Bohemian Iron Age Chronologies and the Seriation of Radovesice*

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This article considers the problems of Iron Age chronological schemes devised for Bohemia, in the light of the results of the analysis of the finds from one site in northwest Bohemia, that of Radovesice. Two questions are considered: the first of these concerns an attempt to produce a serial ordering of the deposits from the first two phases of occupation at Radovesice, based on the pottery within the deposits. It will be argued that the ordering obtained here reflects a change in time. The second aim was to key the phasing of this one site into the overall chronological schemes developed for Bohemia. The generally accepted chronological interpretation for the Iron Age finds in Bohemia has been that based on the work of J. Filip[1]. This scheme has faced increasing criticism in recent years, notably from J. Meduna[2]. It is felt here that the Filip chronology does not make proper sense of the archaeological material and that this hampers the further interpretation of Iron Age society in Bohemia. An attempt will be made to demonstrate this point through a brief review of the phasing of Iron Age settlements in Bohemia during the last thirty years. This review will provide a background against which the seriation of the pottery from Radovesice can be evaluated.

Pottery was used for the phasing of Radovesice, because of the paucity of other datable finds from the early phases of occupation. The seriation was undertaken using a computer because of the amount of pottery to be analysed (some 250,000 sherds from the two phases of the settlement investigated here). The computer was consequently used because of the speed at which it could manipulate the data, not because the results obtained were any more objectively correct than those obtained without its use. Having said this, an attempt was made to treat the analysis in a as rigorous a manner as possible, as it was felt that the weakness of the previous schemes was due to the uncritical manner in which the material was approached. I have consequently given space here to some of the methodological problems concerning the deposition of archaeological material and the analysis of the portion of this obtained in excavation, as this has some bearing on the results presented here. Firstly, however the development of previous work on Iron Age settlement chronologies in Bohemia needs to be considered.

The History of Bohemian Settlement Chronology

The frame of reference within which the construction of chronological schemes within Bohemia has taken place was that provided by Filip in his major work

* I should like to thank Dr. Jiří Waldhauser for making the material from Radovesice available and for constant help and advice during its analysis. I am also most grateful to Dr. John Cherry for advising me in the computing necessary for the analysis. Any errors in this are, of course, my own responsibility.

[1] J. Filip, Keltové ve Střední Europě (1956).

[2] J. Meduna, Die latènezeitlichen Siedlungen in Mähren (1980).

"Keltové ve Střední Europě" (The Celts in Central Europe), which was published in 1956. This work drew on the contemporary evidence, which was almost exclusively evidence of burial, as there had been few excavations of settlements. This situation has been reversed in the period since Filip's book was published to the extent that certain areas of Bohemia, notably the northwest and central regions, have better settlement evidence from the Iron Age than almost any other part of continental Europe. The problem has arisen, therefore, of accomodating the finds from settlements, the majority of which are pottery, into Filip's scheme based on the burial evidence.

I feel that the main weakness of that scheme arises from the historical interpretation which Filip made of the burial evidence and that the attempt to mould the settlement evidence to this interpretation has led to inconsistencies. Filip was centrally concerned with the problem of the Celts and the items of material culture associated with them. These items were those known as La Tène types found in the "Celtic homelands" of western Europe. The presence of the first ethnic "Celts" in Bohemia was seen by Filip to be indicated by the first flat inhumation cemeteries found in the central and northern regions, the start of which he provisionally dated to the beginning of the fourth century B.C. This meant that the items associated with the phase La Tène A, as defined by Reinecke, were felt not to be found in northern and central Bohemia, because of the lack of a "Celtic" population in these areas.

The flat inhumation cemeteries were not found in the west and south of Bohemia during La Tène B. The rich graves of La Tène A date in the west and south posed problems of interpretation and it was uncertain whether these were also burials of true "Celts", or of local Hallstatt inhabitants who had been "celticised" in advance of the influx of the true "Celts" in the north during La Tène B. The La Tène B "Celts" were seen as forming the upper stratum of society, having subjugated the existing "Hallstatt" inhabitants of the area. Consequently there were seen to be two ethnic groups in Bohemia, each with a separate material culture, which existed in parallel until the last century B.C. The continuation of the "Hallstatt people" into the late La Tène was designated by Filip as "pozdně Halštatské" (late Hallstatt)[3]. This parallel development was thought to be evidenced by examples such as the grave in the cemetery of Praha-Bubeneč, where a fibula of middle La Tène type was found with Hallstatt pottery[4]. An alternative explanation for the co-occurrence of these finds from different periods is that this grave represents a later grave cutting across an earlier one; however the situation is unclear from the original excavation report and the fibula itself has been lost[5]. For further discussion of Filip's scheme see the review of the Libenice report by W. Kimmig[6].

The first publication of an extensive excavation in Bohemia was that of Krašovice in southern Bohemia by L. Jansová[7] and this was clearly based on Filip's

[3] Filip, op. cit. (note 1) 286ff.

[4] Ibid. Fig. 94.

[5] L. Hajek, Památky Arch. 41, 1936–1938, 86ff.

[6] Germania 43, 1965, 172ff.

[7] L. Jansová, Památky Arch. 48, 1957, 425ff.

ideas. Jansová distinguished three phases on the site: phase A was represented by Hallstatt forms, which are also thought to be found in the La Tène phases B and C, following Filip's idea of "pozdně Halštatské". Phase C is seen as continuing into La Tène D and the occurrence of Hallstatt forms in the layers assigned to this phase is thought to be evidence for the continuation of the Hallstatt tradition and people into the late La Tène. As Meduna[8] points out, phase C is only represented by layers of settlement debris resulting from the deposition and mixing of artefacts from different periods of occupation. The co-occurrence of Hallstatt and La Tène D forms may therefore not be evidence of these being contemporary, but of the mixing of deposits.

A similar periodisation to that of Jansová is presented by E. Soudská[9], which applies the concept of late Hallstatt to the sites of Krašovice, Tuchoměřice and Tuchoměřice-Kněžívká. The last two sites are in central Bohemia and therefore within the zone of the flat inhumation cemeteries. It was thought by Filip that there was no evidence of the occupation by "Celts" in this area prior to the beginning of these cemeteries, that is no La Tène A material. The few southern imports, such as those at Modřany, Hořin and Činov, were seen as entering a Hallstatt milieu. The "Hallstatt" occupation of settlements continued until the introduction of the La Tène culture by the "Celts" of the flat cemeteries in La Tène B. Soudská, in accordance with this rule, gives a late date to any finds that can be considered to be La Tène in type. Her refusal to recognise the existence of La Tène A material makes it difficult to compare her scheme with those of other areas of Europe. By assuming, as Jansová did, that all the finds in the same deposit must be contemporary, she is able to see the continuation of the Hallstatt tradition into the late La Tène. Unfortunately it is very difficult to make a detailed evaluation of her chronology, as very few of the finds on which it is based have been illustrated. Similar criticisms have been raised against Soudská's interpretation by Meduna[10] and Schwappach[11].

