Points of Confusion: Understanding “Typologically Awkward” Assemblages in the Final Palaeolithic

Christian Steven Hoggard (University of Southampton, UK)

Felix Riede (Aarhus University, DK)

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**Introduction**

The Late Glacial, the first pronounced warming sandwiched between the Last Glacial Maximum and the beginning of the Holocene (c. 16,000-11,700 cal BP), is traditionally viewed as a period of increasing cultural diversity in northern Europe, with groups belonging to the Magdalenian and Epigravettian beginning to migrate northwards (Gamble et al. 2005; Riede, 2014; Wygal and Heidenreich, 2014). Groups occupying particular regions in northern Europe began to develop consistent differences in their toolkits, with variances in shouldered points (e.g. the Hamburgian: Burdukiewicz, 1986), backed points (e.g. the Federmessergruppen and Azilian: Schild, 1996), large tanged points (e.g. the Bromme: Taute, 1968) and small tanged points (e.g. the Ahrensburgian and Swiderian: Taute, 1968; Kobusiewicz, 2002) traditionally considered as important markers of this diversification. These regional cultural entities in turn provide the framework for inferring patterns and processes of migration, adaptation, and potentially even emerging ethnicity for this period. Cultural units are not static, and once their attendant territories are defined, cultures can move around, their economic focus can change, and cultures can interact. It is for this reason that the identification of robust archaeological taxonomic units are a fundamental precondition in our archaeological understanding of this period; without these units, the goal of understanding such past processes cannot be realised (Roberts and Vander Linden, 2011).

Yet, the creation and utilisation of techno-typological classifications for the European Palaeolithic (and further afield) have been repeatedly critiqued (Otte and Keeley, 1990; Neeley and Barton, 1994; Barton and Neeley, 1996; Felgenhauer, 1996; Clark, 1999, Vasil’ev, 2001; 2009; Tomášková, 2013; Clark and Riel-Salvatore, 2006; Shea, 2014; Lisitsyn, 2017; Ivanovaitė and Riede, 2018; Riede et al. 2019; Reynolds and Riede, 2019; Ivanovaite et al. 2019). Otte and Keeley (1990) note that many of the taxonomic units for the Final Palaeolithic, the *fossils directeurs* of prehistoric ethno-geographic variability, are usually rooted in early antiquarian excavations, consisting of only a few key sites as aptly reflected in the practice of naming archaeological units after *loci classici*. Sauer and Riede (2019) have highlighted that, for the Final Palaeolithic of Central Europe, units appear to reflect differing research histories more than empirical variation between assemblages. A more acerbic critique has been voiced by Houtsma et al. (1996: 143), arguing that ‘[o]nly when researchers of the Late Palaeolithic habitation of the Northwest European Plain escape the constraints of contemporary national borders and the paradigmatic straight-jackets of provincialism and regional chauvinism, which lead to insularity, will we be in a position to gain analytical control of the totality of extant data partitioned into uniform and mutually comparable sets of demonstrably relevant attributes’.

Attempts are currently underway to provide a more robust comparative framework for the European Final Palaeolithic (Riede et al. 2019; Ivanovaite et al. 2019). This approach is theoretically motivated by cultural evolutionary theory, in which culture is conceptualised as a system of information transmission across generations; as a learned craft, elements of material culture such a lithics can be used as a proxy for such social transmission. In combination with novel computational tools such as geometric morphometrics, such an approach should in principle facilitate reproducible assessments of archaeological taxonomic units. Yet, these efforts have so far focused almost exclusively on the analysis of projectile points as cultural markers. In doing so, they take advantage of the relative ease with which large datasets of projectile point shapes can be amassed from the literature, but have side-stepped the long-standing debate about the relationship of finished tools and production processes (see Tostevin 2011). Projectile points – especially simple and often rather variable forms as the ones prevalent in the European Final Palaeolithic (see Dev and Riede 2012) – are easily copied in their shape (Carr 1995) or may suffer from strong convergent trends in their overall design (cf. O’Brien et al. 2018). In addition, many assemblages actually contain multiple supposed lithic diagnostics, which maybe the result of genuine cultural contact, gifting or taphonomic processes such as post-depositional mixing. All these confounding factors compromise, in different and often difficult-to-account-for ways, the utility of lithic projectile points as exclusive indicators of cultural affiliation in the Final Palaeolithic.

