonstrated a number of points: First, that waste material or debitage does tend to display distinct patterns in areas where land-use continuity or the spatial separation of land-use episodes may be identified. Such patterns are largely technological and spatial, although evidence derived from blade frequencies does tend to suggest temporal patterning in some cases. By integrating diagnostic artefacts into that frame, it appears that the general trends are confirmed with a concentration of large scale industrial activity on areas of upper chalk and a concentration of domestic activity in the valleys. That this continued from the Mesolithic but with a gradual shift onto the downlands -presumably as a consequence of population pressure on preferred habitats -is confirmed both by palaeoenvironmental evidence from southern England (chapter 3) and from the location of excavated settlements.

A second point concerns the means by which the various types of adaptation may be distinguished. In this thesis the terms fine-and coarse-grained adaptation were adopted, largely because they suggest two very different ways in which humans encounter and use resources. It was suggested that if this distinction between valley and non-valley settlement continued throughout the prehistoric period, then these two extremes may be represented in the nature and density of lithic collections. This proved to be the case and it was argued that the fine-grained/coarse-grained model is a useful working hypothesis in the investigation of regional settlement patterns.

A third suggestion was that the evidence derived from surface collection could profitably be integrated into a more general research strategy, relying more on calibration with other evidence, for example from excavation and palaeoenvironmental studies. Such evidence could provide the vital link which acts as an 'anchor' for a set of data

which is otherwise lacking in context. One example concerns the expected density of worked flint for Neolithic settlements. The ploughzone experiment described in chapter 4 suggested that <5% of flint artefacts from a given assemblage will be present on the surface of a ploughed field. When applied to the case study of Hurst Fen it became apparent that the expected density was less than that derived from every field except one, from both the Avon and Meon valley surveys. This is only one brief example, but it shows the potential for integrating the evidence from excavation and surface collection in this way.

What this suggests therefore is that by looking at general patterns of artefact density and assemblage composition, not in the form of 'sites' but according to a standard set of criteria -field location, field size -valuable and reliable information can be obtained concerning prehistoric land-use. Surface collection will never produce evidence at the level of that obtained through excavation; indeed it was never intended as a means of pinpointing 'moments in time'. Surface collection is a method by which general patterns of discard -reflecting patterns of behaviour which are repetitive and accumulative -may be discerned. Anything beyond that is subject to speculation with any reliable information deriving from the calibration with evidence from excavation and palaeoenvironmental studies.

10.2 Surface collection and the prehistoric settlement of southern England: towards a future policy

It is apparent both from the results of surface collection and from the ploughzone experiment, that the 'site' is an inappropriate measure, at least for the prehistoric period. Artefact scatters are displaced both laterally and vertically, processes which have been at work in southern England for the best part of a century (Canham et.al. 1980). The problem therefore is not so much destruction -as

would be the case if our chief concern was with locating 'sites' -but with visibility. On the downlands, 90% of an assemblage is often contained within the ploughsoil (Gingell and Schadla Hall 1980), while in steep sided valleys colluvium may mask an assemblage altogether. This variable visibility is therefore critical if we are to fully understand regional variations in settlement and land-use and one which must be catered for in any survey project.

A further point concerns the way in which data is retrieved as far as that concerns the potential for inter-regional comparisons. In southern England for example, comparison of density is possible where the content and size of individual fields are available for analysis. At a more refined scale however such an integration of results is less feasible. For example in an attempt to investigate the ubiquity index for diagnostic items in individual collection units -lines walked -from various projects in southern England, the minimum common denominator was $1250m^2$. This was based on the following unit sizes (assuming a line-width of 2.5m):

Project	line length	unit area
Stonehenge environs	50	$125m^2$
Dorset Ridgeway	500	$1250m^2$
Meon valley	50	$125m^2$
Avon valley	100	$250m^2$

If each project had adopted an identical or even a similar collection unit size of 50x2.5m or 100x2.5m, then the level of spatial resolution would have been finer and far more accurate. Ubiquity in relation to specific soil types and units of microtopography may thus have been possible. By this method it is not sufficient to double-up or divide results according to line length. The one major advantage of the ubiquity system is that it provides a quantitative

account of presence/absence, not the scale of activity.

The ubiquity index is therefore one means by which settlement shift or continuity can be assessed across a region (Shennan 1985,187, Earle et.al. forthcoming). It does nevertheless depend upon accurate spatial representation and hence a standard size of collection unit is desirable. Density depends not so much on the size of collection unit as the extent of coverage. A field totally covered by gridded collection (100% recovery) is bound to produce a higher density of artefacts than one covered by lines at 30m intervals (8% recovery). Although multiplying the values up to 100% does provide a rough estimate within specified confidence intervals, it does tend to hide any local variations which may occur within a field. A standard collection ratio would also be desirable if density figures from different areas are to be directly comparable.

Both techniques described above have been used in this thesis to demonstrate their potential and to show the extent of variation within southern England. The onus is now on us to produce a standard methodology, through which the comparison of results will be a true reflection of behavioural or temporal change.

Another point stressed throughout the thesis concerns the value of a technological interpretation of lithic scatters, as opposed to one based solely on chronology. Blades do not always represent Mesolithic "sites", just as hinge fractures and core trimming flakes will not simply be a reflection of Bronze Age activity. In this thesis it was argued that although chronology is useful for establishing presence/absence for a specific period, for example in the form of diagnostic artefacts, long-term trends are more likely to be reflected through the predominance of technological indices.

As part of a future policy therefore, technological

arguments concerning, for example, distance from lithic source areas and the core reduction sequence, are considered of primary importance, ahead of, but not to the exclusion of chronological statements.

A final point concerns the extension of surface collection and the investigation of prehistoric settlement and land-use strategies beyond the area of central-southern England; the work presented in chapters 6 and 7 and the results described in chapter 8 demonstrate the central role which Wessex has played regarding these questions. The density and variation which occurs across the region will only be of real value however when compared with the evidence from other areas such as East Anglia and the Midlands. Was Wessex really a focal area during the prehistoric period or is that simply a reflection of the intensity of investigations in recent years? Can a similar population density be suggested in areas such as east Suffolk, Cambridgeshire, Bedfordshire and Hertfordshire? Is the valley adaptation equally valid in those areas?

Such information as that presented in this thesis is of course valuable in terms of prehistoric occupation in Wessex. It provides a more general context within which the location and nature of monuments may be more fully understood. But to appreciate the value of such specific areas, we need to compare them with others, investigated in a similar way and directed towards a similar set of questions. This works at two levels: First, on a local or micro-scale, for example between the Meon and Avon valleys. The Meon valley was important because it demonstrated the nature of human occupation outside the 'monument zones' of central Wessex by showing a concentration in the Mesolithic and early Neolithic periods. The value of that information is only fully appreciated however when seen in the context of the Avon valley where the majority of evidence was for late Neolithic and Bronze Age occupation. A second level of importance is on a macro-scale, for example between Wessex

and other areas of lowland Britain. Wessex displays considerable variability, both in the types of activity and in the periods during which areas were occupied. This can only be considered further when comparative results from other regions are available. It may be for example that in East Anglia the same level of variability and temporal shift does not occur. Further work is required to investigate this possibility.

