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Intrasite Spatial Analysis of the Early Medieval Hamlet of Develier-Courtételle, Switzerland

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DATA AMASSED during the recent excavation of an early medieval settlement in the Canton of Jura, Switzerland, offered the rare opportunity of conducting an in-depth intrasite spatial analysis of an entire hamlet. Some of the problems encountered and a selection of the results produced during this research are presented. The focus is primarily on methodological issues: data loss during mechanical excavation; the choice between statistical or visual analysis; and distinguishing the effects of taphonomy from patterning due to cultural activities.

Located within the Jura mountain range at an altitude of 450 m, the site of Develier-Courtételle lies on the banks of the brook 'La Pran', in a lateral valley of the Delémont basin (Fig 1). A campaign of archaeological test-trenching, prompted by the construction of the A16 highway, led to the discovery of this rural settlement. Between 1993 and 1997, 3.5 ha of its surface were excavated by the Section d'archéologie of the Office de la culture, République et Canton du Jura. A large majority of the features and finds discovered during the excavation date to the early medieval period and were associated with an archaeological horizon located at a depth of between 35 and 60 cm below the modern soil surface. An extensive publication of the analysis is available in French.[2]

The features cluster unevenly and form six farmsteads and four activity areas, strung out over a distance of 950 m along the banks of the brook and separated by boundary ditches, the streambed or empty spaces (Fig 2). Each farmstead consists of at least one house and several smaller buildings, mostly square four-post constructions or pit-houses (sunken-featured buildings). Hearths, ovens, pits and stone-paved areas are found in and around these constructions. Of the four activity areas, two were primarily used for working iron. The original functions of the remaining two activity areas could not be determined.[3]

The remains of 14 large buildings, ten medium buildings, 40 small structures and 16 pit-houses were discovered. Most of these were post-built, but several houses, outlined by shallow foundation trenches or evenly spaced stone blocks, were constructed on sill-beams. Numerous finds are associated with these features: more than 8100 potsherds, 2300 iron and 140 bronze artefacts, 160 shards of glass vessels, 90 glass and amber beads, 200 stone and 20 wooden tools, 20 pieces of worked bone, 13,000 fragments of animal

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[2] Fellner and Federici-Schenardi 2007, 11–69.

[3] Federici-Schenardi and Fellner 2004.

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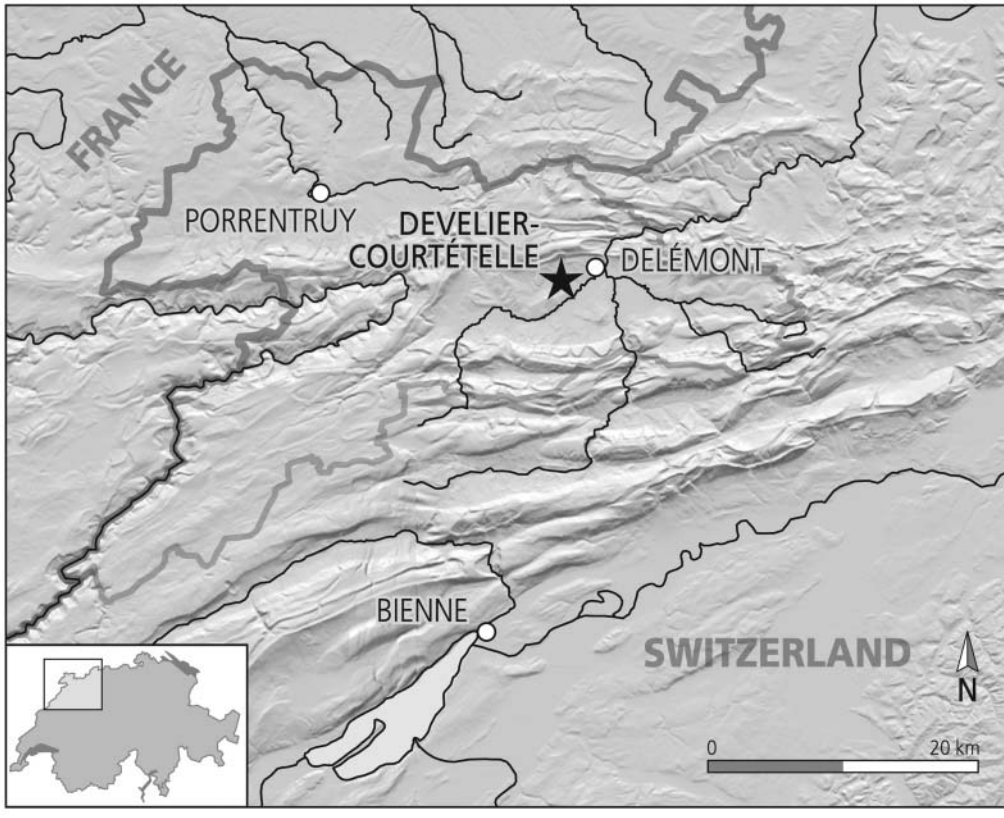

FIG 1
Location of the site of Develier-Courtételle. *Map by M-C Maître. © Office de la culture Jura.*