While sharing the analytical concerns with the research cited above, this article therefore considers Final Palaeolithic taxonomy through detailed technological analysis of selected assemblages. These assemblages are ‘typologically awkward’, i.e. they represent archaeological contexts with multiple techno-typological identifiers (see Table 1 for a list of taxonomies discussed in this article). Our analysis is centred on the two Final Palaeolithic contexts of Häcklingen and Bienenbuttel, both in Germany, and we compare and contextualise these with ten additional assemblages representing broadly contemporaneous cultural taxonomic units from Germany and Denmark. Final Palaeolithic technologies have been compared before (e.g. Hartz 1987, De Bie 1999; Berg-Hansen 2019; Kotthaus 2019) but analytical protocols and data have rarely been presented in a way that allows assessments to be replicated or up-scaled. In addition, we refrain from pre-classifying our assemblages on the basis of supposed projectile point or other diagnostics so as to avoid the seeking differences due to normative biases. Deploying a similar approach, Weiss and colleagues (2017) have recently shown for the Late Middle Palaeolithic how a quantitative technological analysis provides new perspectives on assemblage variability, independently of supposed diagnostics. In line with this effort, we here highlight how an empirical assessment of Final Palaeolithic flint technology can shed light on the positioning of our target inventories within the wider cultural taxonomic landscape, and we further highlight some of the outstanding issues in techno-typological classifications.

**Site Overviews: Häcklingen and Bienenbuttel**

Bienenbüttel-15 is situated on the north-east bank of the Ilmenau river, between the villages of Bienenbüttel and Wichmannsburg, and is approximately 11km to the south-east of Häcklingen. Following test cuttings in autumn 1997, a more detailed investigation commenced in 1998 by the Bezirksarchäologie Lüneburg Ausgrabungen (Lüneburg Distict Archaeological Unit), following proposed building development in the area.

Excavations revealed a wealth of Neolithic material including post-hole features, ceramic material in addition to a cooking pit; later prehistoric material from the Bronze Age was also recovered (Richter 2001). Below, a number of backed points were identified, in addition a number of scrapers, blade cores, burins and blades. Among these were several fragmented and complete Federmesser and Creswellian points, in addition to three Zonhoven points (*sensu* Schwabedissen 1954), blades typical of the Ahrensburgian featuring sloping retouched tips. One Hamburgian point, belonging to the Havelte Group (*sensu* Bohmers 1956 and Stapert 1997) was also identified among the assemblage. A clear temporal separation between the Final Palaeolithic and Neolithic material was acknowledged, with little mechanical redeposition in evidence. An absolute chronometric date was not, however, determined.

