A PROPOSED ATTRIBUTE ANALYSIS OF ARCHAEOLOGICAL GROUND-FEATURES: AN EXPANSION OF THE AUTOMATIC ARTIFACT REGISTRATION SYSTEM.

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The excavation of open-air settlement sites entails the observation, registration and analyses of their three constituent and inter-related elements: their artifacts, ground-features and environmental context. Ideally, all three elements should receive equal consideration. By means of their balanced integration on the observational, analytical and interprative levels, it should be possible to approach a reconstruction of the settlement as a functional habitation unit. This unit should exhibit external borders and an internal structure from which the adaptive strategy has been executed for a finite period of time, by a specifically organised social unit in articulation with its environment (Fig.1).

In earlier publications (Newell and Vroomans; 1972, 1974), the data recording, information retrieval system and preliminary analyses of the artifactual element of the Mesolithic settlement Bergumermeer S-64, gem. Tietjerksteradeel, prov. Friesland, The Netherlands, have been described. At the time of publication, the study of the features element was in its infancy. Where Mesolithic floor-plans have been published in northwestern Europe (Diekmann, 1931, 1939; Clark, 1954; Higgs, 1959; Rankine and Dimbleby, 1960; Wymer, 1962; Nowotnig, 1966; Heesters, 1967, 1968, 1969; Bokelmann, 1971; v.Brunschot and Groels, 1972; Newell, 1973), their features were almost uniformly classed as "hearths". The recent analysis of remaining feature fill from earlier excavations in the Netherlands (Bohmers and Wouters, 1956 and Newell, n.d.) indicated that many of these "hearths" contained little or no charcoal and that their fill appeared to vary considerably in colour. While a two-fold division of features into "hearth" and "non-hearth" or "pit", observed on cover-sand Mesolithic settlements, may be an improvement over older observations, the fact remains that such a division, based merely upon two attributes - abundance of charcoal and colour - is as subjective and artificial as it is untenable. The Bergumermeer features, identified in the field as "hearths" and "pits", show a greater measure of metric, elevational, locational and associational variation among themselves than can be justifiably pressed into one or the other of the two preconceived classed (Fig.2).

Quite clearly, the identification and discrimination of the various classes of features should proceed from an objective and uniform recording and analysis of their constituent attributes, in relation to the pedological matrix in which they are situated. Multivariate clustering may then be expected to provide a classification based upon objective and equal consideration of all the attributes, rather than just a few, When such a classification has been executed, we may expect a more reliable understanding of the range of variation of the features and its relation to the internal organisation of the settlement. To this end, the following attribute list is proposed and will be applied to the Bergumermeer features.

Following identification, drawing and photographing in plan, the field information is entered onto standardized forms, such as those given in Figures 3a and 3b. Such forms should include space

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BERGUMERMEER S-64 RESEARCH STRATEGY

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G O A L

Discover + Define Mesolithic
Adaptive Processes and Life-Ways

I. FEATURES ANALYSIS	II. ARTIFACT ANALYSIS	III. ECOLOGICAL ANALYSIS	
SYNTHESIS Reconstruction of Settlement as a Functional Habitation Unit where Adaptive Strategy is executed by a Specific Social Unit		SYNTHESIS Reconstruction of the Ecological System in which Inhabitants of the Settlement had to integrate. Define Exploitative Potential of Site Catchment Area as Conditioning Context of Habitation	INTEGRATION
Define Activity Areas Define External Borders and Internal Organisation of Settlement Analysis of Horizontal Distribution and Clustering of Features Define Classes of Features	Define Activity Areas Define External Borders and Internal Organisation of Settlement Analysis of Horizontal Distribution and Clustering of Artifact Types Define Range of Material Culture as the Means of executing Adaptive Strategy	Site Catchment Analysis Procurement of Site Resources Flint Metamorphic Stone Structural Stones Red Ochre Species Wood Edible Plants + Nuts Faunal Food Resources Fish/Birds	ANALYSIS
Palaeobotanical Archaeozoological Mechanical Chemical Morphological	Seeds + Nuts C14 Red Ochre Gastroliths + Bones Chipped Flint Industry Metamorphic Stone Industry Structural Stones Hammerstones	Palaeobotanical Analysis Seeds + Nuts Charcoal Identification Surface Pollen Pollen Cores Archaeozoological Gastroliths + Bones Pedological Hydrographical	OBSERVATION

FIGURE 1.