The report of the excavation of the ritual structure at Libenice was concerned to a large extent with the problems of basing a chronology on pottery finds alone[12]. This was made more difficult by the fact that little pottery was recovered (768 sherds) and that much of this was poorly preserved. Also, as the authors pointed out, the assemblage is probably uncharacteristic because of the unusual nature of Libenice structure. The authors therefore drew up a scheme based on the pottery from the nearby sites of Praha Kobylisy, Praha Hloubětín and Hořany, in addition to the Libenice material. The two main points around which the chronology was ordered were the supposed appearance of wheel-turned pottery at Hloubětín II at around 370 B.C.[13] and the assumption that the La Tène B 1 grave at Libenice is contemporary with the use of the main structure. This latter point has been

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[8] Meduna, op. cit. (note 2) 22.

[9] E. Soudská, Arch. Rozhledy 17, 1965, 342ff.; id., Památky Arch. 57, 1966, 535ff.; id., Ber. Amersfoort 18, 1968, 131ff.

[10] Meduna, op. cit. (note 2) 22.

[11] F. Schwappach, On the Chronology of the eastern Early La Tène Pottery (1979).

[12] A. Rybová u. B. Soudský, Libenice. Mon. Arch. 10 (1962).

[13] Ibid. 221.

questioned by Meduna[14], who feels that the pottery indicates a hiatus between the construction and use of Libenice and the grave. The validity of the Rybová-Soudský scheme is difficult to estimate due to the lack of illustrations of the material on which it was based. However, the pottery that is shown seems to be exclusively composed of types, which are designated as Hallstatt D in other areas.

This conclusion is backed up by the chronology drawn up in the preliminary reports for the site of Hostomice in northwest Bohemia[15]. P. Budinsky has distinguished two phases: the former characterised by graphite surface decoration, the latter distinguished by the presence of wheel-turned, stamp decorated pottery. Although Budinsky does not assign his phases to the Reinecke chronology, it is possible to see his first phase as belonging to Hallstatt D and the second to La Tène A/B, as this would make them comparable with the dating of sites from other areas of Europe. Budinsky however gives late absolute dates to his phases following Rybová and Soudský for Libenice, with the first appearance of wheel-turned pottery being used as a similar fixed point around which the scheme is ordered[16].

The above chronological work was based on a historical premise which linked the La Tène material culture with a particular ethnic group, the "Celts". The two main ideas which influenced the interpretation of the material were that the "Celts" did not arrive in northern and central Bohemia until the La Tène B period and that the native inhabitants of the region, the Hallstatt people, continued to occupy the area, together with the newcomers, until the late La Tène. These two ideas have caused considerable difficulty and have made the appearance of La Tène A material on settlements hard to explain. Therefore artefacts such as wheel-turned pottery, which were dated to La Tène A in other areas[17], were given a later date in Bohemia.

The scheme presented here drops any connection between the "Celts" and the La Tène material. It is solely based upon the occurrence together of the various pottery types recovered from the site of Radovesice and an attempt is made to define phases on the basis of the pots found to be regularly associated in archaeological deposits. The terms of Reinecke's chronology (Hallstatt D and La Tène A) are retained as convenient labels in general use. They are not seen to have any necessary cultural or ethnic implications.

The Site of Radovesice

The settlement of Radovesice is situated in northwest Bohemia on the northern edge of the Middle Bohemian mountains and near to the central section of the Bílina river. The settlement was completely excavated and found to be occupied from the Hallstatt period into the so-called La Tène-Roman horizon (laténske-

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[14] Meduna, op. cit. (note 2) 24.

[15] P. Budinský, Arch. Rozhledy 20, 1968, 434ff.; id. ibid. 21, 1969, 320ff.; id. ibid. 23, 1971, 27ff.; id. ibid. 24, 1972, 615ff.; id. ibid. 26, 1974, 348ff.

[16] Id. ibid. 23, 1971, 53ff.

[17] W. Dehn, Zur Verbreitung und Herkunft der latènezeitlichen Braubacher Schalen. Bonner Jahrb. 151, 1951, 83ff. – Schwappach, op. cit. (note 11).

římska horizont). The site was excavated as part of a rescue project necessitated by the digging of open cast coal mines and is now one of a number of Iron Age cemeteries and settlements excavated in this region. The finds of Iron Age date discovered between the Erzgebirge and Ohře river before 1975 have been summarised by J. Waldhauser[18]. Waldhauser, as the excavator of Radovesice, has published a preliminary site report which contains a description of the location and nature of the site and summarises the main artefacts found[19]. As the main pottery types found on the site in different phases are described and illustrated in this report they are not repeated here and reference should be made to this when evaluating the conclusions reached here. The complete publication of the material from the site will be available shortly[20].

The excavation of the whole settlement means that the pottery recovered was more likely to reflect a greater range of the chronological and functional variation of the artefacts on the site than would be exhibited by an assemblage recovered from a more partial excavation, but it did pose some problems of scale. For this reason the analysis presented here was based on the pottery from the 47 largest features on the site. In the final publication all the features of similar date will be fitted into this scheme.

The continuous occupation of the site meant that it provided an ideal case on which to test Filip's view that there was no La Tène A horizon in northwest Bohemia. Filip's idea probably arose because there were no certain grave finds that could be assigned to La Tène A north of the Ohře river (although just to the south of the river are such finds as Činov, Hořin and Panensky Tynec). At the time at which Filip was writing, there appeared to be a blank between the Hallstatt C/D Bylany graves and the La Tène B flat inhumation graves. Thus when the first settlements were excavated, the finds were interpreted in such a way as to reflect this supposed continuity between the Hallstatt D and La Tène B material.

It is hoped to show here that there is a phase of artefacts which fit between the phases labelled Hallstatt D and La Tène B. These are finds such as wheel-turned pottery which make up La Tène A assemblages in other areas. This makes sense of the continuity of artefact forms between Hallstatt D and La Tène B and makes it possible to compare the developments in northwestern Bohemia with those in other areas.

The Problems of Deposition

The evidence from Radovesice is analysed here to uncover the sequence of the production and the use of pottery and to draw up a relative phasing of this site from this sequence. However at the outset it was by no means certain that it would be possible to draw up this phasing, because of the effects of deposition. The assumption underlying a successful seriation is that it will be possible to discover regular associations and developments of types which change through

[18] J. Waldhauser, Arch. Rozhledy 28, 1976, 294ff.

[19] Id. ibid. 29, 1977, 144ff.

[20] J. Waldhauser (Hrsg.), Radovesice (in print).