10.3 Summary

Surface lithic collections are not just 'junk on the surface', but equally they do not represent settlements *per se*. The evidence may be suggestive of domestic or 'home-range' activity but that does not make a flint scatter a 'site'. Flint scatters are signatures, but signatures which require a graphologist rather than a clerk or cashier to interpret them. If this level of interpretation is to be achieved then it is vital that a forum or working party be established, one result of which must be a standard set of guidelines concerning methodology and how results should be presented. Only when that is achieved can the results of surface collection be considered both in terms of intra-*and* inter-regional settlement patterns and the distribution of prehistoric populations. With an increasing input of finance and manpower into surface collection and a growing realisation that the results *can* be useful if interpreted in an objective way, these proposals must be a primary consideration and are vital if the early potential of 'ploughzone archaeology' is to be fully realised.

References

Allen M.J., 1983. Sediment Analysis and Archaeological Data as Evidence of the Palaeoenvironment of Early Eastbourne: The Bourne Valley Excavations. Unpublished BSc dissertation, University of London.

Allen M.J., 1984. Land Mollusca From Wen Barrow; A Bronze Age Bell Barrow, Surrey. Unpublished ms.

Allen M.J., 1985. A Cursory Review of the Prehistoric Environment of a Downland Block in Central Hampshire. Unpublished ms.

Allen M.J., 1986. Land mollusca as evidence for the environmental history of Easton Lane, Hampshire, and its Downland environs. Ancient Monuments Lab. Report.

Allen M.J., 1987. Land mollusca from the Bronze Age barrow at Berwyn Close, Buckskin, Basingstoke, Hampshire. unpublished ms.

Allen M.J., forthcoming. Some Aspects of Valley Colluviation in South-East England; new techniques and research. In Man-Made Soils. BAR Int. Series. Oxford.

Ammerman A.J., 1985. Ploughzone Experiments in Calabria, Italy, J. of Field Arch. 12,33-40.

Andersen S.T., 1970. The Relative Pollen Productivity and Pollen Representation of North European Trees, and Correction Factors of Tree Pollen Spectra, Danm. Geol. Unders. 11 (96), 1-99.

Anderson J., 1984. Between plateau and plain: flexible responses to varied environments in southwestern Australia. Canberra University, Occ. Papers in Prehistory 4.

Antonovics J., 1971. The Effects of a Heterogenous Environment on the Genetics of Natural Populations, Amer. Sci. 59, 593-599.

ApSimon A.M., 1962. The Prehistoric Pottery, in Rahtz P.A., Neolithic and Beaker Sites at Downton, Wilts. Arch. Mag. 58, 116-141.

ApSimon A.M., 1976. Ballynagilly and the Beginning and End of the Irish Neolithic, Diss. Arch. Gandenses 16, 15-30.

Ashbee P., 1956. The Great Barrow at Bishops Waltham, Hampshire, PPS 23, 137-166.

Baker C.M., 1978. The Size Effect: an explanation of variability in surface artefact assemblage content. Amer. Antiq. 43, 288-293.

Bamforth D.B., 1986. Technological Efficiency and Tool Curation. Amer. Antiq. 51, 38-50.

Barber K.E., 1975. Vegetational History of the New Forest; a preliminary note. P. Hants. F.C. 30, 5-8.

Barker G. and Webley D., 1978. Causewayed Camps and Early Neolithic Land-Use in Central and Southern England. PPS 44, 161-186.

Barrett J., Bradley R., Cleal R. and Pike H., 1978. Characterization of Deverel-Rimbury pottery from Cranborne Chase. PPS 44, 135-142.

Beckett S.C. and Hibbert F.A., 1978. The Influence of Man on the Vegetation of the Somerset Levels: a summary. Somerset Levels Papers 4, 86-90.

Behm J.A., 1983. Flake Concentrations; Distinguishing between Flintworking Activity Areas and Secondary Deposits.

Lithic Technology 12, 9-15.

Bell M., 1983. Valley Sedimentation As Evidence of Prehistoric Land-Use on the South Downs. PPS 49, 119-150.

Binford L., 1978. Dimensional Analysis of Behaviour and Site Structure from an Eskimo Hunting Stand. Amer. Antiq. 43, 330-361.

Binford L., 1979. Organisation and Formation Processes; looking at curated technologies. J. Anthrop. Res. 35(3), 255-273.

Binford L., 1980. Willow Smoke and Dogs Tails; hunter-gatherer settlement systems and archaeological site formation. Amer. Antiq. 45, 4-20.

Binford L., 1982. The Archaeology of Place. J. Anthrop. Arch. 1, 5-31.

Binford L., 1983. In Pursuit of the Past: decoding the archaeological record. Thames and Hudson.

Binford L. and Binford S., 1966. A Preliminary Analysis of Functional Variability in the Mousterian of Levallois Facies. Amer. Anthrop. 68(2), 238-295.

Binford L., Binford S., Whallon R. and Hardin M., 1970. Archaeology at Hatchery West. Society for Amer. Arch. Memoir 24.

Bintliff J., 1985. The Boeotia Survey, In MacReady S. and Thompson F.H., editors, Archaeological Field Survey in Britain and Abroad 196-216. Society of Antiq., London.

Bogucki P., 1987. The establishment of agrarian communities on the north European Plain. Curr. Anthrop. 28, 1-24.

Bradley R.J., 1975. Recent Discoveries From Portsmouth and Langstone Harbours: Mesolithic to Iron Age. P. Hants. F.C. 30, 17-27.

Bradley R.J., 1978. The prehistoric settlement of Britain. London, Routledge, Kegan Paul.

Bradley R.J., 1981. Various Styles of Urn; cemeteries and settlement in Southern England c.1400-1000bc. In Chapman R., Kinnes I. and Randsborg K., editors, The Archaeology of Death 93-104. Camb. Univ. Press.

Bradley R.J., 1982. Belle Tout -revision and reassessment. In Drewett P.L., The Archaeology of Bullock Down, Eastbourne, East Sussex: the development of a landscape. 62-71. Sussex Arch. Soc. Monograph No.1.

Bradley R.J., 1984. The social foundations of Prehistoric Britain: themes and variations in the archaeology of power. Longman, London and New York.

Bradley R.J. and Ellison A., 1975. Rams Hill: a Bronze Age fortified enclosure and its landscape. BAR Brit. Series 19, Oxford.

Bradley R.J. and Holgate R., 1984. The Neolithic sequence in the upper Thames valley, In Bradley R.J. and Gardiner J.P. editors, Neolithic Studies: a review of current research. 107-134. BAR British Series 133, Oxford.

Bradley R.J. and Lewis E., 1974. A Mesolithic site at Wakeford's Copse, Havant. Rescue Archaeology in Hampshire 2, 5-18.

Bradley R.J., Cleal R., Gardiner J., Green M. and Bowden M., 1984. The Neolithic Sequence in Cranborne Chase, In Bradley R.J. and Gardiner J.P., editors, Neolithic Studies; a revue of some current research 87-105. BAR British Series

133, Oxford.

Bradley R.J., Lobb S., Richards J. and Robinson M., 1980. Two late Bronze Age settlements on the Kennet gravels: excavations at Aldermaston Wharf and Knights Farm, Burghfield, Berkshire. PPS 46, 217-296.

Brooks I., 1984. Flint Working in the English Iron Age Unpublished BA Dissertation. University of Southampton.