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| --- | --- | --- |
| **Taxonomic Unit** | **Description** | **Reference(s)** |
| **Hamburgian** | Dated to the Older Dryas and comprising of two phases: a **Classic Hamburgian** group (defined by shouldered points) and the **Havelte Group** (defined by both shouldered and tanged points); colonisation in the Western Baltic viewed as ephemeral and possibly unsuccessful. | Schwabedissen (1937); Bohmers (1947); Teberger 1996; Terberger et al. (2004); Grimm and Weber (2008); Riede and Pedersen (2018) |
| **Creswellian** | Dated to the Bølling period and defined by angle-backed Creswell and trapezoidal Cheddar points; distributed throughout the United Kingdom, Belgium and The Netherlands; closely related to the Hamburgian and both rooted in the Magdalenian. | Garrod (1926a, 1926b); Campbell (1977, 1980); Jacobi (1991); Jacobi and Roberts (1992); Maier (2015) |
| **Federmesser** | Dated to the Bölling-Alleröd warming period and characterised by arch-backed points; Schwabedissen (1954) proposed three sub-divisions: the **Rissener** (inclusion of backed bladelets), **Tjonger** (large backed points and short end-scrapers) and **Wehlener** (inclusion of tanged end-scrapers) local units; difficult to differentiate from Bromme culture assemblages in the absence of ‘diagnostic’ tools; parallels the Franco-Cantabrian **Azilian.** | Schwabedissen (1954); Eriksen (2000); Kobusiewicz (2009); Riede et al. (2011); Riede (2017) |
| **Bromme** | Dated to the end of the Alleröd and earliest Younger Dryas and characterised by large tanged points, single-latform prismatic cores (and very rarely double-platform cores). | Taute (1968); Riede (2017) |
| **Lyngby** | Research-historical predecessor of the Bromme; **Tolk-Sprenge** viewed as a sub-division defined by tanged points outweighing backed tool types. | Taute (1968); Brinch Petersen (1970) |
| **Ahrensburgian** | Dated to the terminal period of the Late Glacial; specialised reindeer hunters; characterised by Ahrensburgian points (small laterally retouched tanged points) and antler artefacts; subdivision of the Tanged Points Technocomplex; high diversity of microliths. | Rust (1937); Taute (1968) |
| **Tanged Point Technocomplex (TPT)** | The first of two broad groups with which Late Palaeolithic cultures are commonly ascribed; includes units from Eastern Europe e.g. **Witowian** (Chmielewska 1961a; 1961b; Schild 1975) and **Tarnowian** groups. | Valde-Nowak et al. (2012) |
| **Arch-backed Point Technocomplex (APT)** | The second of two broad groups with which Late Palaeolithic cultures are commonly ascribed; includes units from Eastern Europe e.g. **Swiderian** (Kozłowski 1999; Szymczak 1999; Burdukiewicz 2011). | Valde-Nowak et al. (2012) |

Table 1. A list of archaeological taxonomic units discussed throughout this article.

Richter (2001) first suggested, on the basis blades with obliquely retouched tips, and the end-scraper component of the assemblage, the site shows affinities to both the Wehlen and Tjonger Federmesser sub-groups (*sensu* Schwabedissen 1954). However, with the clear presence of Creswellian – as well as Ahrensburgian and Hamburgian elements – Richter (2001) voiced concerns regarding a unanimous cultural taxonomic assignment of Bienbüttel-15. In doing so, Richter (2001) echoed similar doubts formulated earlier by Paddaya (1971) and Ikinger (1998), stressing the lack of precise qualitative and quantitative analyses in understanding potential Final Palaeolithic group structure and variability (Richter, 2001: 34).

Excavations close to the village of Häcklingen, situated near the town of Lüneburg (Lower Saxony, Germany), first began from 1983-1985, following the identification of Palaeolithic and Neolithic material during routine surface inspection (Assendorp, 1997). Following the identification of Neolithic pit features, ceramic material, burned bone fragments and hazelnut shells, student excavations led by the University of Hamburg and University of Prague were undertaken towards the end of the twentieth century.

With ice wedge formations thought to have occurred at this site, as described elsewhere for northern Germany (Clausen, 1995, 1997; Zoller, 1981), and artefacts separated from discoloured areas in the soil, a vertical shift in archaeological material was hypothesised (Richter, 2001). This is evident in the examination of the Final Palaeolithic material, with patination and minor edge damage contrasting the fresh-edged and largely *in situ* Neolithic material, and contrasts the sequence at Bienenbüttel-15.