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
130	−.03516	−.15823	−.11956	−.05624	−.15078
220	−.00438	.02554	−.07039	.20950	.02216
320	−.03100	−.01397	.04813	.12220	.04953
512	−.01664	−.00444	.13406	−.00054	−.00159
523	.01414	.05439	.00960	.19399	.10410
524	.08421	.00552	−.01264	.04136	−.15333
381	−.00607	−.00349	−.05947	.03426	−.03512
530	−.01108	.01222	.01950	−.06101	.05871
531	−.00000	−.00000	−.00000	−.00000	−.00000
533	−.00607	.06729	−.03640	.05438	−.16658
534	.00328	.02864	−.05394	.04263	.03231
536	−.00138	.03258	−.03681	.01656	.14982
310	−.00215	.08866	−.01471	−.09868	.10068
535	−.02814	.04477	.00519	.02481	.04799
110	−.01231	−.00207	−.04338	.00547	.16351
551	.00389	.00436	.13692	−.09060	.04361
552	−.01317	.02947	.17857	.06754	.02940
120	.01508	−.10395	−.08876	−.13657	−.02577
210	−.03373	−.14912	−.03758	−.04098	.05564
521	−.03873	−.03119	−.01919	.10152	.12354
522	−.01812	.09084	−.00365	−.00440	−.09749
532	−.00425	.12237	−.00506	.03319	−.09545
541	.13322	−.04381	−.00170	.00964	−.01711
542	−.04085	−.11119	.02799	.05524	−.06574
553	−.00733	.01094	.06098	.07152	.07479
600	−.00927	−.00302	−.03926	.03163	−.16075
700	−.01478	−.00441	−.01687	−.06947	−.02086
1000	.13201	−.02618	−.03864	.05600	−.01438
2000	−.01274	−.09002	−.06979	.01821	.07217
3100	−.06807	−.17485	.03593	−.03943	−.09581
3200	−.01126	.10167	−.03958	.08446	.05932
4200	.00176	.09015	.00284	−.07667	.05932
5200	−.00786	.08691	−.05849	−.07514	−.02394
4100	−.03554	.11792	−.01773	−.04750	.03694
1200	−.00317	.04724	−.01521	.06424	−.16879
1300	−.00417	−.01923	−.01643	.07894	−.03667
6101	−.03759	−.00096	.14443	.07861	−.10402
6102	.17825	.04649	−.03414	.00543	.01272
6103	.00000	.00000	.00000	.00000	.00000
6104	−.00930	−.08704	−.03577	.03652	−.02793
6201	.07526	.05756	.17319	.03167	.05116
6301	.16423	.03717	.00337	−.00233	.06694
6302	.17533	.03451	−.02839	−.01290	.02094
6304	.16246	.03110	−.01632	.00254	.00297
6305	−.02664	.02126	.24719	−.04624	−.01236
9000	.00182	.06134	−.03727	−.00874	−.08468
3300	−.00300	−.01677	−.03602	.17443	−.06402
670	−.03324	−.00052	.03607	−.18040	.04106
710	−.00678	.03760	.01879	.09050	.01629
830	−.03379	.01393	.19996	−.03393	−.04896
920	−.00142	−.01338	.00248	.09788	.09284
3400	−.00043	.01775	−.08391	.15177	.18343

Table 1. Factor loadings from the principal component analysis of Radovesice.

time. However this may not be possible if the original associations have been broken due to the subsequent activities on the site. Such activity may include the cleaning and re-use of pits and houses, the processes of erosion and the use of rubbish middens, containing types not in contemporary use, to fill in old features. It is not yet been possible to develop effective methods for examining the build up of deposits on sedentary sites which were occupied for a long period of time, although there is a growing literature on this subject[21].

In the evaluation of the results of the seriation a number of commonsense propositions were used. The main problem was to determine whether the pottery found in a feature was a result of the activities carried out in that feature, in a discrete time period. It was possible to divide the features into two on this basis. In the first group are those structures, such as houses and working pits, in which pottery may have been used. In these cases this pottery may become buried during the process of use or after the abandonment of the feature and may reflect something of its period and nature of use. In contrast there are features such as ditches, grain storage pits and post holes which probably contained no pottery during their use. In these cases the pottery found in the deposits will date from some time after the abandonment of the feature and may contain a mixture of types never in contemporary use.

A method of evaluating the reliability of the features at Radovesice as indicators of chronology was to look at the deposits they contained and the distribution of the finds within the deposits. This was aimed to discover the history of the features after they went out of use. Some features had a layer of loess at the bottom, which may indicate weathering prior to infill. In such cases the fill of the feature may not be contemporary with its use and the pottery within it may have little to do with the period or nature of its use. Also important was whether the finds were distributed throughout the fill, or were only found in part of the deposits. If only part of the deposit contained finds it might indicate that these were the result of dumping, rather than the use to which the feature was put originally. I have added a comment on the perceived reliability of each feature used here as an indicator of chronology in the table presenting the results of the seriation *(Table 2)*. These problems were relevant to the interpretation of the seriation results once they had been obtained. The initial concern was to determine whether the mixing of deposits was so severe as to make their chronological ordering impossible.

The Possibility of Seriation

The deposits used in this seriation came from the two earliest periods of the site's occupation. This increased the likelihood of their being mixed by subsequent activity on the site. I felt that if there had been much disturbance of the material after it became buried, or much infilling of features with rubbish, that there would be no regularly occurring assemblages of types. The first step taken to determine

[21] L. Binford, Journal Anthr. Research 37, 1981, 195ff. – M. B. Schiffer, Archaeological context and systemic context. American Antiqu. 37, 1972, 156ff.; id., Behavioral archaeology (1976).

	Feature	Type of reliability as chronological indicator
Phase Ia		
114	Pit	Uncertain – disturbed by bulldozer
146	Pit	Good – finds throughout fill
39	House	Good – finds throughout fill
38	Pit	Good – finds throughout fill
118	House	Good – finds throughout fill
55	Pit	Good? – few finds, but spread throughout fill
Phase Ib		
116	House	Good – finds throughout fill
122	Pit	Uncertain
142	Pit	Unreliable – most finds in central black deposit
155	House	Good – finds throughout fill
62	Pit	Unreliable – layer of loess at base
150	House	Unreliable – most of finds in top 30 cm
143	House	Good – finds throughout fill
53	House	Uncertain – most finds in top of feature
251	Pit	Unreliable – finds in top of feature
51	Pit	Good – finds throughout fill
390	?	Unreliable – probably not completely excavated
58	House	Good – finds throughout fill
14	House	Uncertain – disturbed by bulldozer
330	House	Unreliable – finds in upper part of feature
345	House	Good – finds throughout fill
Phase IIa		
22	Pit	Good – finds throughout fill
375	?	Unreliable – possible superimposition of 2 features
42	?	Unreliable – loess layer near base
123	Pit	Unreliable – superimposition of three features
300	House	Good – finds throughout fill
395	House	Good – finds throughout fill
228	House	Unreliable – finds in top of feature
23	Pit	Unreliable – finds in top of feature
344	House	Unreliable – finds in top of feature
206	House	Good – finds throughout fill
370	House	Unreliable – finds in top of feature
Phase IIb		
43	Pit	Good – finds throughout fill
162	House	Good – finds throughout fill
369	House	Unreliable – finds in top of feature
225	Pit	Unreliable – possible superimposition of 2 features
107	House	Good – finds throughout fill
18	Pit	Good – finds throughout fill
206	Pit	Unreliable – loess layer at base
368	House	Good – finds throughout fill
186	Pit	Unreliable – finds in top of feature
232	House	Good – finds throughout fill
25	House	Good – finds throughout fill
289	Pit	Good – finds throughout fill
428	House	Good – finds throughout fill
72	House	Good – finds throughout fill

Table 2. The seriation odering.

the feasibility of the seriation was to look for assemblages of regularly co-occurring pottery types which might be regarded as being connected by their usage and closeness in time.

The analysis was based on a code of pottery forms and decorations drawn up by Waldhauser and these are shown in *Fig. 1–3*. The pottery from each feature of the first two phases at Radovesice was coded and the amounts of each form and type of decoration in each feature were calculated. The majority of the pottery contained no indication of the vessel form or type of decoration and although the sherd counts were recorded they were not used in the analysis presented below, as the size of the feature would have then had a major influence on the results obtained. It was only the sherds for which form and/or decoration were known which formed the basis of the analysis.