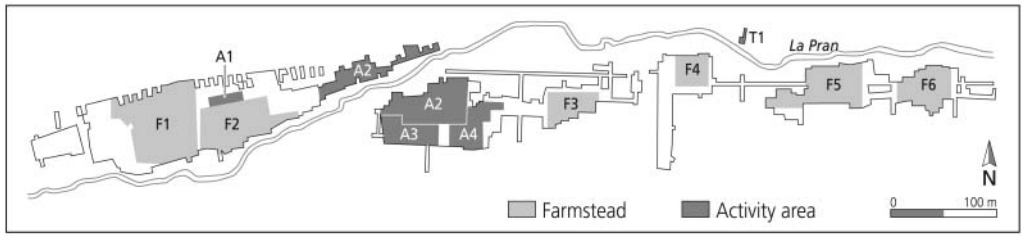

FIG 2
Map of the site outlining the excavated area and situating the different farmsteads and activity areas. *Map by T Yilmaz. © Office de la culture Jura.*

bone, 7200 shards of Roman roof tiles used in the construction of ovens and hearths, 11 kg of daub fragments and four tons of iron slag derived from smithing.[4]

According to radiocarbon and typological dating, farmsteads one, three and five were founded during the second half of the 6th century. The remaining farmsteads were established by the end of the century. Farmsteads three and six were abandoned during

[4] Marti et al 2006; Eschenlohr et al 2007; Guélat et al 2008.

the first half of the 7th century and farmsteads four and five and the activity area four before the year AD 700. Farmsteads one and two and activity areas one and two, all situated in the W half of the site, were occupied until the middle of the 8th century.

SITE CONDITIONS

The excavation produced numerous features and finds, but also detailed information on their respective spatial distribution. Of the 130,000 finds with precise coordinates (3400 finds could not be exactly located), 41% were discovered within features and 59% came from the surrounding surfaces. In many large-scale excavations of early medieval settlements, the archaeological horizon is removed in bulk without locating the finds and only the features are excavated by hand and documented precisely. This limits the validity of a spatial analysis. The data available at Develier-Courtételle is thus of unusual quality. The relatively short occupation period is another asset, further facilitating the analysis of the spatial distribution of the finds and features.

EXCAVATION METHODS AND DATA LOSS

Excavating a surface of 3.5 ha is only possible with mechanical means. We used a tracked hydraulic excavator equipped with a smooth bucket for these operations. The machine first removed the overburden in bulk revealing the archaeological horizon. The second step involved the carefully stripping of the archaeological horizon in 1 cm spits. Two technicians monitoring this operation located, recorded and collected the archaeological finds. The mechanical excavation was halted either at the base of the archaeological horizon, with the appearance of features or when encountering exceptionally dense clusters of finds. The features and the densest artefact concentrations were dug manually. Only samples of the soil were sieved, mostly to recover plant remains and hammerscale (the minute fragments of iron detached during the forging process).

The extensive use of machinery during the excavation obviously results in the loss of some data. Small finds in particular are less likely to be discovered. However, a comparison of the length distribution of the potsherd populations recovered respectively during mechanical and during manual excavation indicates that this loss is less severe than expected (Fig 3a). Only the smallest sherds, measuring less than 2 cm (3% of the total population), are underrepresented in the material recovered during mechanical excavation. The weight distribution of faunal remains (Fig 3b) shows a somewhat greater distortion. Working with machines clearly led to a significant loss of fragments weighing less than 5 g (10% of the total population). Only 30 small bone fragments and one broken glass bead were discovered in the 550 kg of soil samples that were wet-sieved. Nearly all objects measuring 1 cm or more were successfully recovered during manual excavation.

The data loss incurred through mechanical excavation thus concerns mostly small objects measuring less than 2 cm. The spatial analysis of artefact categories dominated by larger pieces (potsherds, iron slag, metal objects, stone tools, roof tiles, most faunal remains) is hardly affected by the difference between manual and machine excavation. However, artefact classes containing mostly small objects (glass beads, bird bones, glass vessel shards) suffered much greater data loss. Only 24% of glass beads and 36% of glass vessel shards were found during mechanical excavation, and all 27 bird bones were recovered manually. These categories have therefore been discounted in the spatial analysis.

STATISTICAL OR VISUAL ANALYSIS?

In many archaeological publications, the presentation and analysis of mapped artefact scatters begins with a visual inspection, followed by a description of observed