Among the Final Palaeolithic material were a variety of tanged point and backed point forms, including small Ahrensburgian and Chwalibogowice tanged points, as well as larger Lyngby points, in addition to a number of Penknife backed points. Given this typological co-occurrence, Richter (2002) noted that, according to traditional classification *sensu* Schwabedissen (1954), Häcklingen can be attributed to the Rissener sub-group of the Federmessergruppen, before highlighting that the Rissener categorisation, and the sub-categories of the Federmesser more generally are unsatisfactory (Ikinger, 1998; Richter, 2001). This led to Richter (2002) considering the assemblage’s placement within the Tolk-Sprenge subdivision of the Tanged-Point-Groups *sensu* Taute (1968), which overlaps in part with Schwabedissen’s Lyngby culture of southern Scandinavia. Such classificatory assignments seem largely arbitrary, however, and driven by preconceived normative biases.

Riede (2017) has pointed out that many of the same inventories were used by Schwabedissen (1954) and Taute (1968) respectively to define their Rissen Group and Lyngby culture on the one hand, and the Tolk-Sprenge and Segebro-Bromme. With the exception of the Lyngby culture, the presence of backed form variants characterises all of these groupings, but whether one prioritises these or the large tanged points as primary index of cultural affinity appears to vary with author preference. Given that many of the relevant assemblages are small and not obtained via controlled excavation rises further doubts with regard to the epistemic robusticity of the resulting groupings. The pitfalls of working with open-air sites have long been acknowledged within Final Palaeolithic research (e.g. Vermeersch 1977; Vermeersch and Budel 1997), existing modelling and experimental data on how post-depositional processes and collections biases typically affect the composition of surface scatters (e.g. Ammerman and Feldman 1974; Dunnell and Simek 1994) are rarely invoked when classification is the goal.

With a distinct chronometric framework lacking (similarly to Bienenbüttel), and as a result of mechanical taphonomic processes at Häcklingen, it is unknown whether the Final Palaeolithic material represents one or multiple occupation events. However, despite cross-contamination in layers, the typologically perspective awkward admixture of tanged and backed point variants at Häcklingen are particularly relevant to the robustness of these artefacts, in their classification, and the combination of them as archaeological taxonomic units.

The sites of Häcklingen and Bienenbüttel represent just two of a number of contexts, with a lack of chronometric dating, and known to feature a wealth of different named artefact units commonly thought to represent specific taxonomic groups. Others include the sites of Kleinenbroich (Thissen et al. 1996) and Sassenholz (Breest and Gerken 2008) in Germany, Zonhoven-Molenheide (Vermeersch 2013) in Belgium and Stoksbjerg Vest (Johanssson 2003) and Hasselø Tværvej (Vang Petersen 2006) in Denmark. All these locales show typologically mixed and hence awkward combinations of projectile points and hence challenge traditional ways of cultural taxonomic assignment. Variously, these mixed elements are sought separated after excavation, but this follows a strictly normative (typo-)logic. Just as at Bienenbüttel-15 and Häcklingen-19, there are often no fully convincing *a priori* reasons to divide such mixed assemblages into less awkward and typologically tidy components. In the following, we circumvent such concerns by focusing, for the first time, on the technological and morphological characteristics among such Final Palaeolithic assemblages.

**Materials and Methods**

To better understand the technological positioning of Häcklingen and Bienenbüttel, quantitative and qualitative technological and morphological analyses are performed on cores, blades and projectile points from these two sites as well as ten additional assemblages previously classified as either Federmesser and Brommean (≈Lyngby culture/Bromme-Segebro Group; see Figure 1).