The groups of forms and decorations which regularly occur together were uncovered using three methods. These, and all subsequent analyses mentioned, were carried out on the 1906S computer at Sheffield University. The first method used looked for correlations between the different forms and decorations using the Pearson correlation coefficient. This was output as part of the clustering package, Clustan 1C[22]. Secondly the features were clustered using this same package and a print-out was given of the F- and T-ratios of the pottery types. These ratios are a measure of the importance of each type in determining the groups obtained. A fuller explanation of the cluster analysis is given below, but what is important here is that the groups obtained are thought to have some significance on archaeological grounds. From the F- and T-ratios it could be seen which types were important in assigning features to different groups, and consequently which types might be chronologically significant.

Lastly, a principal components analysis was run using the SPSS 6 package[23]. This method seeks to provide summary measures (factors) for the variance found within the data and loads each variable (in this case pottery type) against the factors produced. Types that load highly on a factor have a large amount of their variance summarised by that factor. Types which load highly on the same factor may be influenced by common trends in the data[24]. The factor loadings for each type obtained here are given in *Table 1*. Although in this case the percentage of the variance summarised by the first few factors was not high (only 59% of the variance was summarised by the first ten factors, this suggesting that the data may not have been as highly structured as might have been hoped), it was found that certain groups of types did load highly on the first three factors (see *Table 1*). It may be that these types were influenced by the same underlying trends in the data.

On the basis of the three statistical tests it was possible to divide the pottery types into three groups. The types in each group are shown in *Fig. 1–3* respectively. From these figures it can be seen that it is possible to group not only the fine pottery types, whose production might have been standardised, but some of the coarse ones as well. Certain forms were common to all three periods, notably the

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[22] C. Wishart, Clustan IC (1978).

[23] N. H. Nie, D. H. Bent u. C. H. Hull, SPSS: Statistical package for the social sciences (1975).

[24] J. E. Doran u. F. R. Hodson, Mathematics and Computers in Archaeology (1975).

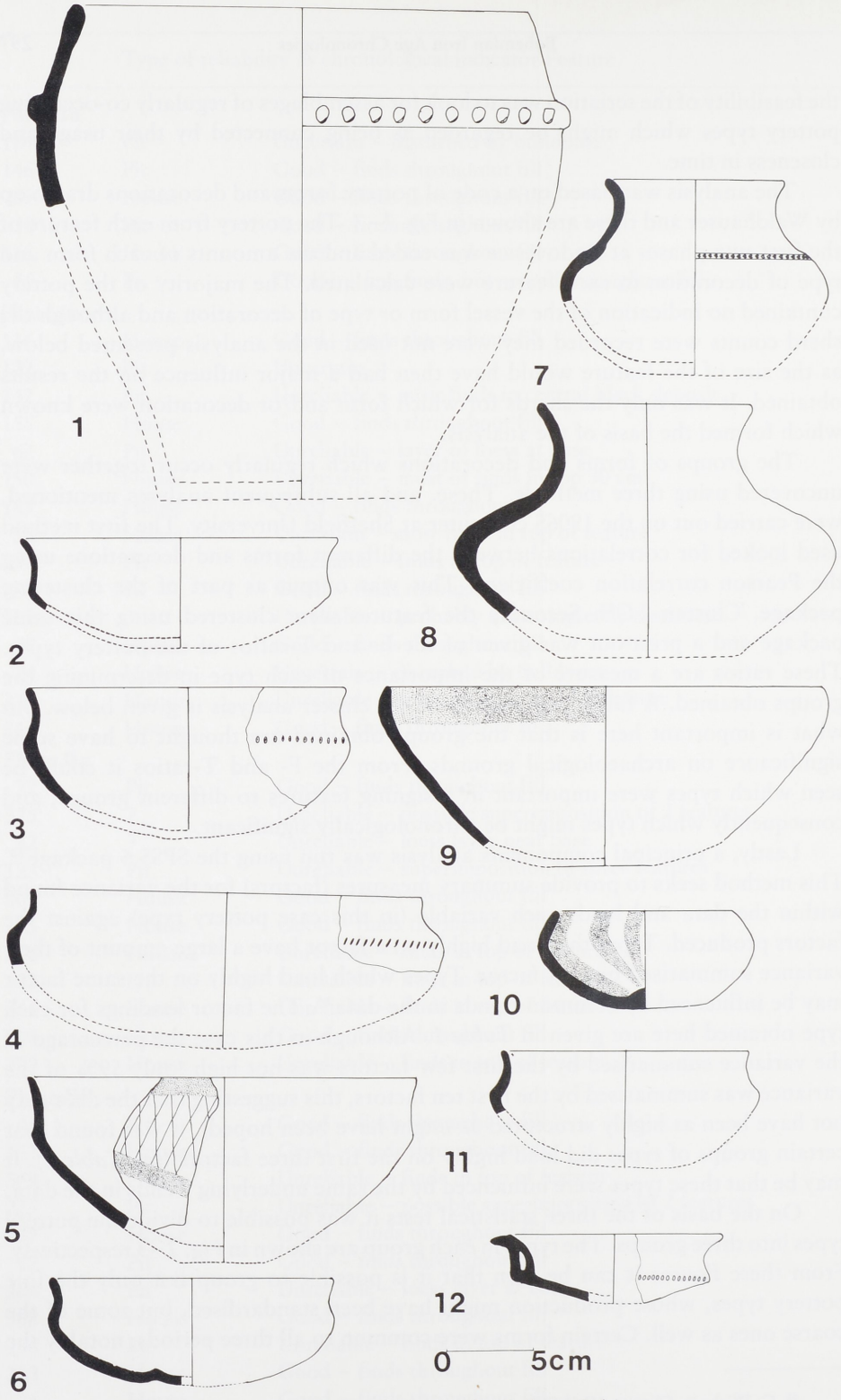

Fig. 1. Group 1 pottery types – the Hallstatt D forms.
1 Type 130; 2 type 531; 3 type 532; 4 type 533; 5 type 534; 6 type 535; 7 type 720; 8 type 710; 9 type 521; 10 type 522; 11 type 536; 12 type 830. – Scale ca. 1:4.

