STRUCTURE IN THE S.W. FRENCH MOUSTERIAN

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The Problem

Thanks to the relatively high density of Middle Palaeolithic sites in the Perigord region of southwest France, and the existence of a number of quite long stratigraphic sequences, the Mousterian industries of the area have for the past two decades provided an important data base for the study of inter-assemblage variability and its interpretation in terms of human behaviour. In particular, detailed study by Professor F. Bordes and his associates of the typology and technology of the lithic material, and of the sediments, flora and fauna with which it is associated, has ensured that we have fuller data for man's activity in this period than for any other prior to the Upper Palaeolithic of the same region. It is therefore a symptom of the present stage of development of a theoretical framework for Stone Age studies that there is little agreement among prehistorians as to the meaning of observed variations in the frequency of occurrence of either flint-working techniques or different types of tool.

At a purely empirical level, Bordes (1972 and elsewhere) has argued for the existence of four major groupings of Mousterian assemblages on typological and technological grounds, two being susceptible to further subdivision into 'variants': the Mousterian of Acheulian Tradition (types A and B, with B later than and perhaps evolved out of A), Typical, Denticulate and 'Charentian' (Quina and Ferrassie variants). Bordes and de Sonneville-Bordes (1970) have suggested that these arise from the coexistence in early Wurm of several distinct cultural groups - a view considered by some workers to be unlikely in the absence of ethnographic parallels and of evidence of a mechanism to maintain discreteness over a long period of time. While interdigitation of the different categories of Mousterian assemblages rules out a simple evolutionary model, Mellars (1968 and 1970) considers that the Quina type postdates the Ferrassie, and that the M.A.T. is the latest (Typical and Denticulate failing to show chronological patterning). It has also been pointed out that seasonal and other factors may be responsible for some specialisation in assemblage composition, though the only attempt as yet to identify 'tool kits' is based on one site in north France and two in the Middle East, and has moreover been criticised on theoretical grounds (Binford and Binford 1966, Binford 1968).

One of the more remarkable features of the controversy is that the proposed groups have been adopted for classificatory purposes by almost all students of the area without their having been formally shown to be discrete entities, despite the necessity which has arisen from time to time to make slight adjustments to their definitions in order to accomodate new material. Yet if the taxa were no more than the result of partitioning a continuous spectrum of variation in an arbitrary manner much of the discussion would be without meaning. It is also possible that some groups may be more valid (in the sense of being phenetically well defined and isolated from other, unrelated, material) than others. While Bordes and de Sonneville-Bordes (op. cit.) have used histograms of two indices to demonstrate the existence of multimodality, these were drawn for only a single set of intervals and therefore leave some room for doubt. Attempts to use multivariate techniques to throw light on internal patterning have served to indicate the more important components of variation but without permitting resolution of the discreteness question for want of sufficient data. Thus Doran and Hodson (1966) had at their disposal only 16 assemblages, which included material from all over France and even from Greece, while an analysis by Hodson on behalf of Mellars (1967) was based on 33 Perigord series.

The somewhat limited objective of the work described here was to establish the extent to which the Bordes partition of the Perigord Mousterian industries is justified by structure detectable within the available typological and technological data, an issue fundamental to the discussion of possible interpretations of observed variability. It is not proposed to consider causal models, since these would involve the introduction of ancilliary evidence requiring lengthy discussion. That the problem studied is far from trivial is however indicated by a similar experiment on Mousterian assemblages from S.E. France, which suggested zoning without discreteness and therefore cast some doubt on the appropriateness of a simple polyphyletic model (or at any rate the possibility of identifying the material culture remains of the different phylae on the basis of the characters examined).

Data

Typological and technological indices based on the system proposed by Bordes (1950 and 1972, 48-50) have been published for over sixty S.W. French assemblages, while Bordes himself has very generously placed at the disposal of the authors a similar quantity of unpublished material (in particular that relating to the crucial site of Combe-Grenal).