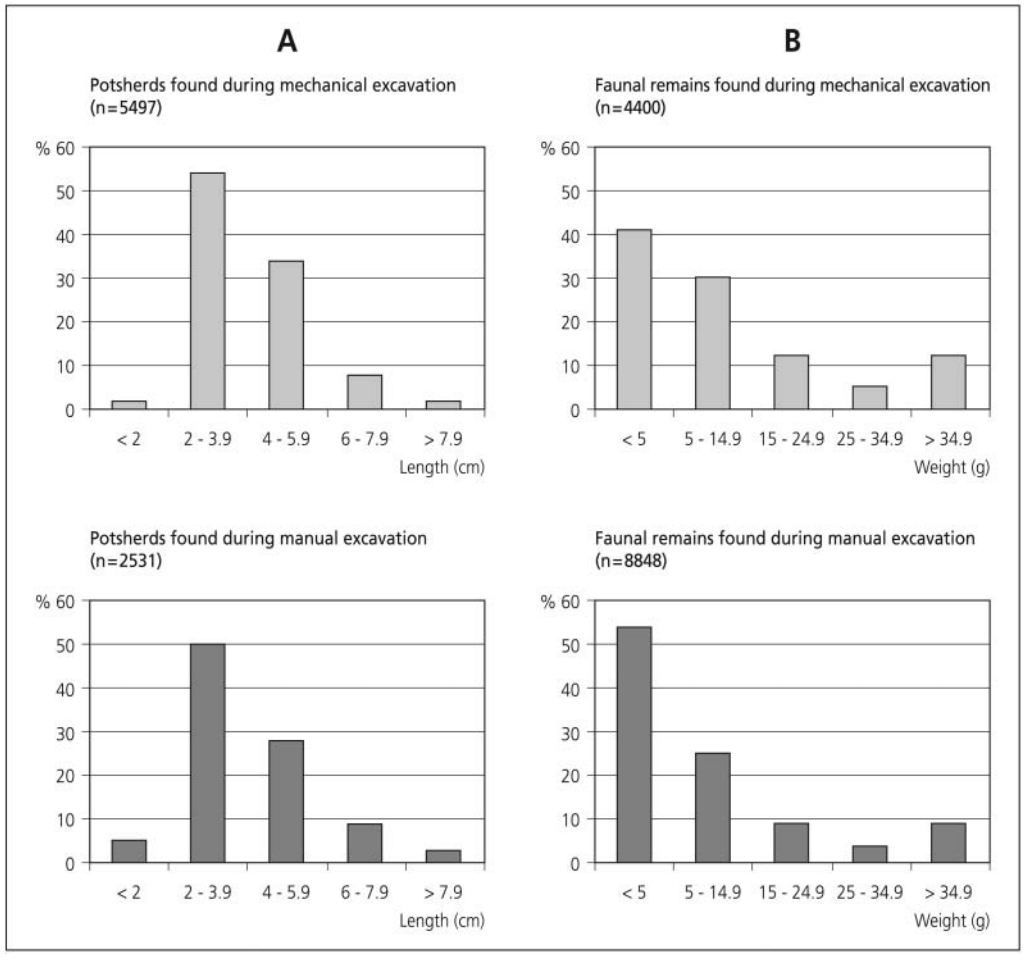

FIG 3

(**a**) Bar charts comparing the length of potsherds recovered during mechanical and manual excavation. (**b**) Bar charts comparing the weight of faunal remains recovered during mechanical and manual excavation. *Graph by T Yilmaz. © Office de la culture Jura.*

concentrations or empty spaces. Several authors consider this procedure too 'intuitive', potentially misleading and biased; they recommend using a multivariate statistical approach to identify significant concentrations or empty spaces.[5] A considerable variety of statistical techniques has been proposed for this task and several have even been specifically developed for it.[6] In a comparative test of seven different methods, four were pronounced more or less effective: k-means cluster analysis of spatial coordinates, k-means cluster analysis of presence/absence counts, unconstrained clustering and correspondence analysis.[7] Of these, the application of k-means cluster analysis of spatial coordinates is

[5] Hodder and Orton 1976.
[6] Djindjian 1991, 109–42; Blankholm 1991.
[7] Blankholm 1991.

particularly simple. More recently, another promising approach using 'k' and 'l' functions has been proposed.[8]

A test using k-means cluster analysis on an artefact scatter from Develier-Courtételle proved disappointing.[9] The test was performed on the spatial coordinates of all tile and brick fragments found in farmstead two, which visually present a structured distribution (Fig 4). The division into five clusters proposed by the method appears reasonable if we do not take the location of the archaeological features into account. Two large concentrations are recognised in the W half of the farmstead, the remaining material is divided into three groups with less obvious boundaries. A more meaningful result could in this case be obtained through a simple visual analysis: practically no tile or brick fragments were found inside the larger buildings, while concentrations are located within pit houses, which were apparently used as dumps after abandonment. Two more or less linear concentrations are located to the northwest and the northeast of the buildings and seem to mark the limits of the inhabited space. Their orientation coincides with that generally given to boundary ditches and palisades observed in this part of the site.[10]

The purpose of explorative statistics of this kind is to simplify the complexity of the dataset and to render undetected patterns visible.[11] In the present case, patterns inherent in the artefact scatter could be 'read' by visual means; the grouping proposed by k-means cluster analysis did not bring any improvement and actually appeared less relevant. We therefore decided to rely on a visual analysis of the artefact scatter. However, other statistical approaches may yet produce results that equal or surpass visual analysis. The complete dataset from Develier-Courtételle is available on request to anyone who wishes to pursue this question.

ARTEFACT SCATTER AND POST-DEPOSITIONAL FORMATION PROCESSES

The spatial distribution of artefacts is not only the result of human behaviour during the occupation of a site; it has subsequently been modified by cultural and environmental processes.[12] The interpretation of any artefact scatter must thus be preceded by an analysis of the local formation processes.