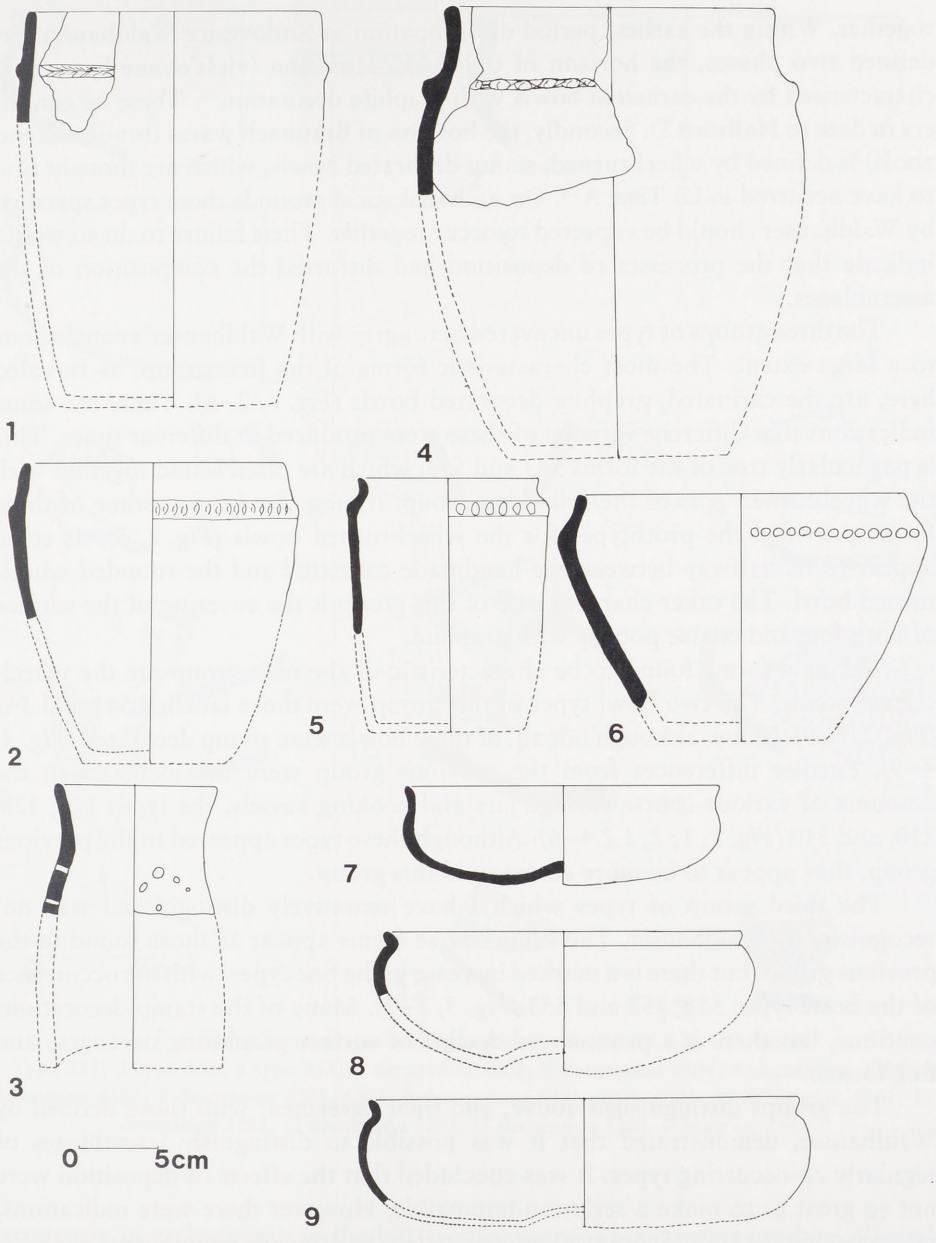

Fig. 2. Group 2 pottery types – the La Tène A forms.
1 Type 110; 2 type 120; 3 type 920; 4 type 210; 5 type 220; 6 type 310; 7 type 542; 8 type 541; 9 type 542. – Scale ca. 1:5.

inturned bowls (types 521 and 522), although these may have been produced in slightly larger numbers in the earliest period. The same may be true of the high sided forms 600 and 700.

These analyses were not carried out in an archaeological vacuum and previous work had laid down guidelines for which types might be expected to occur

together. Within the earliest period of occupation at Radovesice Waldhauser has defined two phases, the horizon of polished decoration (vlešt'ované keramiky) characterised by the carinated bowls with graphite decoration[25]. These he considers to date to Hallstatt D. Secondly, the horizon of Braubach wares (braubašského zboží) is defined by wheel-turned, stamp decorated bowls, which are thought first to have occurred in La Tène A[26]. On archaeological grounds these types specified by Waldhauser should be expected to occur together. Their failure to do so would indicate that the processes of deposition had distorted the composition of the assemblages.

The three groups of types uncovered here agree with Waldhauser's conclusions to a large extent. The most characteristic forms of the first group, as revealed here, are the carinated, graphite decorated bowls *(Fig. 1, 2–6)*. There are some indications that different variants of these were produced at different times. This is particularly true of the forms 533 and 536, which are often found together with the wheel-turned pots of the following group. It may also be that some of these forms provided the prototypes for the wheel-turned bowls *(Fig. 1, 7)*, as some appear to be halfway between the handmade carinated and the rounded wheel-turned bowl. The other characteristic of this group is the covering of the surface of both fine and coarse pottery with graphite.

The new forms found to be characteristic of the next group are the wheel-turned bowls. The two bowl types in this group were those labelled 541 and 542 *(Fig. 2, 7–9)*. Many, although not all, of these bowls were stamp decorated *(Fig. 3, 4–9)*. Further differences from the previous group were the increases in the amounts of various coarse storage jars and cooking vessels, the types 110, 120, 210, and 310 *(Fig. 1, 1; 2, 1.2.4–6)*. Although these types appeared in the previous group, they appear to be more common in this group.

The third group of types which I have tentatively distinguished was not recognised by Waldhauser. The same coarse forms appear as those found in the previous group, but there is a marked increase in the fine types, with the occurrence of the bowl types 551, 552 and 553 *(Fig. 3, 1–3)*. Many of the stamp decorations continue, but there is a pronounced decline of surface graphiting on coarse and fine forms.

The groups distinguished above, and their agreement with those defined by Waldhauser, demonstrated that it was possible to distinguish assemblages of regularly co-occurring types. It was concluded that the effects of deposition were not so great as to make a seriation impossible. However there were indications, most notably the lack of variance summarised in the principle components analysis, that depositional factors had an effect which must be evaluated when considering the results obtained from the seriation.

The Seriation and Cluster Analysis

The three groups of types described in the last section were used as the basis for the seriation. Computer seriation techniques have been used increasingly

[25] Waldhauser, op. cit. (note 19) 152ff. Fig. 7.

[26] Ibid. 158ff. Fig. 9.