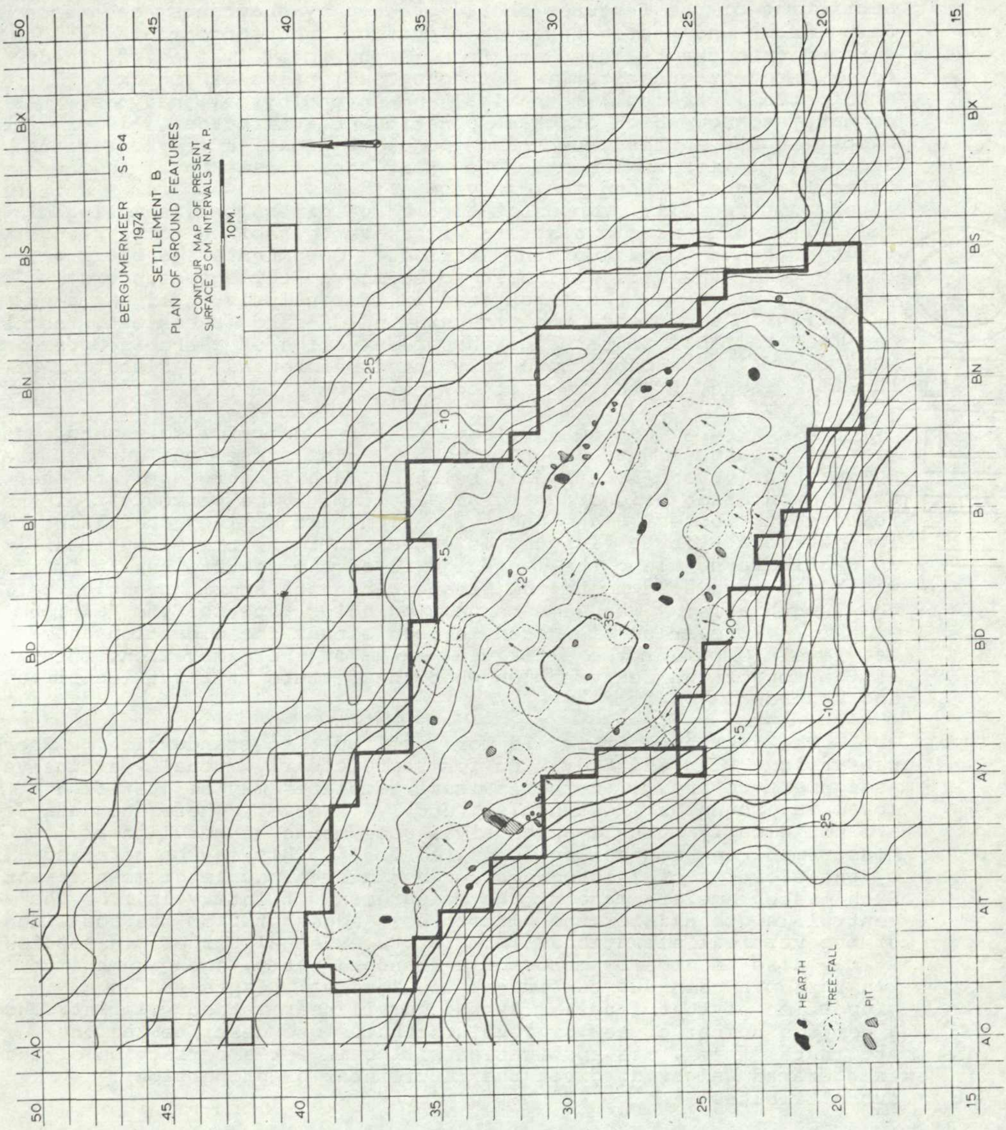
BERGUMERMEER S-64
1974
SETTLEMENT B
PLAN OF GROUND FEATURES
CONTOUR MAP OF PRESENT SURFACE 5CM INTERVALS N.A.P.
10M.
HEARTH
TREE-FALL
PIT
-25
-10
+5
20
+35
50
45
40
35
30
25
20
15
BX
BS
BN
BI
BD
AY
AT
AO