Many of the 63 flake-tool and 21 handaxe classes proposed by Bordes are only rarely present; also the use of a very detailed typology would have excluded all but the largest series from consideration on account of possible sampling errors. For present purposes, therefore, the following more restricted set of attributes was employed (for an explanation the reader is referred to the publications of Bordes cited in the bibliography):

Technological indices - IL, Ilam, IF, IFs, IQ

Typological indices - IR_{ess}, IC_{ess}, IAu_{ess}, IB_{ess}

Characteristic groups - I, II_{ess}, III_{ess}, IV_{ess}

Type frequencies - $Limaces_{ess}$, $Notches_{ess}$

These are the variables employed by Bordes to define the six categories of Mousterian assemblage; it should be stressed that one of the assumptions on which the study is founded is that these are in fact appropriate to the assemblages, and have been correctly defined and applied (verification of this assumption by means of attribute analysis would be prohibitively expensive).

This data was available, at the commencement of the investigation, for 96 usable Mousterian series from the Perigord region; unfortunately IQ (the frequency of Quina-type retouch on scrapers) has not been recorded for a number of other potentially important sites, but this sample is large enough to give an adequate representation of assemblage clustering. Attribution of the assemblages to one or other of the Mousterian variants followed the most recent published views of Bordes and his colleagues where possible, otherwise being performed according to their prescribed rules.

Data transformation

Since the variables used are in fact percentages, and therefore limited to the range 0-100, it was thought advisable to normalise their distributions as far as possible by the use of the arcsine transformation proposed by Fisher (1925):

$$a = \sin^{-1} (P/100)^{\frac{1}{2}}$$

Analysis*

Although as a preliminary step a Principal Components Analysis was carried out in order to examine the behaviour of the data without imposing on it any preconceived structure, a plot of the resulting component scores fails to suggest discrete groups (except in the case of the Quina Mousterian), nor would one necessarily expect them to be apparent in projections onto principal component axes, whose ordering is in any case determined by the amount of redundancy in the input variables. Quina was the only group recovered intact in cluster analyses on raw data and principal component scores, but again this may be a result of the 'noise' introduced by irrelevent variables rather than to a genuine poverty of internal structure or to the incorrectness of Bordes's groups.

A technique more appropriate to the evaluation of groups whose existence is already suspected is provided by Canonical Variates Analysis, which in effect provides an optimal representation of the groups by maximising between-groups variance and minimising within-groups variance. Distances within the resulting multidimensional space are free from the effects of correlation between the input variables; also the same results will be obtained independent of the scale on which the latter were measured. The canonical variates are linear functions of the original observations, and therefore do not distort the relationship between assemblages in any way - i.e. indistinct groups will not appear any clearer than they are at the outset. In a three-dimensional space the process is somewhat analogous to placing a model constructed of table-tennis balls in the centre of a room, with the observer looking at it from different angles to find the viewpoint from which his suspected clusters are most clearly seen. The result is dependent upon the input groups defined; if these do not correspond to 'natural' structuring they will tend to be indistinguishable both in scattergrams based on variate scores and following cluster analysis of the Mahalanobis distance matrix. If only minor changes in the allocation of assemblages would result in improved apparent structure these may be suggested by the results of cluster analysis or by the application of the classificatory functions generated during the analysis; repetition of the cycle 'CVA - reallocation' through several iterations should rapidly lead to a local optimum (there is of course no way to be sure that a global optimum, from the archaeological if not the statistical point of view, is obtained).

In the case of the present data, very few assemblages proved to require reallocation; some of these had in fact been incorrectly assigned in the first instance (for instance as a result of reference to an out-of-date publication), while reassignment of assemblages about which the excavator of the site had expressed doubt actually reduced interdigitation between variants (i.e. simplified the archaeological succession). The results described below are based on the final classification of assemblages.

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*For a full description of techniques see Blackith & Reyment (1971) and similar publications.

Figure 2 shows the groups plotted on the first two canonical variates (it should be remembered that the scattergram represents a two-dimensional projection of points from a five-dimensional space, and that apparently overlapping groups may well be clearly distinguished by other variates). Apart from a stray Ferrassie assemblage, which is partly a result of reduced dimensionality, the Quina group is well isolated from the rest. Among the other groups far less overlap occurs than was the case for principal components, though they are not well separated.