Bryant E.H., 1974. On the Adaptive Significance of Enzyme Polymorphisms in Relation to Environmental Variability. Amer. Nat. 108, 1-28.

Burton J., 1980. Making Sense of Waste Flakes; new methods for investigating the technology and economics behind chipped stone assemblages J. Arch. Sci. 7, 131-148.

Butzer K., 1982. Archaeology as Human Ecology. Camb. Univ. Press.

Canham R.A., Richards J. and Schadla-Hall R.T., 1980. Archaeology and agriculture in Wessex, In Hinchcliffe J. and Schadla-Hall R.T., editors, The past under the plough 49-59. DoE Occ. papers No.3.

Care V., 1982. The Collection and Distribution of Lithic Raw Material During the Mesolithic and Neolithic Periods in Southern England. Oxford J. Arch. 1(3), 269-285.

Cartwright C., 1983. Field survey of Chichester harbour 1982. Sussex Arch. Coll. 122, 23-28.

Catt J.A., 1979. Distribution of Loess in Britain. Proc. Geol. Assoc. 90, 93-95.

Cheetham G.H., 1980. Late quaternary palaeohydrology: the Kennet valley case study, In Jones D. editor, The shaping

of southern England. 203-224. Acad. Press, London.

Cherry J., 1984. Common sense in Mediterranean archaeology? J. of Field Arch. 11, 117-120.

Chisholm M., 1968. Rural settlement and land-use. Hutchinson, London.

Clapham A.R., 1932. The Form of the Observational Unit in Quantitative Ecology. J. of Ecology 20, 192-197.

Clark J.G.D. and Rankine W.F., 1939. Excavations at Farnham, Surrey, 1937-8, the Horsham culture and the question of Mesolithic dwellings. PPS 5, 61-108.

Clark J.G.D., Higgs E. and Longworth I.H., 1960. Excavations at the Neolithic site at Hurst Fen, Mildenhall, Suffolk, 1954, 1957 and 1958. PPS 26, 202-245.

Colebourne P., 1983. Hampshire's Contryside Heritage 2: Ancient Woodland. Hants. C.C.

Coleman Cook J., 1970. The Red Deer Herds, In Exmoor, National Park Guide No. 8, 41-44. HMSO, London.

Collins F.B. and Hurst J.C., 1978. Some Chapters in the History of Meonstoke and Soberton. Winton Publications Ltd.

Connah G. and MacMillan N.F., 1964. Snails and Archaeology. Antiquity 38, 62-64.

Coy J.P., 1982. Woodland mammals in Wessex: the archaeological evidence. In Bell M. and Limbrey S., editors, Archaeological aspects of woodland ecology 287-296. BAR Int. Series 146, Oxford.

Cribb R., 1982. The Archaeological Dimensions of Near Eastern Nomadic Pastoralism. PhD thesis, Univ. of

Southampton.

Cross J.R., 1983. Twigs, branches, trees and forests: problems of scale in lithic analysis, In Moore J. and Keene A., editors, Archaeological hammers and theories 88-107. Academic Press, New York.

Curwen E.C., 1936. Excavations at Whitehawk Neolithic camp, Brighton. Sussex Arch. Coll. 77, 60-92.

Davies S.M. and Graham A.H., 1984. Evidence of Prehistoric and Anglo-Saxon Settlement found during gravel extraction near Hucklesbrook, in the Avon Valley, Hampshire. P.Hants. F.C. 40, 127-130.

Davis M.B., 1963. On the Theory of Pollen Analysis. Amer. J. of Science. 261, 897-912.

Deetz J., 1965. Cultural Patterning of Behaviour as reflected by Archaeological Materials, In Chang K.C. editor, Settlement Archaeology 31-42. California National Press.

de Nahlik A.J., 1974. Deer management: improved herds for greater profit. David and Charles, Vancouver.

Dimbleby G.W., 1974. Pollen analysis, In Ashbee P. and Dimbleby G.W., The Moor Green Barrow, West End, Hampshire: excavations 1961. P. Hants. F.C. 31, 5-18.

Dimbleby G.W., 1981. The Mesolithic, In Simmons I.G. and Tooley M.J., editors, The Environment in British Prehistory. 82-124. Duckworth.

Dimbleby G.W. and Evans J.G., 1974. Pollen and land snail analysis of calcareous soils. J. Arch. Sci. 1, 117-133.
Dixon P., 1981. Crickley Hill. Curr. Arch. 76, 145-147.

Downer A.S., 1977. Activity Areas, Surface Collection and Factor Analysis at the Phillips Spring Site, 23H1 216, Missouri. Plains Anthrop. 22, 299-311.

Draper J.C., 1955. Mesolithic and Neolithic Distribution in South-East Hampshire. Archaeol. Newsletter 5(10), 199-200.

Drewett P.L., 1978. Neolithic Sussex., In Drewett P.L. editor, Archaeology in Sussex to 1500AD. CBA Res. Report 29, 23-29.

Drewett P.L., 1981. The flint industry, In Bedwin O., Excavations at the Neolithic enclosure on Bury Hill, Houghton, west Sussex 1979. PPS 47, 77-79.

Drewett P.L., 1982a. Later Bronze Age downland economy and excavations at Black Patch, east Sussex. PPS 48, 321-400.

Drewett P.L., 1982b. The archaeology of Bullock Down, Eastbourne, east Sussex: the development of a landscape. Sussex Arch. Soc. Monograph No.1.

Drewett P.L., 1986. The excavation of a Neolithic oval barrow at north Marden, west Sussex, 1982. PPS 52, 31-52.

Dunnell R.C and Dancey W.S., 1983. The Siteless Survey: a regional scale data collection strategy, In Schiffer M.B., editor, Advances in Archaeological Method and Theory 6, 267-287. Academic Press.

Earle T., Bellamy P., Boismier W., Ford S., Lobb S., Richards J., Riley H., Schofield J., Tingle M. and Woodward P., in prep. Lithic evidence for pre-Iron Age populations in Wessex.

Ebert J., 1979. An Ethnoarchaeological Approach to Reassessing the Meaning of Variability in Stone Tool Assemblages, In Kramer C., editor, Ethnoarchaeology:

Implications of Ethnography for Archaeology. 58-74. Columbia Univ. Press.

Edwards K.J., 1979. Palynological and Temporal Inference in the context of prehistory, with special reference to the evidence from lake and peat deposits. J. Arch. Sci. 6, 255-270.

Edwards K.J., 1982. Man, Space and the Woodland Edge: speculations on the detection and interpretation of human impact in pollen profiles, In Bell M. and Limbrey S., editors, Archaeological Aspects of Woodland Ecology. 5-22. BAR Int. Series 146. Oxford.

Edwards K.J. and Hirons K.R., 1984. Cereal Pollen Grains in pre-Elm Decline Deposits: implications for the earliest agriculture in Britain and Ireland. J. Arch. Sci. 11, 71-80.

Ellison A., 1980. Deverel-Rimbury urn cemeteries: the evidence for social organisation. In Barrett J. and Bradley R.J., editors, Settlement and society in the British later Bronze Age. 115-126. BAR Brit. Series 83, Oxford.

Ellison A., 1981. Towards a socioeconomic model for the middle Bronze Age in southern England. In Hodder I., Isaac G. and Hammond N., editors, Pattern of the Past. 413-438. Cambridge Univ. Press, Cambridge and New York.