FIGURE 2

for all pertinent data for entry on the final data sheets. Ideally, sectioning of the features should proceed by quadrants, each face being drawn and photographed in elevation, the appropriate data being entered onto the Feature Data Form. The total fill is retained for subsequent quantitative morphological, paleo-biological, artifactual, chemical, mechanical and chronological analyses. As we do not yet know which of these constituent attributes will form the discriminants in the clustering and classification of the various features, it is our intention to treat them all as equal in the first instance. When the excavation is far removed from a suitable laboratory facility, representative three dimensional sampling of the fill and/or possible strata will have to replace total recovery for the "content" part of the attribute "Components" (see Fig.4). In any case, the fill will need to be sieved through standard graduated sieves as the first step in the analysis. It has been the writer's experience that the sieving of sand is easiest, fastest and most reliable in terms of the preservation of carbonized remains, when the fill has been thoroughly dried beforehand. Flotation of the fill is an alternative method.

Figure 4 gives the Attribute List for entry of data onto the proposed Features Data Sheets (Fig.5). The first four entries are administrative and locational, relating each feature entry to the basic excavation grid or coordinate system. The parameters of the feature attributes "Plan" and "Elevation" are defined as follows. The metric attribute "length" is suggested to be the measurement, in centimeters, along the longest axis of the feature, while "maximum width" is suggested to be the greatest breadth at right angles to the length axis. The same convention holds true for the "minimum width". "Elevation" is taken to mean either the elevation above sea-level (O.D.) or the artificial datum of the excavation, recorded at the top of the feature plan when the feature is first identified and recorded.

The attribute "form" is more difficult to standardize. Where the various Plan and Elevation forms are clearly mutually exclusive, assignment to one or another "visual template" may be justified (oval vs. round vs. rectangular, etc.). Hoever, where the data are not clearly mutually exclusive, some means of curvilinear measurement and comparison is called for. This may be effected by the erection of "histograms" on an interval scale of measurement. Such histograms are made by the measurement of intervals from the central length axis of the plan to both edges or from the top line of the vertical elevational form to its external border, in section. It may also be done by means of a standard ratio, such as maximum length/depth using up to five or ten intervals expressed as a proportion of that index. As the curvilinear method will introduce a certain number of new or "sub-attributes" to describe the one attribute "form", its application will call for a correction of the exaggerated weighting given the curvilinear or proportional sub-attributes

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FIGURE 3a.

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FEATURE DATA FORM

Name of excavation: ____________________ Square no: ____________________

Location: ____________________ Feature no: ____________________

Date: ____________________ Preliminary Identification: ____________________

Day Elevation: ____________________ Name of Excavator: ____________________

FIRST OBSERVATIONS IN PLAN: ____________________

1 Elevation: ____________________ 2 Soil Layer: ____________________

3 Relation to Culture Layer ____________________ 4 Degree of Dessication: ____________________

5 Sharpness of Outline ____________________ 6 Composition ____________________

7 Hardness of Fill ____________________ 8 Length ____________________

9 Colour ____________________ 10 Width ____________________

CONTENTS: ____________________

a Charcoal ____________________ f Nuts ____________________

b Stones ____________________ g Ochre ____________________

c Pebbles ____________________ h Other (specify) ____________________

d Gastroliths ____________________

e Flints ____________________

SECTION: ____________________

a Homogenous ____________________ d Disturbances ____________________

b Stratified ____________________ e Other (specify) ____________________

c Charcoal Lenses ____________________

CONTENTS: ____________________

a Charcoal Blocks ____________________ h Nuts ____________________

b Charcoal Flecks ____________________ i Ochre ____________________

c Carbonacious Smear ____________________ j Other (specify) ____________________

d Stones ____________________

e Pebbles ____________________

f Gastroliths ____________________

g Flints ____________________

P.T.O.

FIGURE 3b.

Colour of Constituent Pedological Elements: ____________________

Relation of Feature to Podzol Formation: ____________________

Depth of Feature: ____________ Orientation of Feature Drawing: ____________

Elevation of Top of Feature in Drawing: ____________________

Scale(s) of Drawing(s): ____________________

Observations during Collection of Fill: ____________________

Number of Sacks of Fill: ____________ Additional Samples: ____________

Number of Photos Taken: ____________________

Artifact Numbers of Artifacts Recovered from Fill: ____________________

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ATTRIBUTE ANALYSIS OF ARCHAEOLOGICAL FEATURES

Card 1

Administration	
Excavation Code	COLUMNS 1- 3
Square Number	4- 9
Feature Number	10-12
Stratum or Sample Number	13-15
Plan	
Maximum Length in cm.	16-20
Maximum Width in cm.	21-25
Minimum Width in cm.	26-30
Form	31-40
Elevation	
Elevation O.D. in cm.	41-45
Depth in cm.	46-50
Volume	51-55
Form	56-64