Once one group of assemblages has been shown unlikely to be drawn from the same population as the others, it is legitimate to exclude it from a repetition of the analysis, so reducing the number of dimensions required to represent the configuration of groups and thus the likelihood of overlapping arising during projection onto the plane of a scattergram. In this way succesive variants were stripped from the dataset as their discreteness was established. A variety of clustering algorithms were also applied to the generalised distance matrix to confirm the extent to which the groups were defined in more than two dimensions.

As a final step, the investigation of pairs of variants was undertaken both in order to assess their separation and to derive a set of discriminant functions which would be optimal for classification of border-line cases.

Results

While it is not possible in the available space to give a full description of the experiments, it should be apparent from the illustrations given that there is considerable justification for the partition of S.W. French Mousterian assemblages proposed by Bordes. Not only is the typological and technological data multimodal in character, but it is possible to identify several discrete clusters of assemblages corresponding to his suggested variants. The primary goal of this investigation - to confirm or otherwise the existence of such clusters on which much discussion of the Mousterian depends - would seem to have been achieved. The interpretation of the clusters in terms of activity facies or socio-cultural groups is a separate issue requiring comparison with the (usually incomplete) data for site location and size, limitations of raw material, available meat and food resources, date and climatic conditions etc. In fact, given that most of the assemblages derive from caves or rock shelters and are therefore liable to be palimpsests of material from successive occupations, it is altogether remarkable that such clear structure should be recoverable.

Despite the limitations imposed by the inclusion of industrial data alone in the study, it is possible to make a number of comments pertinent to selection of an interpretative model. Thus the clear definition of the Quina and Ferrassie groups, and more particularly the M.T.A. 'A' and 'B' (though in the latter case the small number of assemblages is a problem), suggests that if an evolution from one to the other is to be supported it is necessary to postulate either a comparatively shortlived transitional phase, or a poor recovery rate for its lithic assemblages. It may also be noted that the poorest separation between any two groups is that between Ferrassie and Typique - while it is possible to obtain complete discrimination between these, it is possible that some assemblages could be reassigned to give better structuring, since the latter variant is something of a 'catch-all' category.