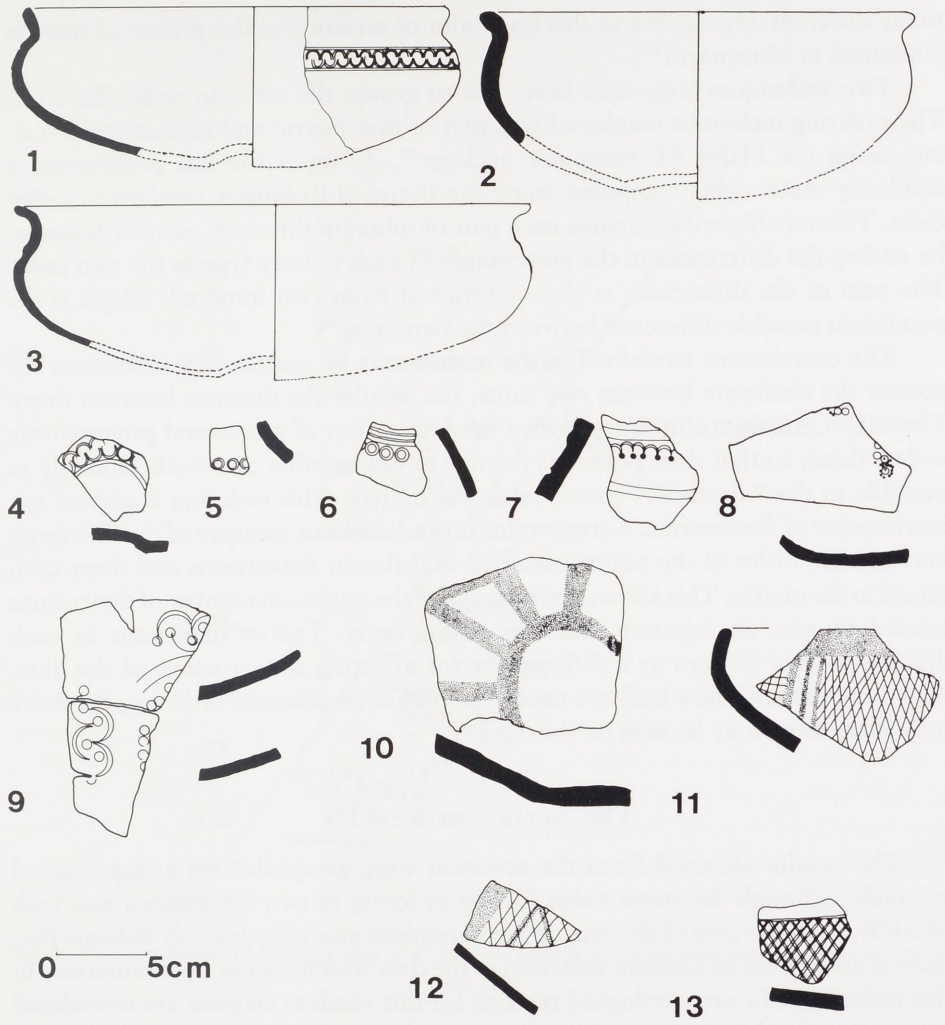

Fig. 3. Group 3 pottery types and decorations – the later La Tène A forms.
1 Type 551; 2 type 552; 3 type 553; 4 decoration 6302; 5 decoration 6104; 6 decoration 6104; 7 decoration 6102; 8 decoration 6305, 6202; 9 decorations 6301, 6202, 6304; 10 decoration 5202; 11 decoration 5203; 12 decoration 5203; 13 decoration 5203. – Scale ca. 1:4.

frequently in archaeology in the last twenty years. They aim to produce a serial ordering of archaeological units (often units of excavation, such as layers or features) on the basis of the number of artefacts within them. One of the earliest forms of frequency seriation was that undertaken by J. A. Ford[27], who drew up so-called battle-ship curves which represented the rise and decline in the frequency of particular types. It was then possible to order the archaeological units containing these types on the basis of the number of the artefacts within them and it was hoped that the order of the units reflected their chronological order. There are

[27] J. A. Ford, A quantitative method for deriving cultural chronology (1962).

many different approaches to this basic aim of seriation and a review of these is contained in Marquardt[28].

Two techniques were used here: one to group, the other to order the units. The ordering technique employed was that of non-metric multidimensional scaling, using the MDSCAL computer package[29]. As input for this programme a similarity matrix was computed using the Brainerd-Robinson similarity co-efficient. This co-efficient compares each pair of units (in this case, pairs of features) by adding the differences in the percentages of each pottery type in the two units. The sum of the differences is then subtracted from two hundred, which is the maximum possible difference between the two units[30].

The correlations contained in the matrix may be imagined as distances; the greater the similarity between two units, the smaller the distance between them. The MDSCAL algorithm starts with a random scatter of points and progressively orders these, so that their positions relative to one another approach as nearly as possible to the "distances" contained in the matrix. This ordering is carried out in a number of dimensions. A stress value is produced as a measure of the difference between the order of the points obtained in different dimensions and those contained in the matrix. This allows one to evaluate the minimum number of dimensions needed to give an accurate ordering of the units. This is important as each dimension may be seen as a different factor affecting the structure of the data. The more dimensions which are needed to obtain an accurate ordering, the more influences there may be seen on the data[31].

The Seriation Results

The results obtained from the seriation were acceptable on archaeological grounds, although the stress value for the ordering in two dimensions was high (0.2075). As in the case of the principle components analysis, this may indicate that there is an amount of random variation in the data which cannot be summarised in this ordering. The archaeological reasons for this random element are considered below. Despite this, it appears that the types chosen are capable of producing an ordering which makes archaeological sense. The result of this ordering is shown in *Fig. 4*. Following Waldhauser's preliminary phasing it appears that the earliest features occur at the bottom left of the scatter and become increasingly later as one moves up the diagonal to the top right[32]. Following a procedure suggested in Cherry and Hodges[33] two regression lines were calculated on both the X and Y

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[28] W. H. Marquardt in: M. Schiffer (Hrsg.), Advances in archaeological theory and method I (1978) 257ff.

[29] J. B. Kruskal u. F. Carmone, MDSCAL 5M (1969).

[30] Doran u.a., op. cit. (note 24) 139.

[31] This technique is described in detail in J.B.Kruskal, Psychometrika 29, 1964, 1ff.; ibid. 115ff. – Archaeological applications are discussed in J. Cherry in: J. Bintliff (Hrsg.), Mycenean Geography (1977) 76ff. – J. Cherry u. R. Hodges, Antiqu. Journal 58, 1978, 299ff. – D. G. Kendall in: F. R. Hodson, D. G. Kendall u. P. Tautu (Hrsg.), Mathematics in the Archaeological and Historical Sciences (1971) 215ff.

[32] Waldhauser, op. cit. (note 19) 150f.

[33] Cherry u. Hodges, op. cit. (note 31) 304.

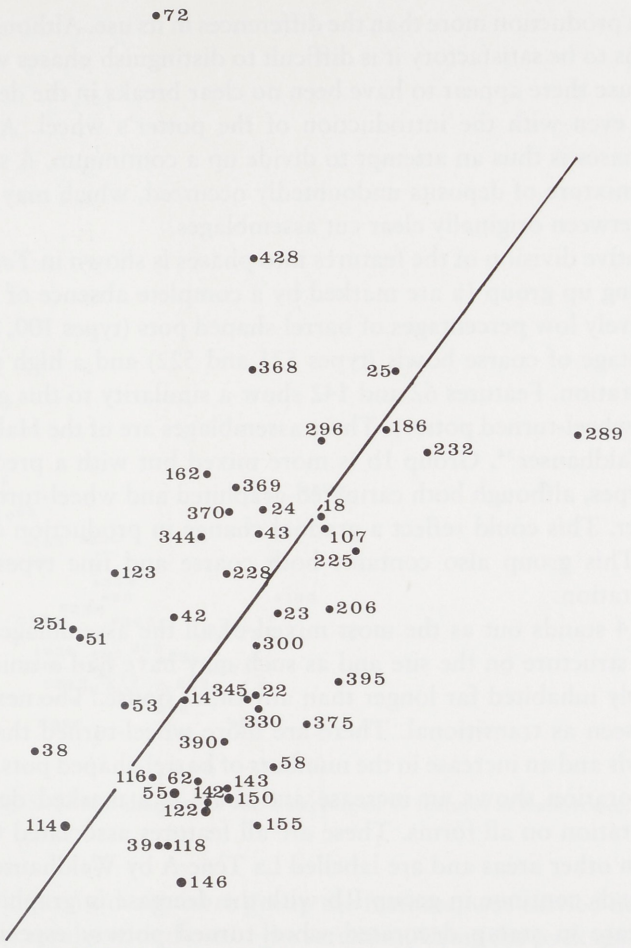

Fig. 4. Two-dimensional MDSCAL plot of 47 features from Radovesice with averaged best-fit regression line.

co-ordinates for the points in two dimensions. Two lines were calculated as neither the X or the Y variable could be seen as dependent upon the other. The averaged regression line plotted on the two dimensional scatter is shown on *Fig. 4*. Although the basic trend of the features was up the diagonal as just described, the order of the units was read off in a more systematic manner by measuring the distance of a point from the line along its orthogonal projection onto the line. Those points which were at the same distance up the diagonal, but further from the line, were judged to be earlier than those which were nearer the line when measuring along the orthogonal projection.