Card II

Feature Number	COLUMNS 1- 3
Components	
Colour-wet Munsell Colour 7.5 yr 5.0/4.0	4-14
Colour-dry " "	15-25
Colour-ignited " "	26-36
Density Penometer	37-39
Strata Number	40-42
Content	
1. Charcoal by Weight	43-47
2. Nuts by Number	48-50
3. Bone " "	51-53
4. Shell " "	54-56
5. Gastroliths by Number	57-59
6. Flints " "	60-62
7. Pebbles " "	63-65
8. Stones " "	66-68
9. Ochre " "	69-71
10. Div. Artifacts by Number	72-79

Card III

Feature Number	COLUMNS 1- 3
Chemical Properties	
1. Phosphate mg p/100 gm or Percentage	4- 8
2. Nitrogen " " " "	9-13
3. Organic Humus " " " "	14-18
Alkali Soluble	19-23
Total Humus	
4. Iron " " " "	24-28
5. Calcium " " " "	29-33
6.-10. Div. Trace Elements " "	34-77
11. p.H	78-79

Card IV

Feature Number			COLUMNS 1- 3
Physical Properties			
2.00-0.600	Sand	Coarse Percentage	4- 7
0.600-0.200	Sand	Medium "	8-11
0.200-0.060	Sand	Fine "	12-15
0.060-0.020	Silt	Coarse "	16-19
0.020-0.006	Silt	Medium "	20-23
0.006-0.002	Silt	Fine "	24-27
$<$ 0.002	Clay	"	28-31
Associations			
Total Number of Flints			32-35
Total Number of Flint Tools			36-39
Additional Artifactual Associations			40-74
Age			
C_{14} Date		C_{14} Years B.P.	75-79

FIGURE 4.

ORGANISATION
EXCAVATION
CODE

ATTRIBUTE ANALYSIS OF ARCHAEOLOGICAL FEATURES

NAME
DATE

CARD NUMBER 1

EXC CODE	SQUARE NUM	FEAT NUM	STRA NUM	PLAN: MAX L	PLAN: MAX W	PLAN: MIN W	PLAN: FORM	ELEVATION: ELV O D	ELEVATION: DEPTH	ELEVATION: VOLUME	ELEVATION: FORM		C N

Columns numbered 1–80; column 80 pre-printed 1.

ORGANISATION
EXCAVATION
CODE

ATTRIBUTE ANALYSIS OF ARCHAEOLOGICAL FEATURES

NAME
DATE

CARD NUMBER 2

FEAT NUM	COLOUR COMPONENT: COLOUR WET	COLOUR COMPONENT: COLOUR DRY	COLOUR COMPONENT: COLOUR IGNIT.	DENS.	STR NO.	CONTENT COMPONENT: CHARC.	NUT	BON	SHE	GAS	FLI	LIN	PEB	STO	OCH		C N

Columns numbered 1–80; column 80 pre-printed 2.

ORGANISATION
EXCAVATION
CODE

ATTRIBUTE ANALYSIS OF ARCHAEOLOGICAL FEATURES

NAME
DATE

CARD NUMBER 3

FEAT NUM	CHEMICAL PROPERTIES: PHOSPH	NITROG	ORG HUM	IRON	CALCIUM		PH	C N

Columns numbered 1–80; column 80 pre-printed 3.

ORGANISATION :
EXCAVATION :
CODE

ATTRIBUTE ANALYSIS OF ARCHAEOLOGICAL FEATURES

NAME :
DATE .

CARD NUMBER 4

FEAT NUM	SAND: COARSE	SAND: MEDIUM	SAND: FINE	SILT: COARSE	SILT: MEDIUM	SILT: FINE	CLAY	ARTIFACT ASSOCIATIONS: T FL	T FL T		C14 DATE	C F

Columns numbered 1–80; column 80 pre-printed 4.

FIGURE 5.