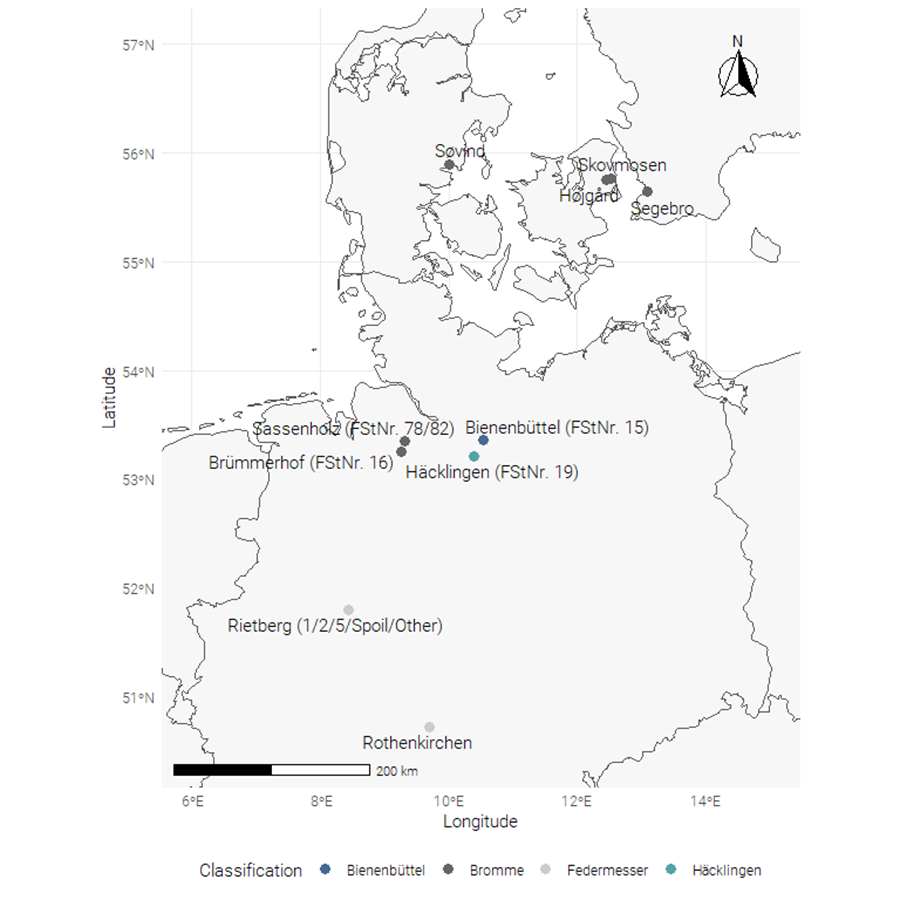


Figure 1. A map of all assemblages examined in this article.

Federmesser sites *without* large tanged points but *with* typologically mixed arch-backed points:

1. **Rietberg (1/2/5/Other/Spoil)** (North Rhine-Westphalia, Germany): Following initial discovery (Tinnes 1988), these assemblages have been extensive discussed by Holzkämper, Richter and colleagues (Holzkamper and Maier 2011). In fact, the assemblages are used to define a precocious facies of the Final Palaeolithic characterised by a variety of typological elements.

Federmesser sites *with* large tanged points but *with* typologically mixed arch-backed points:

1. **Brümmerhof (FStNr. 16)** (Lower Saxony, Germany): The assemblage from Brümmerhof in north-western Germany derives from the surface and shows a combination of standard arch-backed points (Federmesser) as well as angle-backed Cheddar/Creswell points and two large tanged points (Gerken 2001). Gerken (2001) did not find any indications of mixing or disturbance at the site suggesting that the lithic material represents one coherent assemblage.

Federmesser sites *with* only arch-backed points:

1. **Rothenkirchen** (Hesse, Germany): Located along the Fulda River in the Federal State of Hesse, this was originally suggested on the basis of artefact size to date to very end of the Pleistocene, although typo-technological similarities to the supposedly much earlier Rissen Group of Schwabedissen (1954) were also noted (Fiedler 1976; Hofbauer 1992). Later tephrochronological investigations suggest a date older than 13,000 cal BP – before the Laacher See eruption – for this site (Riede 2012). The diminutive size of the artefacts evidently relates to the limited availability of larger tool-stone (cf. Hess and Riede 2020), and the dating of the site into the earlier part of the Allerød interstadial aligns with that of sites in the wider region (Riede 2016).