Ellison A. and Harriss J., 1972. Settlement and Land-Use in the prehistory and early history of Southern England: a study based on locational models, In Clarke D.L., editor, Models in Archaeology 911-962. Methuen.

Elton C., 1927. Animal Ecology. Sidgewick and Jackson.

Emmons L.H., 1980. Ecology and Resource Partitioning among nine species of African Rain Forest Squirrels. Ecol.

Monograph 50, 31-54.

Ericson J.E., 1984. Towards the analysis of lithic production systems. In Ericson J.E. and Purdy B.A., editors, Prehistoric Quarries and Lithic Production. 1-9. Cambridge University Press.

Evans J.G., 1978. Comment on Barker and Webley, 1978. PPS 44, 185-186.

Evans J.G., 1979. The Environment, In Ashbee et.al., Excavations of three Long Barrows at Avebury, Wiltshire. PPS 45, 275-300.

Evans J.G. and Smith I.F., 1983. Excavations at Cherhill, North Wiltshire, 1967. PPS 49, 43-117.

Evans P., 1975. The intimate relationship: an hypothesis concerning pre Neolithic land use, In Evans J.G., Limbrey S. and Cleere H., editors, The Effect of Man on the Landscape: the highland zone. 43-48. CBA Research Report 11.

Farley M., 1979. Flint Flake Dimensions in the British Neolithic. PPS 45, 322-323.

Fasham P.J., 1985. The Prehistoric Settlement of Winnall Down. Hants F.C. Monograph 2.

Fasham P.J., Schadla Hall R.T., Shennan S.J. and Bates P.J., 1980. Fieldwalking for Archaeologists. Hants. F.C.

Ferdiere A. and Zadora Rio E., editors, 1986. La prospection archeologique: paysage et peuplement. Documents D'Archeology Francaise No.3. Paris.

Field N.H., Matthews C.L. and Smith I.F., 1964. New Neolithic sites in Dorset with a note on the distribution

of Neolithic storage pits in Britain. PPS 30, 352-381.

Fischer A., Gronmow B., Jonsson J.H., Nielsen F.O. and Petersen C., 1979. Stone Age Experiments in Lejre; internal organisation of the settlement. Working Papers of the National Museum of Denmark 8.

Flannery K., editor, 1976. The Early Mesoamerican Village. Academic Press, London and New York.

Fleming A., 1983. The prehistoric landscape of Dartmoor, Part 2: North and east Dartmoor. PPS 49, 195-242.

Foard G., 1978. Systematic Fieldwalking and the investigation of Saxon Settlement in Northamptonshire. World Arch. 9(3), 357-374.

Ford S., Bradley R., Hawkes J. and Fisher P., 1984. Flint working in the metal age. Oxford J. Arch. 3, 157-173.

Ford S., 1987. Flint scatters and prehistoric settlement patterns in south Oxon and east Berks. In Brown A.G. and Edmonds M.R., editors, Lithic analysis and later British prehistory. 101-136. BAR Brit. Series 162, Oxford.

Foley R., 1981. Off-Site Archaeology and Human Adaptation in Eastern Africa: an analysis of Regional Artefact density in the Amboseli, Southern Kenya. Cambridge Monographs in African Archaeology 3. BAR Int. Series 97. Oxford.

Froom F.R., 1972. Some Mesolithic Sites in South-West Berkshire. Berks. Arch. J. 66, 11-22.

Froom F.R., 1976. Wawcott 111: a stratified Mesolithic Succession. BAR British Series 27. Oxford.

Gabel F., 1976. St. Catherines Hill: A Mesolithic Site near Guildford. Research Volume of the Surrey Arch. Soc. 3, 77-

101.

Gaffney V. and Tingle M., 1985. The Maddle Farm Project and Micro-Regional Analysis, In Macready S. and Thompson F.H., editors, Archaeological Field Survey in Britain and Abroad. 67-73. Society of Antiq., London.

Gallagher J.P., 1977. Contemporary Stone Tools in Ethiopia: implications for archaeology. J. of Field Arch. 4, 407-414.

Gamble C., 1982. Review of Foley 1981. PPS 48, 529-530.

Gamble C., 1984. Alternative Hunter Gatherer Strategies in the Upper Pleistocene of Europe, In Foley R. editor, Community Ecology and Human Adaptation in the Pleistocene. Academic Press, London and New York.

Gamble C., 1986. The Palaeolithic settlement of Europe. Cambridge University Press.

Gardiner J.P. and Shennan S.J., 1985. The Mesolithic, Neolithic and Bronze Age periods, In Shennan S.J., Experiments in the collection and interpretation of archaeological survey data: the East Hampshire survey. 47-72. Sheffield University Press.

Garwood P., 1985. The Cuckmere valley project fieldwalking programme, 1982-3. Inst. Arch. Bull. 21/22,49-68.

Gill W.R., 1967. Soil Dynamics in tillage and traction. Agricultural Handbook 316. Agric. Research Service, U.S. Dept. of Agric.

Gingell C. and Schadla Hall R.T., 1980. Excavations at Bishops Cannings Down, 1976, In Hinchcliffe J. and Schadla Hall R.T., editors, The Past Under the Plough 109-113. DoE Occ. Public. No.3, London.

Gingell C. and Harding P., 1981. A Method of Analysing the Technology of flaking in Neolithic and Bronze age flint assemblages, In F.H.G. Engelen editor, 3rd. Int. Symp. on Flint 73-76. Sittard.

Godwin H., 1945. A Submerged Peat Bed in Portsmouth Harbour: data for the study of postglacial history 1X. New Phytol. 44, 152-155.

Godwin H., 1975. History of the British Flora. Camb. Univ. Press.

Godwin H. and Godwin M.E., 1940. Submerged Peat at Southampton: data for the study of postglacial history V. New Phytol. 39, 303-307.

Gordon P. and Shakesby R., 1973. Study of the valley infill, Rake Bottom, Butzer Hill. The South Hants Geographer 6, 10-20.

Gould R., 1980. Living Archaeology. Cambridge University Press.

Green H.S., 1980. The Flint Arrowheads of the British Isles. BAR British Series 75. Oxford.

Green H.S., 1984. Flint Arrowheads: typology and interpretation. Lithics 5, 19-39.

Grigson C., 1981. Fauna, In Simmons I.G. and Tooley M.J., editors, The Environment in British Prehistory. Duckworth, London.

Grigson C., 1983. Mesolithic and Neolithic animal bones. In Evans J.G. and Smith I.F., Excavations at Cherhill, North Wiltshire. PPS 49, 64-72.

Grigson C. and Smith I.F., 1985. Neolithic pottery and the

horncore of an aurochs (Bos primigenius) from Corhampton, Hampshire. Proc. Hants. F.C. 41, 63-68.

Grinsell L.V., 1964. Settlement in Prehistoric and Roman Times. In Monkhouse F.J., editor, A Survey of Southampton and its Region. 189-204. Southampton.

Gunn J., 1975. Idiosyncratic behaviour in chipping style: some hypotheses and preliminary analysis. In Swanson E., editor, Lithic technology: making and using stone tools. 35-62. Mouton.

Haggett P., 1965. Locational analysis in human geography. London, Edward Arnold.

Hall E.T., 1968. Proxemics. Current Anthrop. 9, 83-108.

