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NATURAL MOVEMENTS IN PREHISTORIC VILLAGES?

MARKUS SPRING

Institute of Prehistoric Archaeology, Zurich University
joycemarkus@gmail.com

ABSTRACT

Hillier and other researchers combined analysis of urban grids using axial maps with counts of pedestrian movements. They recognised the influence these grids played on pedestrian movements in cities and developed the 'law of natural movement' in which urban grids are principal generators of pedestrian movement and starting point for a city's development into specialised 'generative' and 'conservative' zones.

In archaeology, tree ring dating has allowed to analyse growth processes of prehistoric villages. This paper looks at some of these settlements in the Circum-Alpine region using axial maps. It analyses how new buildings fitted into emerging street patterns.

Contrary to modern economies, it remains extremely difficult to determine in prehistoric settlements what could be considered equivalent to modern 'movement-rich land uses' to further explore the 'law of natural movement'. However, there are signs of changing and increasingly specialised economies in the second half of the 4th millennium BC. Also within certain settlements, there are occasions in which 'not normal buildings' were added respectively different settlement sections used for specific purposes.

The paper cannot provide new inputs into the 'law of natural movement' as such but gives 'spatial-based' arguments to the discussion of social changes during the transition from Neolithic to Early Bronze Age.

KEYWORDS

Axial maps, Natural movement, Archaeology, Neolithic, Bronze Age

1. INTRODUCTION

In 1993, Hillier et al. combined the analysis of urban grids using axial maps with counts of pedestrian movements. They recognised the influence urban grids played in generating pedestrian movements in cities and developed their 'law of natural movement'. It identified urban grids as the principal generator of pedestrian movement and starting point for a city's development (Figure 1). In subsequent steps, movement-rich businesses such as e.g. retail sector tend to be allocated along well-integrated axial lines, while lesser lines are typical for residential areas. With this feedback loop, cities develop into specialised 'generative' respectively 'conservative' zones as outlined in a series of further research (e.g. Hillier 1996, 2001 etc.).

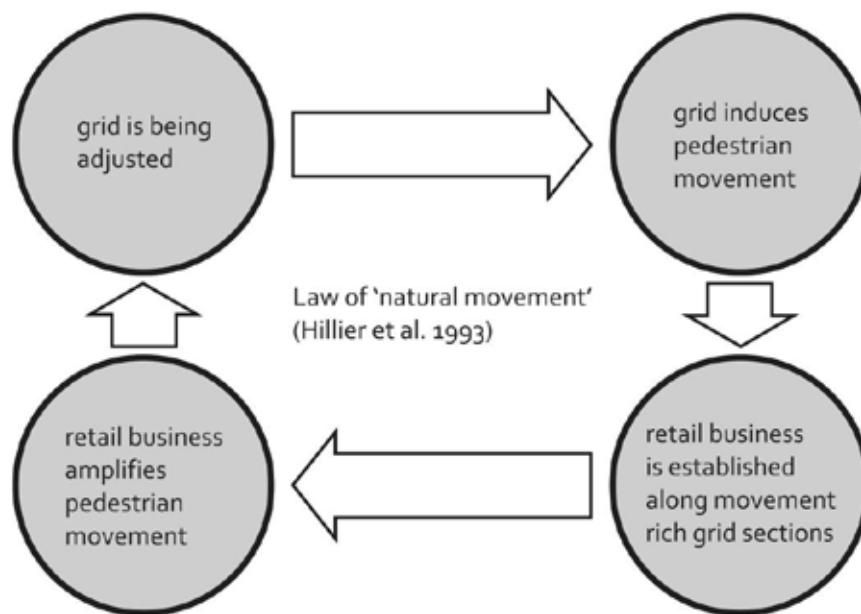


Figure 1 - 'Law of Natural Movement' and its feedback loop.

2. DATASETS AND METHODS

Tree ring dating, as the most precise dating method in archaeology, has recently allowed to analyse growth processes of prehistoric villages. In optimal cases with preserved wanes on structural remains and oak as construction material, accuracy of tree ring data can be within half a year. However, in most cases felling dates of trees used to build these settlements remain within approximately a year. Still, this allows to fairly accurately follow the construction and repairs of even single houses.

This paper therefore aims to combine archaeological and Space Syntax methods to look into the development of selected villages in the Circum-Alpine region (Figure 2). It wonders, whether the transition from Late Neolithic (late 4th millennium BC) to Early Bronze Age (1st half of 2nd millennium BC) brought forward spatial configurations in which similarities to 'natural movement' in modern cities can be traced. However, since the 'law of natural movement' is related to economic structures of a city, the paper will first take an introductory look at economic aspects of the time in question.

The second half of the 4th millennium BC was marked by important economic changes. They are seen as reactions to an unfavourable climatic period between 3400 and 3000 BC when temperatures in central Europe were about 1-2 °C lower (Amesbury et al., 2008; Bleicher and Sirocko, 2010). These new technologies were primarily aimed at facilitating food production.