POST-DEPOSITIONAL CULTURAL FORMATION PROCESSES

New construction is the human activity most likely to distort artefact scatters after deposition.[13] The site of Develier-Courtételle remained mostly untouched by later building activity, with the exception of several modern drainage ditches. These had a negligible influence on the distribution of finds as they affected only a tiny part of the total site surface. It is more difficult to evaluate the impact of ploughing, which can bring buried objects to the surface and may also result in horizontal displacement.[14] In activity areas three and four, furrows left by ploughing marked the surface of several features. The local archives indicate, however, that the floodplain bordering the brook 'La Pran' was considered too humid for the cultivation of cereals and was mostly reserved for pasture.[15] The

[8] Orton 2004.
[9] Fellner and Federici-Schenardi 2007, 22–3.
[10] Ibid, 63.
[11] Shennan 1988, 195–7.
[12] Schiffer 1987; Sommer 1991; Wilson 1994.
[13] Schiffer 1987, 125.
[14] Boismier 1997.
[15] Guélat et al 2008, 14.

only good soil within the boundaries of the site is found on a river terrace to the south of the stream and coincides with the location of the activity areas three and four. Outside of these areas, major disturbance by ploughing is therefore unlikely.

POST-DEPOSITIONAL ENVIRONMENTAL FORMATION PROCESSES

The activity of earthworms or burrowing animals can cause vertical displacements of artefacts and may pose a problem in stratified sites.[16] As the overwhelming majority of finds discovered at Develier-Courtételle comes from a single archaeological horizon, vertical displacement does not present a problem. Every artefact is also a component of the sediment which encloses it. The most powerful environmental processes acting on the distribution of finds after deposition are often geological in nature: soil creep, solifluction and erosion can lead to major modifications of artefact scatters.[17]

IDENTIFYING POST-DEPOSITIONAL DISTORTIONS OF ARTEFACT SCATTERS

At Develier-Courtételle, biological or cultural processes occurring after deposition seem to have had only a minor impact on the spatial distribution of all finds. Evaluating the effect of geological processes such as erosion and soil creep on the spatial position of an artefact is more difficult. We developed a simple visual representation that makes it easier to identify the effects of erosion or soil creep: a map of each farmstead or activity area showing the distribution of all artefacts and major features is accompanied by simplified stratigraphic sections (Figs 4 and 5). The vertical dimension of the sections is exaggerated by a factor of five. The archaeological horizon is represented by a dark band of varying thickness. This map allows us not only to visualise the spatial relationships between artefacts and features, but to perceive the extent, thickness and dip of the archaeological horizon at the same time. This additional information is used to visually identify erosion or soil creep-induced distortion of the artefact scatter, which in turn makes it easier to recognise obvious concentrations or gaps that were caused by human activity.

First example: farmstead four

The archaeological horizon is relatively well preserved in this part of the site (Fig 5). We can only detect traces of erosion next to the medieval streambed, where the layer thins and become discontinuous. Apart from the banks of the brook, the spatial distribution of the 2600 finds discovered within farmstead four seems largely unaffected by erosion. We can conclude that post-depositional distortion of the artefact scatter is minor.

The distribution of finds is clearly structured, although very dense concentrations are absent. Building A, which does not contain many finds, is surrounded by a largely empty and 1.5 m wide corridor. The N wall of the building coincides with another division within the artefact scatter: three quarters of all finds are concentrated south of the axis materialised by this partition. To the north, the annex of the building and the surrounding surface are relatively empty, although the density of finds increases once more near the banks of the brook. The S and the E limits of the farmstead are indicated by a sharp drop in artefact numbers, clearly independent of the preservation quality of the archaeological horizon. None of the patterning within the artefact scatter correlates with the limits of the excavation units and it must therefore originate during the occupation of the farmstead.

[16] Stein 1983.
[17] Schiffer 1987, 251–5.