Handel S.N., 1976. Restricted Pollen Flow of two Woodland Herbs determined by Neutron Activation Analysis. Nature. 260, 422-423.

Hasel A.A., 1938. Sampling Error in Timber Surveys. J. of Agric. Research 57, 713-736.

Haslegrove C., Millett M. and Smith I., editors, 1985. Archaeology from the Ploughsoil: studies in the collection and interpretation of field survey data. Sheffield Univ. Press.

Haskins L.E., 1978. The Vegetational History of South East Dorset. PhD thesis, Univ. of Southampton.

Healey F. and Robertson Mackay R., 1983. The Lithic Industries from Staines Causewayed Enclosure and their relationship to other early neolithic industries in Southern England. Lithics 4, 1-27.

Healy F., 1983. Are First Impressions Only Topsoil Deep?

The evidence from Tattershall Thorpe, Lincs. Lithics 4, 28-33.

Healy F., 1984. Lithic Assemblage Variation in the late 3rd. and early 2nd. millennia bc in Eastern England. Lithics 5, 10-18.

Hedges J. and Buckley D., 1978. Excavations at a causewayed enclosure, Orsett, Essex, 1975. PPS 44, 219-308.

Higgs E., 1959. Excavations at a Mesolithic Site at Downton, Wilts. PPS 25, 209-232.

Higgs E. and Vita Finzi C., 1970. Prehistoric economy in the Mount Carmel area of Palestine: site catchment analysis. PPS 36, 1-37.

Hillman G., 1981. Crop Husbandry: evidence from macroscopic remains, In Simmons I.G. and Tooley M.J., editor, The Environment in British Prehistory 183-191. Duckworth, London.

Hodder I. and Malone C., 1984. Intensive Survey of Prehistoric Sites in the Stilo Region, Calabria. PPS 50, 121-150.

Holden E.W. and Bradley R.J., 1975. A late Neolithic site at Rackham, Sussex. Sussex Arch. Coll. 113, 85-103.

Holgate R., 1985. Identifying Neolithic settlements in Britain: the role of field survey in the interpretation of lithic scatters. In Haslegrove C., Millett M. and Smith I., editors, Archaeology from the Ploughsoil: studies in the collection and interpretation of field survey data. 51-58. Sheffield Univ. Press.

Holgate R., 1987. Neolithic settlement patterns at Avebury, Wiltshire. Antiq. 61, 259-263.

Howard H., 1981. In the wake of distribution: towards an integrated approach to ceramic studies in Prehistoric Britain. In Howard H. and Morris E., editors, Production and distribution: a ceramic viwpoint 1-30. BAR Supp. Series 120, Oxford.

Howell J.M., 1983. Settlement and Economy in Neolithic northern France. BAR Int. Series 157, Oxford.

Ingold T., 1981. The Hunter and his Spear: notes on the cultural mediation of social and ecological systems, In Sheridan A. and Bailey G., editors, Economic Archaeology. 119-130. BAR Int. Series 96, Oxford.

Isaac G., 1981. Stone age visiting cards, In Hodder I., Isaac G. and Hammond N., editors, Pattern of the Past. 131-155. Cambridge University Press, Cambridge and New York.

Iversen J., 1941. Land Occupation in Denmarks Stone Age: a pollen analytical study of the influence of farmer culture on the vegetational development. Danm. Geol. Unders. 11(66), 20-68.

Iversen J., 1973. The Development of Denmarks Nature since the last Glacial. Danm. Geol. Unders. 5(7), 1-126.

Jacobi R., 1981. The last hunters in Hampshire. In Shennan S.J. and Schadla Hall R.T., editors, The Archaeology of Hampshire. 10-25. Hants. F.C. and Arch. Soc., Monograph No. 1.

Jacobsen J.A., 1984. A contribution to the evaluation of Archaeological Field Surveying. J. of Danish Arch. 3, 187-198.

James B., 1977. The flint industry, In Drewett P., The Excavations of a Neolithic Causewayed enclosure on Offham

Hill, East Sussex, 1976. PPS 43, 211-218.

Jarman M.R., 1972. European Deer Economies and the advent of the Neolithic, In Higgs E., editor, Papers in Economic Prehistory. 125-147. Camb. Univ. Press.

Jobling H.J., Parkington J.E., Poggenpoel C.A. and Mazel A.D., 1984. Patterning on a Talus Slope, In Hall M. et.al. editors, Frontiers: Southern African Archaeology Today. 152-166. BAR Int. Series 207, Oxford.

Jochim M.A., 1976. Hunter-gatherer subsistence and settlement: a predictive model. Academic Press, London and New York.

Jochim M.A., 1981. Strategies for Survival. Academic Press, London and New York.

Johnson I., 1984. Cell Frequency recording and analysis of artefact distributions, In Hietala H.J., editor, Intra-Site Spatial Analysis in Archaeology. 75-96. Camb. Univ. Press.

Jones M., 1980. Carbonised Cereals from Grooved Ware contexts. PPS 46, 61-64.

Jones R., 1985. Archaeological research in the Kakadu National Park. Australian National parks and Wildlife services, 13.

Judge J., Ebert J. and Hitchcock R., 1975. Sampling in Regional Archaeological Surveys, In Mueller J.W., editor, Sampling in Archaeology 82-123. Univ. of Arizona Press.

Juel Jensen H., 1986. Unretouched blades in the late Mesolithic of southern Scandinavia: a functional study. Oxford J. Arch. 5, 19-34.

Kerney M.P., Brown E.H. and Chandler T.J., 1964. The late

glacial and postglacial history of the chalk escarpment near Brook, Kent. Phil. Trans. Roy. Soc. London B. 248,135-204.

Kroll E.M. and Isaac G., 1984. Configurations of Artefacts and Bones at Early Pleistocene Sites in East Africa, In Hietala H.J., editor, Intra-Site Spatial Analysis in Archaeology 4-31. Camb. Univ. Press, Cambridge and New York.

Kuper R., Lohr H., Luning J., Stehli P. and Zimmerman A., 1977. Der Bandkeramische siedlungplatz langweiler 9, Gem. Aldenhoven, Kr. Duren. Rheinische Ausgrabungen 18. Rheinland-Verlag, Bonn.

Kwaad F.J. and Mucher H.J., 1979. The Formation and Evolution of Colluvium on Arable Land in Northern Luxemburg. Geoderma 22, 173-192.

Lamb H.H., 1966. Britains Climate in the Past, In The Changing Climate 170-195. London.

Lamb H.H., 1977. Climate Present, Past and Future. Methuen.

Lambrick G., 1977. Archaeology and Agriculture. Oxfordshire Arch. Unit, Survey No. 4., CBA.

Lee R.B., 1968. What hunters do for a living, or, how to make out on scarce resources. In Lee R.B. and DeVore I., editors, Man the Hunter. 30-48. Chicago, Aldine.

Lee R.B., 1979. The !Kung San: men, women and work in a foraging society. Cambridge University Press.

Levin S.A. and Paine R.T., 1974. Disturbance, Patch Formation and Community Structure. Proc. National Acad. Sci. USA 71, 2744-2747.

Lewin J., 1977. Palaeohydrology. Cambria 4, 112-123.

Lewis E.R. and Walker G., 1977. Bronze Age Occupation Site at Westbury, West Meon. P. Hants. F.C. 32, 33-44.

Limbrey S., 1975. Soil Science and Archaeology. Academic Press, London.