Federmesser sites *with* large tanged points:

1. **Sassenholz (FStNr. 78/82)** (Lower Saxony, Germany): The assemblage from Sassenholz contains Federmesser elements as well as large tanged points. Traditional grouping practice would place it in the Rissen Group of the Federmessergruppen, had these not been summarily dismissed by earlier research (Ikinger 1998; Sauer and Riede 2018): the site is also located west of the River Elbe and so rather far away from the traditional ‘territory’ of large-tanged point groups. Breest and Gerken (2008) instead use the Sassenholz assemblage to discuss processes of cultural contact between the Brommean/Lyngby culture of southern Scandinavia and the more southerly Federmessergruppen.

Bromme/Lyngby sites (i.e. sites only with large tanged points):

1. **Højgård** (Zealand, Denmark):
2. **Skovmosen (I)** (Zealand, Denmark): A Final Palaeolithic assemblage comprising of tanged points, scrapers, burins, and primary reduction products including blades and cores (Boye, 2006; Hilgart, 2003; Eggers-Kaas et al. 2019). Can be traditionally placed within the Bromme culture (Hilgart, 2003; Boye, 2006; Brinch Petersen, 2009), but due caution has been noted in its classification (Eggers-Kaas et al. 2019).
3. **Segebro** (Malmö, Sweden):

Bromme/Lyngby sites lacking projectile points:

1. **Søvind** (Jutland, Denmark):

For an artefact breakdown on a contextual level refer to Table 2 and Table 3.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Context** | **Blade  (n)** | **Core  (n)** | **Backed Point  (n)** | **Tanged Point  (n)** |
| Bienenbüttel FStNr. 15 | 15 | 1 | 5 |  |
| Brümmerhof FStNr. 16 | 6 |  | 13 | 3 |
| Häcklingen FStNr. 19 | 43 | 8 | 9 | 7 |
| Rietberg (various) | 96 | 9 | 6 |  |
| Rothenkirchen | 11 | 2 | 4 |  |
| Sassenholz FStNr. 78 & 82 | 133 | 27 | 36 | 22 |
| Højgård | 2 | 1 |  |  |
| Segebro | 24 | 11 |  | 4 |
| Søvind | 88 | 5 |  |  |
| Skovmosen 1 |  | 6 |  | 1 |

Table 2. Artefact breakdown (grouped by context) of material examined in this article   
(total: 598 artefacts)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Context** | **Blade  (n)** | **Core  (n)** | **Backed Point  (n)** | **Tanged Point  (n)** |
| Bromme | 253 | 50 | 49 |  |
| Federmesser | 107 | 11 | 10 | 30 |
| Bienenbüttel FStNr. 15 | 15 | 1 | 5 |  |
| Häcklingen FStNr. 19 | 43 | 8 | 9 | 7 |

Table 3. Artefact breakdown (grouped by taxonomic unit) of material examined in this article   
(total: 598 artefacts)

In understanding the underlying *chaînes opératoires*, and in adopting a common terminology for identifying technological signatures and characteristics, attributes originate from the Nordic Blade Technology Network (Sørensen 2006). Minor amendments, and the extension of categories in a small number of instances were necessary to reflect Final Palaeolithic variability e.g. dorsal scar directionality. In our analysis, we seek to combine technological expertise with quantitative acumen. Our reasons to do so lie with the critiques of overly idiosyncratic technological analyses that do not lend themselves to comparison and replication (Darmark and Apel 2008). A full list of technological and attributes can be found in the supplementary material.

First, technological and morphological characteristics are first examined through visual and descriptive summaries. Where appropriate, the distribution of continuous variables across assemblages were assessed using pairwise Wilcoxon rank sum testing (Mann Whitney U) with Bonferroni-corrected p values. Gini-Simpson indices of qualitative measures were then employed to examine intra-assemblage variability, while Morisita-Horn diversity indices were employed to better understand inter-assemblage dissimilarity. These indices have been of particular value to archaeologists, better understanding variation among qualitative technological attributes (Crema, 2014; Maiorano et al. 2020; Leplongeon et al. 2020).