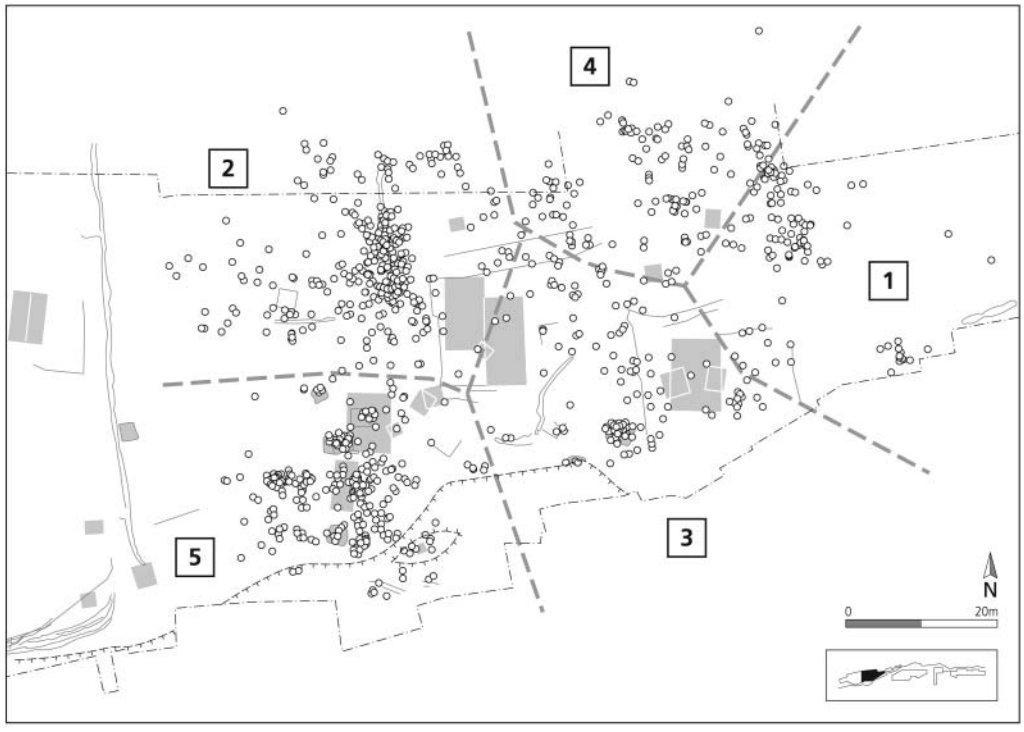

FIG 4

Farmstead two and activity area one. Spatial distribution of reused roof tile fragments, showing the results of a k-means cluster analysis of their spatial coordinates (five cluster solution). *Map by T Yilmaz. © Office de la culture Jura.*

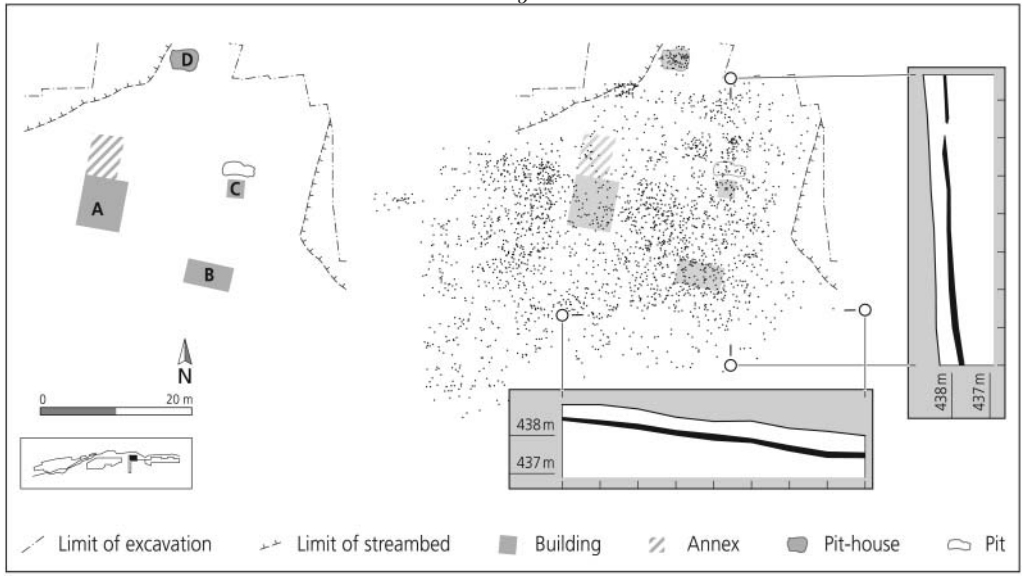

FIG 5

Farmstead four. Map of artefact scatter (all finds) superimposed on a simplified plan of the archaeological features, accompanied by two schematic stratigraphic sections. The vertical dimension of the sections is exaggerated (multiplied by 5). *Map by T Yilmaz. © Office de la culture Jura.*