The ordering of the features obtained by this method is given in *Table 2* together with an estimate of the archaeological reliability of the features used. It seems possible in the seriation to group features which probably had different functions, such as pits and houses. This shows that the ordering obtained reflects

the changes in production more than the differences in its use. Although the overall ordering seems to be satisfactory it is difficult to distinguish phases within it. This is partly because there appear to have been no clear breaks in the development of the industry, even with the introduction of the potter's wheel. An attempt to distinguish phases is thus an attempt to divide up a continuum. A second reason is that some mixture of deposits undoubtedly occurred, which may have blurred distinctions between originally clear cut assemblages.

The tentative division of the features into phases is shown in *Table 2*. The six features making up group Ia are marked by a complete absence of wheel-turned pottery, relatively low percentages of barrel-shaped pots (types 100, 200 and 300), a high percentage of coarse bowls (types 521 and 522) and a high percentage of graphite decoration. Features 62 and 142 show a similarity to this group, mainly in the lack of wheel-turned pottery. These assemblages are of the Hallstatt D types defined by Waldhauser[34]. Group Ib is more mixed but with a predominance of Hallstatt D types, although both carinated-graphited and wheel-turned bowls are found together. This could reflect a gradual change in production and/or use of these types. This group also contains both coarse and fine types which have graphite decoration.

Feature 14 stands out as the most mixed of all the assemblages. This is the largest house structure on the site and as such may have had a unique function, or was possibly inhabited far longer than any other house. The next group, IIa, may also be seen as transitional. There are more wheel-turned than handmade carinated bowls and an increase in the numbers of barrel-shaped pots. The amount of stamp decoration shows an increase and there is a marked decrease in the graphite decoration on all forms. These are all features associated with La Tène assemblages in other areas and are labelled La Tène A by Waldhauser[35].

These trends continue in group IIb with the decrease in graphite decoration and the increase in stamp decorated wheel-turned pottery especially marked. Within this last class of pottery there is an increase in the forms 551, 552 and 553. These may be seen as more developed versions of the 541 and 542 types, although these continue to be found as well *(Fig. 3, 1–3)*. This assemblage may represent a later La Tène A group, although some of the more unusual combinations of forms may reflect a difference in the use of the features rather than a change in production.

The end point of the seriation is provided in a negative manner by the pottery types found in the La Tène B flat cemeteries. These are dated by association with metal objects generally recognised as characteristic of La Tène B. None of these pottery types were found in the features used in the seriation, although they were found in other features at Radovesice. This suggests that the features analysed here are prior to La Tène B and this supposition is increased by the fact that the La Tène B types at Radovesice appear to have developed out of La Tène A types, as defined here. Forms such as 551, 552 and 553 may be seen as prototypes for La Tène B wheel-turned forms.

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[34] Waldhauser, op. cit. (note 19) 152ff.

[35] Id., op. cit. (note 19).

Fig. 5. Scatter diagram of the clustering of 47 features at Radovesice.

A cluster analysis, designed to group the features, was carried out to compare and contrast its results with those of the seriation. Using the package Clustan IC[36], the features were clustered using Ward's linkage method, the error sum of squares. Two main clusters were isolated, the first containing most of the features thought to be Hallstatt D, the second comprised those of La Tène A. The results of the cluster analysis are given in *Fig. 5–6* and a comparison of the seriation, the cluster analysis and the archaeological evidence is given in *Table 3*. In addition to the two main groups there were two outliers, features 370 and 162, which were characterised by high percentages of wheel-turned pottery. This left feature 72 completely isolated. This feature contained a higher percentage of wheel-turned pottery than any other and was similarly picked out by the MDSCAL analysis. The broad division of features thought to be Hallstatt D and La Tène A compared well with the results of the seriation and provided further evidence that the types chosen are capable of producing results which make archaeological sense. Those features which appear mis-assigned on archaeological grounds (such as 345 and 206) contained relatively low percentages of wheel-turned pottery. This suggests that the fine types may be more useful in distinguishing the assemblages than the coarse ones.

[36] Wishart, op. cit. (note 22).