McGhee R., 1980. Individual stylistic variability in Independence 1 stone tool assemblages from Port Refuge, NWT. Arctic 33, 443-453.

MacArthur J.W., 1975. Environmental Fluctuations and Species Diversity, In Cody M.L. and Diamond J.M., editors, Ecology and Evolution of Communities 74-80. Harvard Univ. Press.

MacArthur R.H., 1972. Geographical Ecology. Harper and Row.

MacReady S. and Thompson F.H., editors, 1985. Archaeological Field Survey in Britain and Abroad. Soc. of Antiq. occ. paper No. 6. London.

Magny M., 1982. Atlantic and Sub Boreal: dampness and dryness? In Harding A., editor, Climatic Change in Later Prehistory. 33-43. Edinburgh Univ. Press.

Maguire D.J., 1983. The Identification of Agricultural Activity using pollen analysis, In Jones M., editor, Integrating the Subsistence Economy. 5-18. BAR Int. Series 181, Oxford.

Marshall A., 1985. Neolithic and early Bronze Age settlement in the northern Cotswolds: a preliminary outline based on the distribution of surface scatters and funerary areas. Trans. Bristol Gloucs. Arch. Soc. 103, 23-54.

Mason C., 1979. The Land Snails, In Fasham P.J.,

Excavations at Bridgetts and Burntwood Farms, Itchen Valley Parish, Hants. P.Hants.F.C. 35, 37-86.

Mason C., 1982. The Land Snails, In Fasham P.J., The Excavation of Four ring ditches in Central Hampshire. P.Hants.F.C. 38, 37-38.

Meddens B., 1983. The mollusca, In Millett M. with James S., The excavations at Cowdery's Down, Basingstoke, Hampshire, 1977-8. Arch. J. 140, 161-162.

Meggers B., 1954. Environmental Limitations on the Development of Culture, Amer. Anthrop. 56, 801-824.

Mellars P., 1976. Settlement patterns and industrial variability in the British Mesolithic, In Sieveking G. de G., Longworth I.H. and Wilson K.E., editors, Problems in economic and scocial archaeology. 374-399. Duckworth, London.

Mellars P. and Reinhardt S.C., 1978. The Patterns of Mesolithic Land-Use in Southern England: a geological perspective, In Mellars P., editor, The Early Postglacial Settlement of Northern Europe 243-294. Duckworth.

Mercer R., 1980. Hambledon Hill: a Neolithic landscape. Edinburgh Univ. Press.

Mercer R., 1981. Excavations at Carn Brea, Illogen, Cornwall, 1970-73: a Neolithic fortified complex of the 3rd millennium bc. Cornish Arch. 20, 1-204.

Miles D., 1978. Abingdon, Radley, Barton Court Farm, 1972-6. CBA Group 9 Newsletter 8, 106-7.

Moffat A.J. and Cope D.W., 1984. The Hampshire Chalklands, In Jarvis M.G. and Findlay D.C., editors, Soils of the Southampton District 82-116. British Society of Soil

Science.

Mueller J.W., 1975. Archaeological Research as Cluster Sampling, In Mueller J.W., editor, Sampling in Archaeology 33-41. Univ. of Arizona Press.

Munday F.C., 1984. Middle Paleolithic Intrasite Variability and its relationship to regional patterning, In Hietala H.J., editor, Intra-Site Spatial Analysis in Archaeology 32-43. Camb. Univ. Press.

Murphy P.L., 1977. Early Agriculture and Environment on the Hampshire Chalklands, 800bc-400AD. M.Phil thesis, Univ. of Southampton.

Myers A., 1987. All shot to pices? Inter-assemblage variability, lithic analysis and Mesolithic assemblage 'types'. Some preliminary observations, In Brown A.G. and Edmonds M.R., editors, Lithic analysis in later British Prehistory: some problems and approaches. 137-154. BAR British Series 162, Oxford.

Nicholson R.J., 1980. Modern Ploughing Techniques, In Hinchcliffe J. and Schadla Hall R.T., editors, The Past Under the Plough 22-25. DoE Occ. Publications No. 3. London.

Norusis M.J., 1983. SPSSx Introductory statistics guide. M^{C}Graw Hill.

O'Brien M.J. and McDaniel C., 1982. Prehistoric community patterns: subsurface definition. In O'Brien M.J., Warren R.E. and Lewarch D.E., editors, The Canon Reservoir Human Ecology Project: an archaeological study of cultural adaptation in the southern Prairie peninsular. 217-254. Academic Press, New York.

O'Nuallain S., 1972. A Neolithic house at Ballyglass, near

Ballycastle, Co. Mayo. J. Roy. Soc. Antiq. Ireland 102, 1-11.

Orians G.H., 1975. Diversity, stability and maturity in natural ecosystems. In von Dobben W.H. and Lowe-McConnell R.H., editors, Unifying concepts in ecology 139-150. The Hague: Dr W. Junk B.V.

Orians G.H. and Pearson N.E., 1979. On the theory of central place foraging. In Horn D.J., Stairs G.R. and Mitchell R.D., editors, Analysis of ecological systems 155-177. Columbus, Ohio, State Univ. Press.

O'Riordain S., 1954. Lough Gur excavations:Neolithic and Bronze Age houses on Knockadoon. P. Royal Irish Acad. 56C, 297-460.

Packham J.R. and Harding D.J.L., 1982. Ecology of Woodland Processes. Edward Arnold.

Page A.B., 1974. The Excavation of a Round Barrow at West Meon Hut, Hants. Rescue Arch. in Hants. 2, 19-28.

Palmer S., 1977. Mesolithic cultures of Britain. Dolphin Press, Poole.

Parker Pearson M., 1981. A Neolithic and Bronze Age Site at Churston, South Devon. P. Devon Arch. Soc. 39, 17-26.

Peck R.M., 1973. Pollen Budget Studies in a small Yorkshire Catchment, In Birks H.J.B. and West R.G., editors, Quaternary Plant Ecology. 43-60. Blackwells, Oxford.

Peterken G.F. and Tubbs C.R., 1965. Woodland Regeneration in the New Forest, Hampshire since 1650. J. Applied Ecology. 2, 159-170.

Pianka E.R., 1983. Evolutionary Ecology. (third edition).

Harper and Row, New York.

Piggott S., 1954. Neolithic Cultures of the British Isles. Camb. Univ. Press.

Pitts M. and Jacobi R., 1979. Some aspects of change in flaked stone industries of the Mesolithic and Neolithic of Southern England. J. of Arch. Sci. 6, 163-177.

Prentice I.C., 1985. Pollen Representation, Source Area and Basin Size: Toward a unified Theory of Pollen Analysis. Quat. Research 23, 76-84.

Prescott R., 1983. Hampshire's Countryside Heritage 6: Chalk Grassland. Hants. C.C.

Price T.D., 1978. Mesolithic Settlement Systems in the Netherlands, In Mellars P., editor, The Early Postglacial Settlement of Northern Europe. 81-114. Duckworth.

Pryor F., 1974. Excavations at Fengate, Peterborough, England: the third report. Arch. Monog. 4. Royal Ontario Museum.

Putnam R. and Wratten S., 1985. Principles of Ecology. Croom Helm.

Rahtz P.A., 1962. Neolithic and Beaker Sites at Downton. Wilts. Arch. Mag. 58, 116-141.