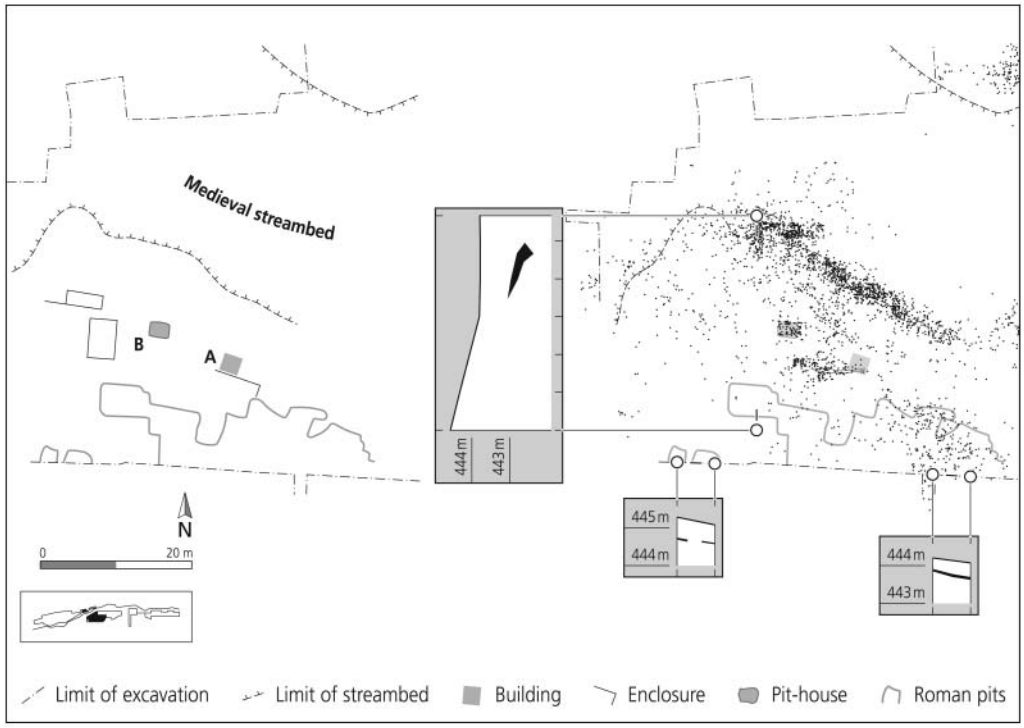

FIG 6

Activity area three. Map of artefact scatter (all finds) superimposed on a simplified plan of the archaeological features, completed by three schematic stratigraphic sections. The vertical dimension of the sections is exaggerated (multiplied by 5). *Map by T Yilmaz. © Office de la culture Jura.*

Second example: activity area three

The archaeological horizon is not well preserved in this part of the site and is mostly restricted to the banks of the medieval brook (Fig 6). From there, the ancient land surface sloped upwards towards a pre-Holocene river terrace. A cluster of clay extraction pits were dug into this terrace during Roman times.[18]

A majority of the finds discovered in this activity area (1270 of 2330) are concentrated within a narrow ribbon running parallel to the medieval streambed. Several smaller clusters of artefacts were found within the fills of the larger features, such as the pit-house B (65 finds).[19] A weaker concentration of about 300 finds covers the E half of the cluster of Roman pits. These objects, found in the upper fill of the Roman structures, are mostly of early medieval date. Few finds were recovered from the remainder of the activity area.

The slope running from the terrace to the streambed explains the extensive erosion of the archaeological horizon. This was probably accelerated by ploughing, traces of which were observed on the surface of several features. The artefact scatter was clearly modified by post-depositional processes. Only the finds found inside features or along the bank of the medieval brook seem to have retained their original position.

[18] Fellner and Federici-Schenardi 2007, 127–30.
[19] Federici-Schenardi and Fellner 2004, 106–7.

IMPACT OF DISCARD BEHAVIOUR ON THE SPATIAL DISTRIBUTION OF FINDS

Largely undisturbed patterns of artefact scatter are presumably a reflection of the behaviour of the original inhabitants of a site; however, ethnoarchaeological studies show that the location of discard of a given object is often not identical with its location of use. People tend to maintain the interior of their dwelling reasonably free of cluttering refuse, which is dumped outside.[20] Some effort is usually expended in periodically cleaning or at least clearing living quarters and activity areas, as these will otherwise become inaccessible or unusable.[21] Refuse gathered during maintenance is transported to a dump, which may be located right outside the entrance of a dwelling or activity area or in its immediate neighbourhood.[22] When these 'proximity dumps' become too large, the refuse is often removed to a permanent dump zone outside the occupied area. Preferred locations include: the borders of hedges, fences or paths; abandoned pits or natural depressions; and streambeds and ravines.[23] Travel distance to these dumps is usually kept as short as possible.[24]

Animal behaviour can also influence the preservation and distribution of artefacts and ecofacts prior to the abandonment of a site. Large animals may break or displace objects through trampling.[25] Faunal remains and other potentially edible discards are often consumed by domestic or wild animals such as dogs. This may result in a marked reduction of these finds in the archaeological record.[26] Even preserved bones could have been moved by dogs or other carnivores.[27]

The interpretation of the spatial distribution of artefacts remains complex even when post-depositional distortions can be excluded. The analysis of artefact scatters can, nonetheless, reveal considerable information about living conditions within a settlement as the following examples, all taken from the part of the site occupied by farmstead two and the adjoining activity area one, will demonstrate.

ORGANISATION AND PARTITIONING OF SPACE

Activity area one is situated immediately to the north of farmstead two; for the purposes of spatial analysis, they can be considered as one coherent unit. Most of the artefacts discovered here cluster in well-defined concentrations (Fig 7). The three large dump zones R1, R2 and R3 together contain about two-thirds of the 14,900 located finds, the dump zone ZR2, located on the banks of the brook, accounts for a further 10%, as do the fills of the pit-houses R, S, U and V.

The spaces separating R1, R2 and R3 are nearly empty and the S limits of these dump zones form a straight line, a division of space which partly corresponds with archaeological features, such as ditch 186 and fence 'e'. Ditch 244 is parallel to the E border of R1 but lies three metres within it. Ditch 228 seems to materialise the W limit of this dump zone. The observed partitions do not correlate with the limits of excavation units, nor can they be the product of erosion or soil creep.[28]

[20] Schiffer 1987, 59.
[21] Sommer 1991, 64.
[22] Hayden and Cannon 1983, 126.
[23] Schiffer 1987, 61–2; Blum 2003, 206.
[24] Hayden and Cannon 1983; Beck 2006; Beck and Hill 2004.
[25] Eren et al 2010.
[26] Walters 1984.
[27] Fellner and Federici-Schenardi 2007, 48–9.
[28] Ibid, 63–4.