The first of the "Components" attribute is colour. In accordance with standard pedological practice (Cornwall, 1958; Tinsley, 1970; Soil Survey Staff, 1962;) colour should be determined on dry, wet and ignited samples with a Munsell-Soil-Color-Chart (Munsell Color Company, 1971) or, less expensively, with the Revised Standard Soil Color Charts (Oyama and Takehara, 1967). The density of the feature or strata can be measured quickly and easily in the field with a C.50 Pocket Penetrometer (marketed by Wykeham Farrance Engineering Ltd., Weston Road, Slough, England), or with a similar device. The component "strata" is taken to mean the number of strata in the feature. The quantitative recording of the contents of the feature should be self-explanatory for each suggested class of material. This list may be expanded or contracted to meet the needs of each excavation situation.

Recent work on the soil chemistry of archaeological sites (Lutz, 1951; Solecki, 1951; Cornwall, 1958; Biek, 1963; Cook and Heizer, 1965; Provan, 1971;) has indicated that certain environmental and functional information may result from the quantitative analyses of the elements and compounds mentioned below. Provan (1971) and Egner et.al.(1960) describe methods, applications and results of phosphate determination. Lutz (1951) has successfully identified nitrogen and calcium concentrations on stone-age settlements. Organic humus may be measured by the alkali-soluble fraction (Cornwall, 1958; Tinsley, 1970) or, more expensively, by total humus (Tinsley, 1950). Cook and Heizer (1965) have demonstrated the success of this test in numerous archaeological contexts. Iron determination may be equally useful. Hofstee's method (Hofstee, 1966) is perhaps the most current. In addition to these five basic chemical properties, local conditions, the artifactual material on the site, or the nature of the archaeological question being asked may call for additional determinations (Sokoloff and Carter, 1952). Finally, the pH may be determined colorimetrically or, less accurately, with pH test-papers (Cornwall, 1958). Further archaeological applications of pH analysis are discussed by Deetz and Dethlefsen (1963).

Variations in the function and activities associated with the ground-features may also be indicated by the physical properties of the fill. The process of mechanical analysis and comparison of the grain size of the fill is described in Cornwall (1958) according to principles and grades established by the British Standards Institution (1948).

Entries for the total number of flints, total number of flint tools, or any other class of artifacts associated with a particular feature may be read off frequency contour maps or extrapolated from the counts per excavation unit. Their inclusion guarantees that their relation to the horizontal distribution of one or a number of classes of features is taken into account in the primary clustering and classification.

If the charcoal weighed for the "content" attribute is sufficient for a C_{14} measurement, its determination may contribute toward the identification of contemporary features in the final cluster analysis. A word of caution is required here. Divergences in the standard deviation (±) values for the various dates may cause anomolies in the clustering. Only after a statistical comparison of the dates and their standard deviations may they be considered of equal reliability and entered on the Features Data Sheet for primary analysis. Alternatively, one could argue that the C_{14} should be considered independently and the clustering first be conducted on more similar kinds of attributes.

Quite clearly, an attribute list of this nature is open-ended and can be expanded or contracted to meet local conditions or specific archaeological and/or field-technical questions. However, the above list is offered as being sufficiently complete and detailed to cover most situations encountered on stone age open-air settlement sites.

Once the attributes have been decided upon and the various analyses executed, the data are suitable for analysis by multivariate techniques such as average-link (Hodson, 1970) and maximum or minimum link (Lance and Williams, 1967 a+b) cluster analysis. Finally, Gower (1971) has suggested a promising method for the comparison of different methods of multivariate analysis of the same data.

The application of such analysis to the full range of recorded and equally weighted attributes can be expected to produce an objective classification of the features. Furthermore, the clustering and significance levels can be objectively tested. The resulting classification will then be more reliable for the identification of horizontal distribution and spatial clustering of features for the definition of the external parameters and internal organisation of the settlement. By means of a comparison with the environmental data, the resulting classification may yield more specific information as to the function and/or activity areas associated with each class and/or location of features. This classification can also be expected to approximate more closely than the former two-fold dichotomy the real variability of the features, as they existed in the prehistoric situation. By relating this classification to the artifactual elements of the floor-plan (e.g. artifact frequency contours, concentrations of artifacts, single types or combinations of types), we may expect to isolate and define more exactly the nature and extent of specific activity areas. At the same time, we can measure their relative significance and intensity in terms of area occupied and numbers of associated tools and/or artifacts. Finally, by judiciously performing these analyses, the features element attains equal weight in the excavation research strategy and its final execution.

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