To better detect and understand the underlying structure in the technological characteristics within a low-dimensional Euclidean space, Multiple Correspondence Analysis (MCA henceforth) was employed. MCA is an unsupervised multivariable procedure for analysing non-linear interactions between several categorical variables (Abdi and Valentin, 2007). Used widely among archaeologists (Ringrose, 1992; Macheridis, 2017; Asouti et al. 2018; Leplongeon, 2020), MCA is an extension of correspondence analysis (CA) and can be viewed as a generalisation of principal component analysis (PCA) for categorical and dichotomous data. In being a dimensionality reduction strategy, MCA is designed to produce new synthetic dimensions comprising of different contributions from each variable, while being maximally informative. Similarly to CA, proximities (distances) are meaningful only between points from the same dataset (i.e. rows with rows and columns with columns). However, in its ability to explore the relationship between a large number of variables, MCA is of greater benefit here. As noted by Abdi and Valentin (2007), equivalent methodologies include optimal scaling, appropriate scoring, dual scaling, homogeneity analysis and scalogram analysis.

To better understand the underlying structure of variation for all quantitative (morphometric) data Principal Component Analysis (PCA henceforth) was adopted. PCA is another dimensionality reduction technique, akin to MCA for quantitative, and is often used for transforming a large set of variables (here measurements) into a small suite of variables which contain most of the information in the overall data. Finally, Prinicpal component scores, the measures representing the individual artefacts contained within the n-dimensional space of variation, are used to create an underlying a bottom-up (agglomerative) phylogenetic tree through the neighbor-joining (NJ) method (*sensu* Saitou and Nei 1987).

Visual and descriptive summaries, statistical testing, index measures, ordination methods (PCA/MCA) and the NJ trees were employed on the four different datasets: core data, blade data, backed point data and tanged point data to better understanding underlying variation between each (largely undebatable) category of artefact, and discussed together towards the end of this article. While the sample sizes for several artefact categories are relatively low, given the fragility of Final Palaeolithic points and the generally low count of artefacts at each site, the holistic and pluralistic framework, examining a variety of artefact types through a variety of methodologies, is a credible means of understanding the relationship between ‘typologically awkward’ assemblages and the surrounding Final Palaeolithic.

All ordination methods in this analysis were conducted using the FactoMiner (Le et al. 2008), factoextra (Kassambara and Mundt, 2020) and the tidymodels packages (Kuhn et al. 2020), while diversity measures were calculated using the diverse (Guevara et al. 2016) and vegan (Oksanan et al. 2020) packages, and NJ trees produced in ape (Paradis, 2004). A number of other packages were used to aid data wrangling, transformation and visualising, including rio (Chan et al. 2018), tidyverse (Wickham et al. 2019), gt (Iannone et al. 2020), broom (Robinson et al. 2020), tidytext (Silge and Robinson, 2016) and doBy (Højsgaard and Halekoh, 2020). In encouraging greater data transparency and method replicability and reproduction, all data, R code and supporting material (including figures and technological classifications) used to create this article can be found on the Open Science Framework (<https://osf.io/3h2rq/>).

**Analysis and Results**

**Blades**

An examination of morphometric variables highlights that, for contexts categorised as Bromme, blades are heavier, larger (in width, length and thickness) with large platform depths in comparison to contexts designated as Federmesser in nature. Generally, both Häcklingen and Bienenbüttel feature dimensions more akin to Federmesser contexts such as Rietberg and Rothenkirchen, however the generally smaller material at Brummerhof, and a lack of consensus in the Wilcoxon pairwise values (refer to the Supplementary Material) complicate this dichotomy.

Chart, box and whisker chart

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Figure 2. Box-and-whisker plots of quantitative variables  
(dark grey: Bromme; light grey: Federmesser)

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Figure 3. Grouped bar charts highlighting technological differences in blades produced at Häcklingen, Bienenbüttel and Federmesser and Bromme taxonomic units (for acronym definitions please refer to the Supplementary Information).

**Cores**

**Backed points**

**Tanged Points**

**Discussion**

**Conclusion**

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