FIG 7

Farmstead two and activity area one. Map of dump zones as revealed by the spatial distribution of finds, superimposed on a simplified plan of the archaeological features. *Map by T Yilmaz. © Office de la culture Jura.*

Analysis of the features already suggests that activity area one was divided into orthogonal sectors, partly materialised by segments of boundary ditches and fences.[29] The artefact scatter allows us to extend the visible traces of this organisation both eastward and northward (R2 and R3). We can now also distinguish the 'occupied' spaces, also used as dump zones, from 'empty' areas, probably parts of an orthogonal network of unpaved paths. Similar networks are known from several contemporary sites.[30]

The S half of farmstead two was not partitioned in the same way. Refuse was mainly dumped in abandoned features (pit-houses R, S, U and V; smithing hearths and work pits to the south of R2 and R3) or on the banks of the brook (ZR2). The larger buildings and their immediate surroundings were maintained relatively litter-free.

SPATIAL ANALYSIS AND CHRONOLOGY

Analysis of the spatial distribution of potsherds, grouped into three chronological categories, produced information on the evolution of several parts of the settlement, including farmstead two and the adjoining activity area one.

In this part of the site, the distribution of potsherds changes through time (Fig 8).[31] During a first phase, a third of the potsherds are found in the dump zone R3 and another concentration is situated on the S edge of R1. Some of these older potsherds are also found within the pit-houses R, S and V. The pottery belonging to the second phase clusters in the S half of R1. Other fragments are found in the pit-houses R and S and in the dump zone R3.The most recent pottery is mainly found on the N and E border of R1 and inside the pit-houses R, S and V.

This distribution correlates well with the occupation phases established through radiocarbon dating.[32] The oldest dwelling, house D, is situated 20 m south of R3 and is probably the source of the concentration of first-phase pottery within that dump zone. Contemporary smithing hearths and work pits were dug near the S edge of R1: the site of another concentration of early pottery. Towards the middle of the 7th century, house A became the main dwelling. It lies 15 m to the south of R1, which contains much of the pottery dating to this period.

Many of the potsherds from the last phase are found along the N and E edge of R1, not far from the houses B and C, occupied during this period. Although they contain some sherds of older pottery, the fills of the pit-houses R, S and V have mostly produced material from the late 7th and early 8th century, which confirms their relatively recent radiocarbon dates. The spatial distribution of dated artefacts also informs us about the chronological development of the dump zones. Within dump zone R1, potsherds gradually move from the south to the north and east, while R3 ceases to be used during the youngest phase.

RECONSTRUCTING DISCARD BEHAVIOUR

The clearly structured distribution of faunal remains in farmstead two and activity area one materialises a particular type of discard behaviour (Fig 9).[33] The majority of burnt bones are located in dump zones R1, R2 and R3. The fills of the pit-houses R, S and V also contain many burnt bones. Bones with butchery marks were found at the edges of the occupied area, mostly on the banks of the brook (ZR2), but also along its N

[29] Federici-Schenardi and Fellner 2004, 89–91.
[30] Waterbolk and Harsema 1979.
[31] Marti et al 2006, 105–6.
[32] Federici-Schenardi and Fellner 2004, 95.
[33] Fellner and Federici-Schenardi 2007, 45–50.

FIG 8

Farmstead two and activity area one. Spatial distribution of potsherds assigned to three chronological classes, superimposed on a simplified plan of the archaeological features. *Map by T Yilmaz. © Office de la culture Jura.*