Rankine W.F., 1951. Quarzite pebble maceheads with hour-glass perforation: their distribution in England. Archaeol. Newsletter 4, 53-55.

Rankine W.F., 1952. A Mesolithic chipping floor at the Warren, Oakhanger, Selborne, Hampshire. PPS 18, 21-35.

Rankine W.G., Rankine W.M. and Dimbleby G.W., 1960. Further

Excavations at a Mesolithic Site at Oakhanger, Selbourne, Hampshire. PPS 26, 246-262.

Redman C.L. and Watson P.J., 1970. Systematic, Intensive Surface Collection. Amer. Antiq. 35, 279-291.

Renfrew A.C., 1973. Monuments, Mobilisation and Social Organisation in Neolithic Wessex, In Renfrew A.C., editor, The Explanation of Culture Change. 539-558. Duckworth.

Renfrew A.C., 1983. Geography, Archaeology and Environment 1: Archaeology. Geog. J. 149, 316-323.

Richards J.C., 1978. The Archaeology of the Berkshire Downs: an introductory survey. Berks. Arch. Committee.

Richards J.C., 1984. The Development of the Neolithic Landscape in the Environs of Stonehenge, In Bradley R.J. and Gardiner J.P., editors, Neolithic Studies: a revue of some current research. 177-187. BAR British Series 133. Oxford.

Richards C. and Thomas J., 1984. Ritual activity and structured deposition in late Neolithic Wessex. In Bradley R.J. and Gardiner J.P., editors, Neolithic Studies: a revue of some current research. 189-218. BAR British Series 133. Oxford.

Rick J.W., 1976. Downslope Movement and Archaeological Intra-Site Spatial Analysis. Amer. Antiq. 41, 133-144.

Robertshaw R.T., 1978. The Archaeology of an abandoned Pastoralist Campsite. S.African J. Science 74, 29-31.

Robertson Mackay M.E., 1980. A 'head and hooves' burial beneath a round barrow, with other Neolithic and Bronze Age sites on Hemp Knoll near Avebury, Wiltshire. PPS 46, 123-176.

Rogers E.S. and Black M.B., 1976. Subsistence Strategy in the Fish and Hare Period, Northern Ontario: the Weagamow Ojibwa, 1880-1920. J. of Anthrop. Research 32, 1-43.

Roper D., 1976. Lateral Displacement of Artefacts due to Plowing. Amer. Antiq. 41, 372-375.

Russel A., 1986. Chilbolton. Past 1, 3.

Sappington R.L., 1984. Procurement without quarry production: examples from SW Idaho. In Ericson J.E. and Purdy B.A., editors, Prehistoric Quarries and lithic production. 23-34. Cambridge University Press.

Saville A., 1980. Five flint assemblages from excavated sites in Wiltshire. Wilts. Arch. Mag. 72/73, 1-27.

Saville A., 1981a. Grimes Graves, Norfolk: Excavations 1971-1973, Volume 2, The Flint Assemblage. DoE Arch. Reports 11.

Saville A., 1981b. Iron age Flintworking: fact or fiction? Lithics 2, 6-9.

Sawyer J. et.al., 1966. World Climate from 8000bc to 0bc. London.

Scaife R.J. and Burrin P.J., 1983. Floodplain development in and the vegetational history of the Sussex high Weald and some archaeological implications. Sussex Arch. Coll. 121, 1-10.

Scaife R.J. and Burrin P.J., 1985. The environmental impact of prehistoric man as recorded in the upper Cuckmere valley at Stream Farm, Chiddingly. Sussex Arch. Coll 123, 27-34.

Schick K.D., 1986. Stone age sites in the making:

experiments in the formation and transformation of archaeological occurrences. BAR Int. Series, 319. Oxford.

Schofield A.J., 1986. The ASDA Factor: core reduction, resource stress and the nature of lithic assemblages in central-southern England. Lithics 7, 17-29.

Schofield A.J., 1987. Putting lithics to the test: non-site analysis and the Neolithic settlement of southern England. Oxford J. Arch. 6, 269-286.

Schofield A.J., forthcoming. A jadeite axe from Droxford, Hampshire and its regional context. PPS 53.

Schofield A.J., editor, (forthcoming). The interpretation of artefact scatters: a contribution to ploughzone archaeology. Oxbow.

Schiffer M.B., 1976. Behavioural Archaeology. Academic Press, New York.

Seagrief S.C., 1959. Pollen Diagrams from Southern England: Wareham, Dorset and Nursling, Hampshire. New Phytol. 58, 316-325.

Seagrief S.C., 1960. Pollen Diagrams from Southern England: Cranes Moor, Hampshire. New Phytol. 59, 73-83.

Shennan S.J., 1980. Meeting the plough damage problem: a sampling approach to area-intensive fieldwork. In Hinchcliffe J. and Schadla Hall R.T., editors, The Past under the Plough 125-133. DoE Occ. Papers, No. 3.

Shennan S.J., 1985. Experiments in the Collection and Analysis of Archaeological Survey Data: The East Hampshire Survey. Sheffield University Press.

Shennan S.J., 1986. Interaction and change in third

millennium bc western and central Europe. In Renfrew A.C. and Cherry J.F., editors, Peer polity interaction and socio-political change. 137-148. Cambridge University Press.

Shennan S.J., forthcoming. Excavation of a Bronze Age boiling mound at Harbridge. In Light A., Schofield A.J. and Shennan S.J., The Avon Valley survey: a study in landscape history.

Shore T.W., 1888. Ancient Hampshire Forests and the Geological Conditions of their Growth. P. Hants F.C. 2, 40-60.

Shore T.W., 1890. The Clays of Hampshire and their Economic Uses. P. Hants. F.C. 4, 23-45.

Shore T.W. and Elwes J.W., 1889. The New Docks Excavation at Southampton. P. Hants. F.C. 3, 43-56.

Sidaway R., 1964. A Buried Peat Deposit at Litton Cheney. P. Dorset Nat. Hist. and Arch. Soc. 85, 78-86.

Sielmann B., 1972. Die Fruhneolithische Besiedlung Mitteleuropas. Fundamenta Va, 1-65.

Simmons I.G., 1981. Climate, In Simmons I.G. and Tooley M.J., editors, The Environment in British Prehistory. 89-93. Duckworth.

Simmons I.G. and Dimbleby G.W., 1974. The Possible Role of Ivy in the Mesolithic Economy of Western Europe. J. Arch. Sci. 1, 291-296.

Simpson G.G., 1961. Principles of Animal Taxonomy. Oxford.
Singer C.A., 1984. The 63-kilometer fit, in Ericson J.E. and Purdy B.A., editors, Prehistoric quarries and lithic production. 35-48. Cambridge University Press.

Small R.J., 1958. The Origin of Rake Bottom, Butzer Hill. P. Hants. F.C. 21, 22-30.

Smith A.J., 1981. An Analysis of the Flint Industry from Meare Village West, In Orme B.J. et.al., Meare Village West 1979. Somerset Levels Papers 7, 65-66.

Smith I.F., 1965. Windmill Hill and Avebury: excavations by Alexander Keiller. Society of Antiq., London.

Smith R.W., 1984. The ecology of Neolithic farming systems as exemplified by the Avebury region of Wiltshire. PPS 50, 99-120.