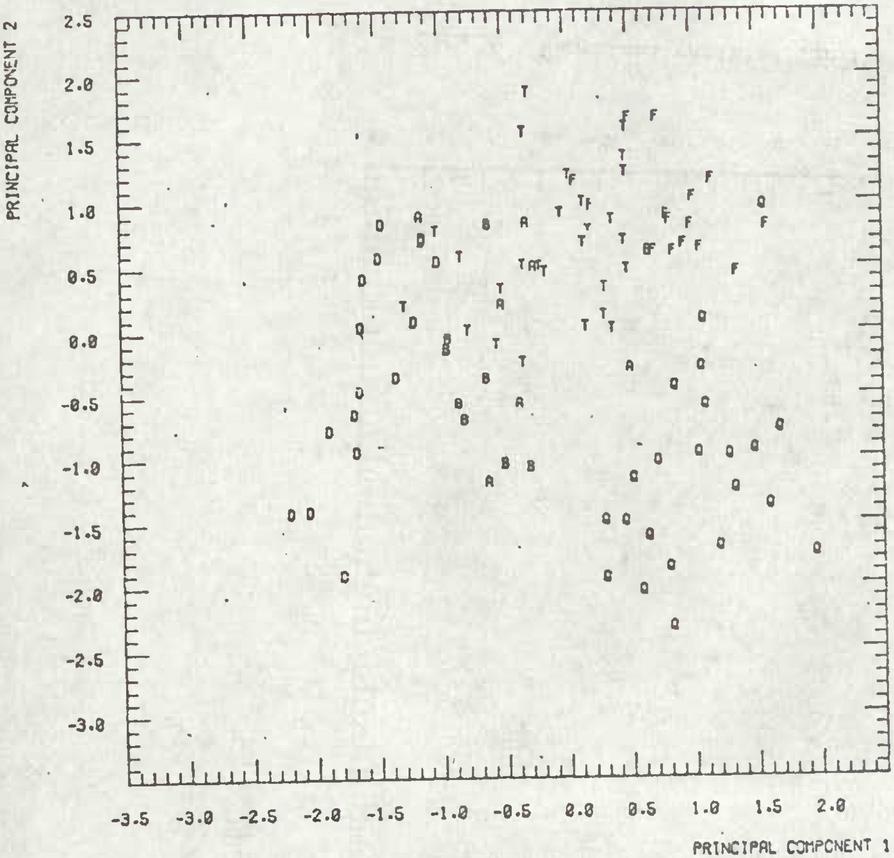

Fig. 1

Principal Components on 96 Perigord Mousterian assemblages. PC1 contrasts IQ, IR, IC and II (positive) with IV and Notches(neg.). PC2 scores positive for technical indices (I, IL, Ilam, IF, IFs).