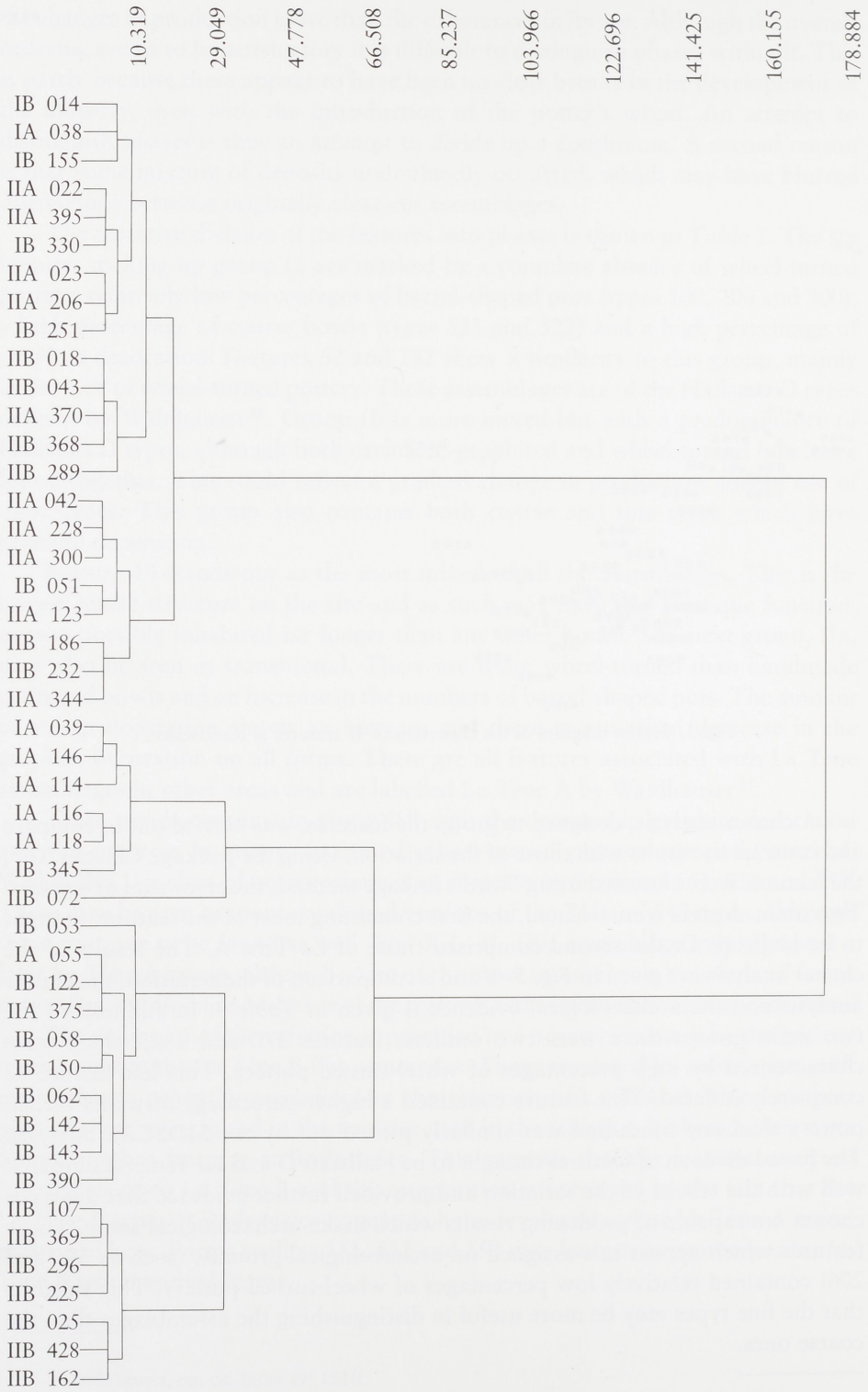

Fig. 6. Dendrogram from the cluster analysis with the seriation phases added.

Seriation	Feature	Cluster	Archaelogical evidence
Phase Ia	114	3	
	146	3	
	39	3	
	338	1	
	118	3	
	55	4	
Phase Ib	116	3	
	122	4	
	142	4	
	155	1	
	62	4	Hallstatt D fibula
	150	4	
	143	4	
	53	4	
	251	1	
	51	2	
	390	4	
	58	4	
	14	1	
	330	1	Hallstatt D fibula
	345	3	
Phase IIa	22	1	
	375	4	
	42	2	
	123	2	La Tène A fibula and knife
	300	2	
	395	1	
	228	2	
	23	1	
	344	2	
	206	1	
	370	1	
Phase IIb	43	1	
	162	5	
	369	5	
	225	5	
	107	5	
	18	1	
	206	1	
	368	1	
	186	2	
	232	2	
	25	5	
	289	1	
	428	5	
	72	isolated	

Table 3. Seriation ordering, cluster analysis and archaeological evidence.

Independent Evidence of the Phasing at Radovesice

The results of any seriation must be checked against such independent archaeological evidence as exists[37]. In the case of Radovesice there are two forms of independent evidence, neither of which is full enought to provide an adequate check. The lack of other persuasive evidence was one of the main reasons why pottery was chosen as a means of phasing in the first place. The first alternative source of evidence was that of stratigraphy. The site was excavated as part of a rescue project and the features were usually removed in ten or twenty centimetre spits. This meant that there is not as much information on vertical stratigraphy as might be hoped. Also the details of the positions of the finds within the features was not as full as it might have been.

The features which occur in the transitional phases of the seriation, Ib and IIa, often had most of their pottery in their upper layers (see *Table 2*). This may suggest that the transitional phases are due to the mixing of deposits, rather than the fact that both Hallstatt D and La Tène A types remained long in contemporary use, although some overlap cannot be excluded. It is the features in these transitional phases which may be the main cause of the random element noted in the principal components and MDSCAL analyses. The features at either end of the seriation, with predominantly Hallstatt D and La Tène A assemblages respectively, may be less mixed and reflect the changes in production more accurately. However, although there was certainly some mixing of deposits there does not seem to have been a sudden changeover from the Hallstatt D and La Tène A types in use, but instead a gradual transition.

The second means of checking the seriation was to look at artefacts within the features whose status as markers of Hallstatt D and La Tène A assemblages is generally accepted. The few objects which were found tend to confirm the results of the seriation. Two fibulae were found which were accepted as Hallstatt D types. The first was in feature 330/74 (phase Ib) and is known from Hallstatt D graves in other areas[38]. The second was an iron fibula with a cup-shaped foot found in 62/72 (phase Ib) which is dated to Hallstatt D 2/3 in other areas[39].

Of the La Tène A features, 123/72 (phase IIa) contained a Certosa fibula, which is not a good chronological indicator within the La Tène period, being found from La Tène A to C, but which is not found in Hallstatt D[40]. An iron knife, which was also thought to date to La Tène A, was also found in this feature[41]. These two features are the only ones included in the seriation which have produced objects assigned to La Tène A on typological grounds. This information is summarised in *Table 3*. All that it is possible to say from this evidence is that the results of the seriation were not contradicted.

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[37] C. H. McNutt, On the methodological validity of frequency seriation, American Antiqu. 38, 1973, 45ff. – Marquardt, op. cit. (note 28).

[38] Waldhauser, op. cit. (note 19) 153. – V. Saldová, Památky Arch. 62, 1971, 98.

[39] L. Pauli, Untersuchungen zur Späthallstattkultur in Nordwürttemberg. Hamburger Beitr. Arch. 2, 1, 1972, Fig. 5. – Waldhauser, op. cit. (note 19) 158.

[40] M. Primas, Zur Verbreitung und Zeitstellung der Certosafibeln. Jahrb. RGZM 14, 1967, 118. – Waldhauser, op. cit. (note 19) 158.

[41] Id. ibid. 161 Fig. 9, 13.

Conclusions

I hope to have demonstrated here that Filip's scheme, based on the premise that "late Hallstatt" survivals continue into the late La Tène, cannot hold in the case of Radovesice and that there is a La Tène A phase of settlement in northwest Bohemia. The material discussed here is not found in features given a later date at Radovesice and thus seems to have been restricted to a discrete part of the sites occupation. There is evidence at Radovesice for a continuous development from Hallstatt D, through La Tène A, to La Tène B. This is shown by the continuity in many coarse forms, as well as the possible development of the wheel-turned La Tène A bowls from the carinated Hallstatt D types. This is shown by forms which appear to be transitional between the two *(Fig. 3, 7)*. The following La Tène B phase shows continuity from La Tène A, again particularly in the bowl forms. Such types as 551, 552 and 553 continue in slightly developed form in the later period.

The La Tène B pottery can be dated by association with metal types found in the flat inhumation graves[42]. The types prior to these in the pottery sequence at Radovesice, and later than those held to be Hallstatt D, may therefore be designated La Tène A. Also, as there is no evidence for the continuation of the Hallstatt D fine pottery after the phases Ib and IIa defined above the idea of late Hallstatt appears to be invalid for Radovesice at least.

These conclusions also support the more general point that the archaeological material should not be forced into an externally derived framework, such as the movement of the Celtic tribes in La Tène B, but instead should be used to refute or support such a supposition. The phasing of settlement deposits, in particular, is an extremely uncertain undertaking and maximum care should be taken not to force an interpretation on the material that it cannot bear. The scheme derived for Radovesice cannot be considered as necessarily valid for all contemporary sites in the immediate area, much less for Bohemia as a whole. It can best be seen as a hypothesis to be tested against the material from other sites. I hope, however, to have made some sense of the archaeological material in this particular case and to have presented a chronological argument which can enable the development of the site of Radovesice to be investigated in due order.

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[42] Ibid. 164ff.