Smith R.W., 1985. Prehistoric Human Ecology in the Wessex Chalklands with special reference to evidence from Valleys. PhD thesis, Univ. of Southampton.

Smith W.C., 1963. Jade axes from sites in the British Isles. PPS 29, 133-172.

Starling N., 1985. Colonization and succession: the earlier Neolithic of central Europe. PPS 51, 41-57.

Tauber H., 1965. Differential Pollen Dispersion and the interpretation of pollen diagrams. Danm. Geol. Unders. 11(89), 1-69.

Tavener L.E., 1964. Land use and Agriculture, In Monkhouse F.J., editor, A Survey of Southampton and its Region. 131-151. Southampton.

Taylor W.W., 1964. Tethered nomadism and water territoriality: an hypothesis. Acts of the 35th International Congress of Americanists. 197-203.

Taylor-Page F.J., editor, 1971. Field guide to British

Deer. Blackwell, Oxford.

Thomas D.H., 1975. Non-Site Sampling in Archaeology: up the creek without a site, In Mueller J.W., editor, Sampling in Archaeology. 61-81. Univ. of Arizona Press.

Thomas J., 1984. A tale of two polities: kinship, authority and exchange in the Neolithic of south Dorset and north Wiltshire. In Bradley R.J. and Gardiner J.P., editors, Neolithic studies: a revue of some current research. 161-176. BAR British Series 133. Oxford.

Thomas K.D., 1982. Neolithic Enclosures and Woodland Habitats on the South Downs. In Bell M. and Limbrey S., editors, Archaeological Aspects of Woodland Ecology. 147-170. BAR Int. Series 146. Oxford.

Thorley A., 1981. Pollen Analytical Evidence relating to the vegetational history of the chalk. J. of Biogeography. 8, 93-106.

Tingle M., 1987. Inferential limits and surface scatters: the case of the Maddle Farm and the Vale of the White Horse fieldwalking survey. In Brown A.G. and Edmonds M.R., editors, Lithic analysis and later British prehistory: some problems and approaches. 87-100. BAR British Series 162. Oxford.

Tinsley H.M. and Smith R.T., 1974. Surface Pollen Studies across a Woodland/Heath transition and their application to the interpretation of pollen diagrams. New Phytol. 73, 547-565.

Tomalin D. and Scaife R.J., 1980. A Neolithic flint assemblage and associated palynological sequence at Gatcombe, Isle of Wight. P. Hants. F.C. 36, 25-33.

Torrence R., 1983. Time Budgetting and Hunter-Gatherer

Technology, In Bailey G., editor, Hunter Gatherer Economy in Prehistory: a European perspective. 11-22. Cambridge University Press.

Torrence R., 1986. Production and exchange of stone tools: prehistoric obsidian in the Aegean. Cambridge University Press.

Trigger B., 1965. The Determinants of Settlement Patterns, In Chang K.C., editor, Settlement Archaeology. 53-78. California National Press.

Trinder H.W., 1907. The Meon Valley. P. Hants. F.C. 6, 65-89.

Troels Smith J., 1960. Ivy, Mistletoe and Elm: Climatic Indicators-Fodder Plants: a contribution to the interpretation of the pollen zone border V11-V111. Danm. Geol. Unders. 1V 4(4), 1-32.

Trubowitz N.L., 1978. The Persistence of Settlement Pattern in a Cultivated Field, In Engelbrecht W. and Grayson D., editors, Essays in Northeastern Anthropology in Memory of Marion E. White. Occ. Publications in NE Anthrop. 5, 41-66.

Tubbs C.R., 1978. An Ecological Appraisal of the Itchen Valley Floodplain. P. Hants. F.C. 34, 5-22.

Wagstaff M., 1986. The archaeological 'site' from a geographical perspective. Paper given at the TAG annual conference, 1986.

Wainwright G., 1972. The Excavation of a Neolithic Settlement on Broome Heath, Ditchingham, Norfolk. PPS 38, 1-97.

Wainwright G. and Longworth I.H., 1971. Durrington Walls: Excavations 1966-1968. Society of Antiq., London.

Walls E., 1929. The Salisbury Avon. Arrowsmith.

Warren R.E., 1982. Prehistoric settlement patterns. In O'Brien M.J., Warren R.E. and Lewarch D.E., editors, The Cannon Reservoir human ecology project: an archaeological study of cultural adaptations in the southern Prairie peninsula. 337-368. Academic Press, New York.

Waton P.V., 1982. A Palynological Study of the Impact of Man on the landscape of Central Southern England, with special reference to the chalklands. PhD thesis, Univ. of Southampton.

Watt A.S., 1947. Pattern and Process in the Plant Community. J. of Ecology 35, 1-22.

Whallon R., 1973. Spatial Analysis of Occupation Floors 1: application of dimensional analysis of variance. Amer. Antiq. 38, 266-278.

Whittaker R.H., 1965. Dominance and Diversity in Land Plant Communities. Science 147, 250-260.

Whittle A.W.R., 1977. The Earlier Neolithic of Southern England and its Continental Background. BAR Supp. Series 35. Oxford.

Whittle A.W.R., 1984. Early farming societies: seventh to fourth millennia bc. In Champion T.C., Gamble C., Shennan S.J. and Whittle A.W.R., Prehistoric Europe. 113-152. Academic Press, London.

Wiens J.A., 1969. An Approach to the Study of Ecological Relationships among Grassland Birds. Ornithol. Monograph 8, 1-93.

Wiens J.A., 1976. Population Responses to Patchy

Environments. Annual Revue Ecol. System. 7, 81-120.

Willock E., 1936. A Neolithic house on Haldon. Proc. Devon Arch. Soc. 2, 244-263.

Winterhalder B., 1981. Optimal foraging strategies and hunter-gatherer research in Anthropology: theory and models. In Winterhalder B. and Smith E.A., editors, Hunter-gatherer foraging strategies: ethnographic and archaeological analyses. 13-35. University of Chicago Press, Chicago.

Winterhalder B. and Smith E.A., editors, 1981. Hunter Gatherer Foraging Strategies: ethnographic and archaeological analyses. University of Chicago Press, Chicago.

Winters H.D., 1963. An archaeological survey of the Wabash valley in Illinois. Illinois State Museum, Reports of investigations, 10.

Wobst M., 1983. We can't see the forest for the trees: sampling and the shapes of archaeological distributions. In Moore J. and Keene A., editors, Archaeological hammers and theories. 37-85. Academic Press, New York.

Wood J.J., 1978. Optimal Location in Settlement Space: a model for describing location strategies. Amer. Antiq. 43, 258-270.

Woodman P., 1981. Problems of Flint Utilization within Eastern Ireland, In Engelen F.H.G., editor, 3rd. International Symp. on Flint. 113-115. Sittard.

Woodman P., 1985. Excavations at Mount Sandel, 1937-77. Northern Ireland Arch. Monographs, 2. HMSO, Belfast.

Wymer J.J., 1962. Excavations at the Maglemosian site of

Thatcham, Berkshire, England. PPS 28, 329-361.

Wymer J.J., 1977. Gazateer of Mesolithic Sites in England and Wales. CBA Research Report 20.

Yellen J., 1977. Archaeological Approaches to the Present. Academic Press, New York.

Young R., 1984. Potential Sources of Flint and Chert in the North East of England. Lithics 5, 3-9.