Key:
A M.T.A. 'A'
B M.T.A. 'B'
D Denticulate
F Ferrassie
Q Quina
T Typical

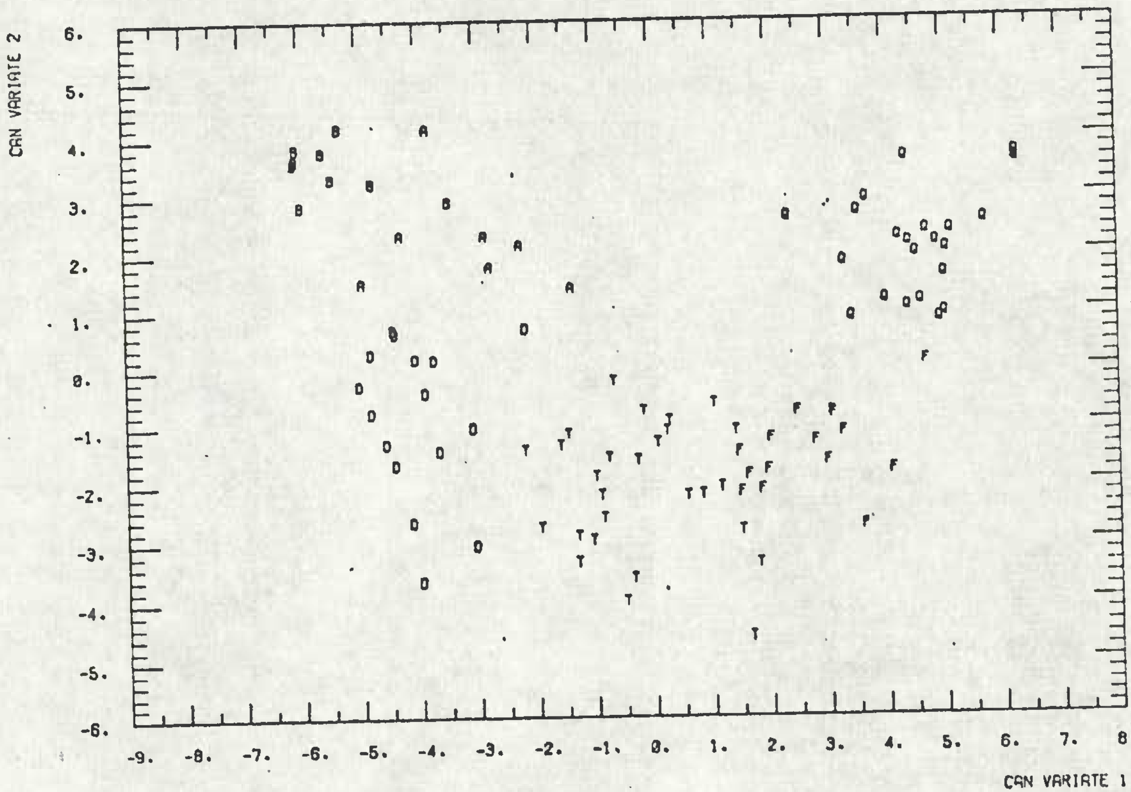

Fig. 2 Canonical variates for the data used in Fig. 1

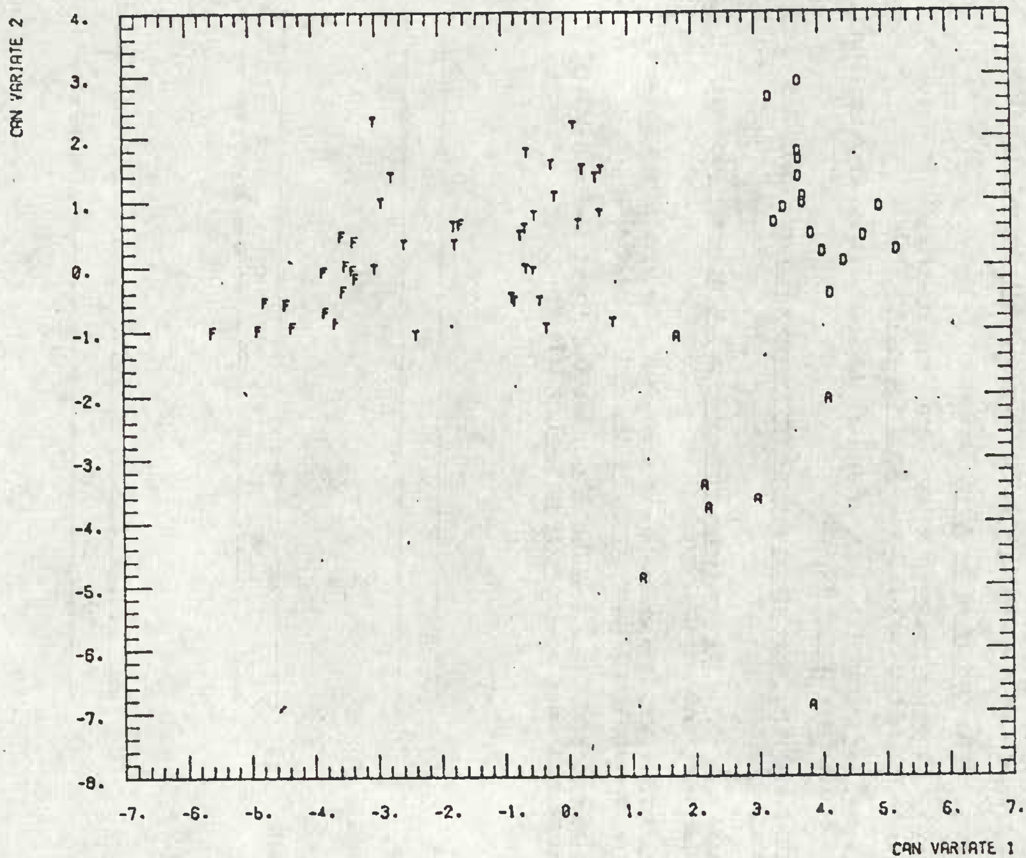

Fig. 3

As Fig. 2, but omitting the Quina and M.T.A. 'B' assemblages.

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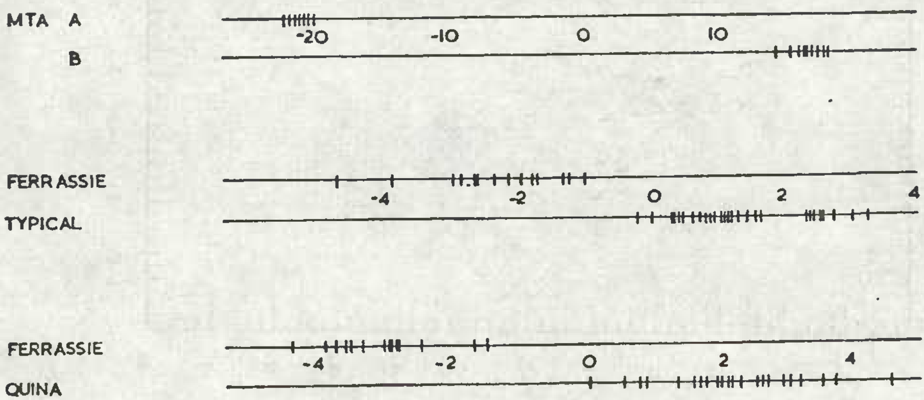

Fig. 4. Canonical variate scores for pairs of groups