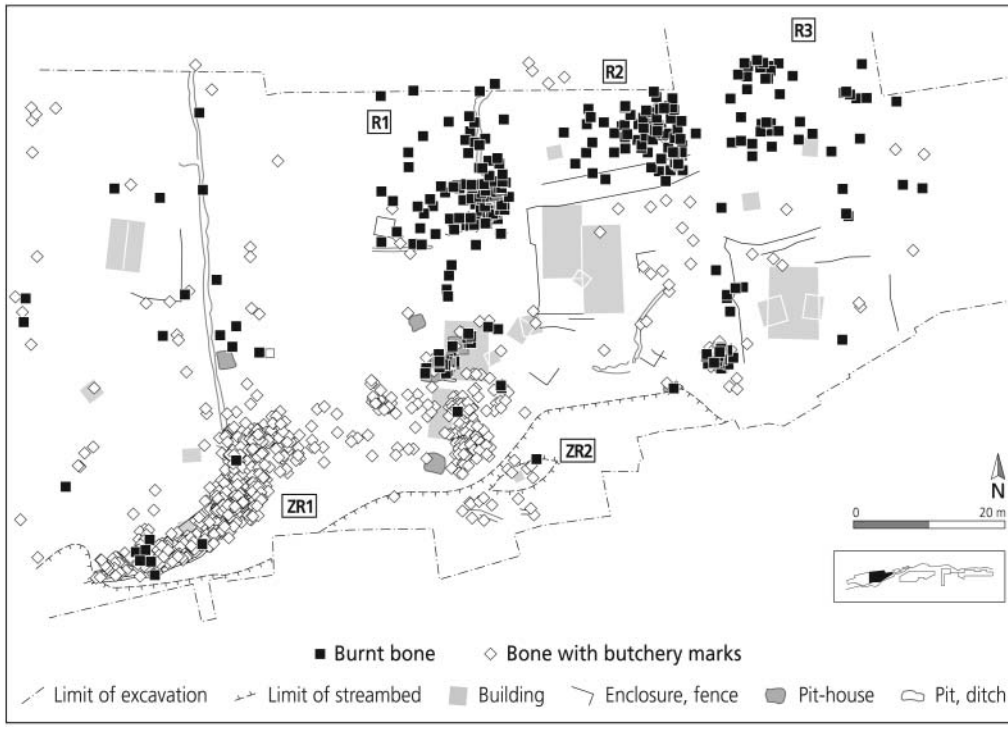

FIG 9

Farmstead two and activity area one. Spatial distribution of faunal remains that were either burnt or carried butchery marks, superimposed on a simplified plan of the archaeological features. Bone fragments without traces of fire or butchery marks are not represented. *Map by T Yilmaz. © Office de la culture Jura.*

and W margins. The influence of carnivores on the spatial distribution of faunal remains was also examined. It became clear that faunal remains with butchery marks and bones with bite marks (apparently caused by canids) generally occurred in the same concentrations.[34] The strong structuring of these finds cannot be explained by differential preservation.

The concentrations containing frequent burnt and largely fragmented faunal remains probably represent kitchen and table waste, dumped near the houses. The larger bones discarded during butchery and initial preparation, more attractive to dogs and other carnivores, were deposited at a greater distance from the dwellings, on the banks of the brook or at the edge of the inhabited space. The inhabitants of farmstead two seem to have practiced this separation of butchery and kitchen waste for two centuries. Curiously, no traces of this custom could be observed in the other farmsteads.

INTRASITE SPATIAL ANALYSIS OF A 'PERMANENT' SETTLEMENT: SOME GENERAL CONCLUSIONS

At Develier-Courtételle, intrasite spatial analysis of the artefact scatter made a substantial contribution to our understanding of this hamlet, but the limits of the method

[34] Ibid, fig 24.

also became apparent. The analysis was greatly facilitated by the excavation of complete farmsteads and activity areas, but the parts of the site that had suffered extensive erosion or soil creep did not produce informative results. The analysis was particularly useful in producing otherwise unobtainable information on the partitioning and use of space within the farmsteads. It also provided some data on the chronological evolution of this spatial organisation.

We can conclude that intrasite spatial analysis of artefact distribution is most likely to yield useful results when a large and well-preserved segment of a settlement can be excavated. The exact location of all finds, whether discovered within features or found scattered throughout the archaeological horizons, must be known. The taphonomy of the finds must be understood before their spatial distribution can be interpreted.[35]

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[35] Rosenswig 2009, 28.

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Résumé

Analyse spatiale intrasite du hameau de Develier-Courtételle du début du Moyen-Âge, en Suisse *par* Robert Fellner

Les données accumulées lors du récent programme de fouilles d'un site du début du Moyen-Âge, dans le canton du Jura (Suisse), a offert une rare opportunité d'effectuer une analyse spatiale approfondie intrasite sur l'ensemble du hameau. Cet article présente certains problèmes rencontrés, ainsi qu'une sélection de résultats issus de ces recherches. Les questions de méthodologie sont centrales: perte de données dues à l'excavation mécanique; choix entre analyse statistique et visuell; enfin, distinction entre les effets taphonomiques et les motifs résultant d'activités culturelles.

Zusammenfassung

Räumliche Analyse zwischen Fundstätten im frühmittelalterlichen Dörfchen Develier-Courtételle, Schweiz *von* Robert Fellner

Die während der kürzlich erfolgten Ausgrabung einer frühmittelalterlichen Siedlung im Schweizer Kanton Jura angehäuften Daten boten die seltene Möglichkeit, eine tiefer gehende räumliche Analyse zwischen den Fundstätten in einem gesamten Dörfchen durchzuführen. Einige der dabei aufgetretenen Probleme und eine Auswahl der im Laufe dieser Forschung erzielten Ergebnisse werden hier vorgestellt. Dabei liegt die Betonung hauptsächlich auf methodologischen Fragen: Datenverlust während der mechanischen Ausgrabung; die Entscheidung zwischen statistischer oder visueller Analyse; und die Unterscheidung zwischen den Auswirkungen der Taphonomie und der Musterbildung durch kulturelle Aktivitäten.

Riassunto

Analisi spaziale all'interno del sito del borgo altomedievale di Develier-Courtételle, Svizzera *di* Robert Fellner

I dati accumulati durante i recenti scavi di un abitato altomedievale nel Canton Giura in Svizzera hanno fornito la rara opportunità di condurre un'analisi approfondita all'interno del sito di un intero abitato. Qui vengono presentati alcuni dei problemi incontrati e una selezione dei risultati ottenuti durante questa ricerca. L'attenzione si concentra principalmente su questioni di metodologia: la perdita di dati durante gli scavi meccanizzati, la scelta tra analisi statistica e analisi visiva, e la distinzione tra gli effetti della tafonomia e le configurazioni derivanti da attività culturali.