Increased food production was achieved by exploiting less yielding soils and 'mechanising' production. Disk wheels were found in Zurich (Ruoff and Jacomet, 2002) and at Lake Feder, South Germany (Schlichtherle, 2002) dating to mid 4th millennium BC. Furthermore, cattle drawn carts increased transport capacities (Deschler-Erb et al., 2006; Leuzinger, 2002). From 3400 BC onwards appeared spindle whorls in large numbers. These corresponded to the introduction of new flax varieties, produce of which e.g. the villages of Alleshausen-Grundwiesen and Seekirch-Achwiesen, Germany were specialised (Maier, 2004, p.105–106, 123).

In the course of this paper, spatial configurations will also be abstracted using elementary syntaxes developed by Hillier et al. in the very nascent state of Space Syntax (Hillier et al., 1978, p.372–373; Hillier and Hanson, 1984, p.78) although rarely used in archaeology (e.g. Banning, 2010). This allows to identify common genotypic features otherwise over-shadowed by phenotypic differences.



Figure 2 - Sites mentioned in the text.

2.1 'XX O Y-CONFIGURATION' DURING CORTAILLOD CULTURE (3900–3500 BC)

The axial line map of Sutz-Lattrigen, Hauptstation innen SW [south-west] with its overall configuration of 'Y o X ((XX o y)₁ ... (XX o y)_n o y)' shows most integrated axial lines along its central lane between two rows of main buildings as well as in open spaces between them and their corresponding auxiliary buildings (Figure 3, left). Least integrated axial lines run perpendicularly to the former and separate building pairs.

An interesting insight into the social organisation of Cortaillod Culture lakeside settlements offers the marking of trees growing in the surrounding forests. Trees suitable for later construction purposes were marked by their individual owners with adze marks. These trees were later felled and used e.g. for house repairs. However, should the need arise, such 'private ownership' could be overridden and respective 'privately reserved' trees used for 'communal purposes' such as building wave breakers around the villages (Pillonel, 2007).

In this socio-cultural context, least integrated axial lines of Sutz-Lattrigen, Hauptstation innen SW most likely indicated different lots of individual households within the village. Such interpretation is further supported by elevated walkways linking individual main- and auxiliary building pairs in the younger but almost congruent sites of Murten-Pantschau (3428–3418 BC; Mauvilly, 2015) and Sutz-Lattrigen, Riedstation (3393–3389 BC; Stapfer et al., 2016, p.29, Abb. 15).

In the last quarter of 4th millennium BC, the western part of Switzerland came under increasing influence from developing Early Horgen Culture.

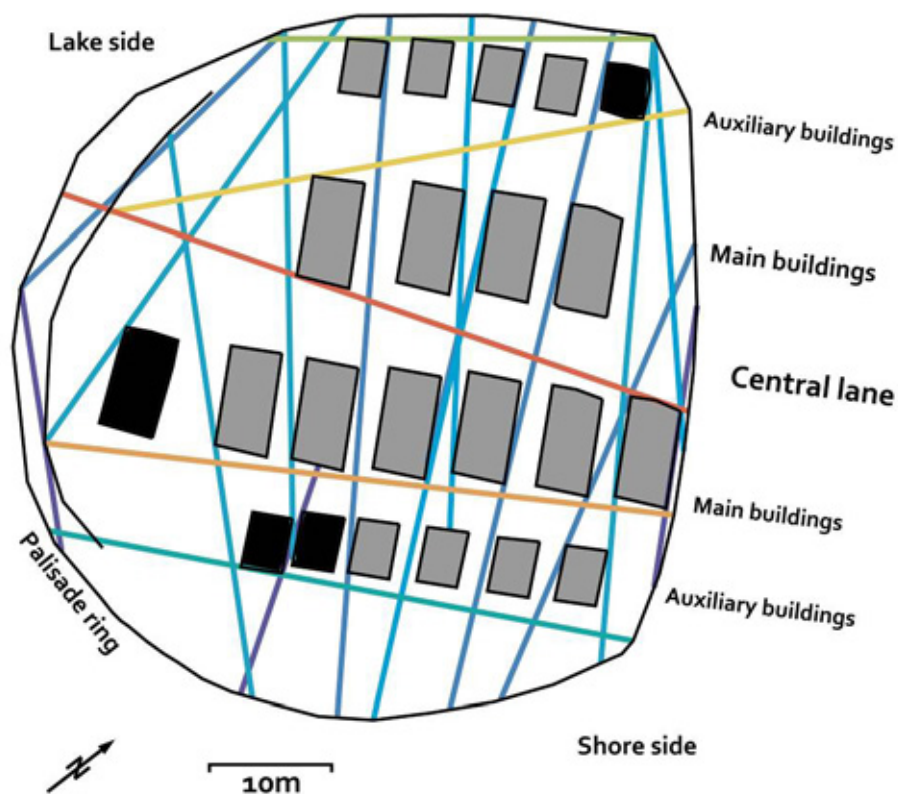
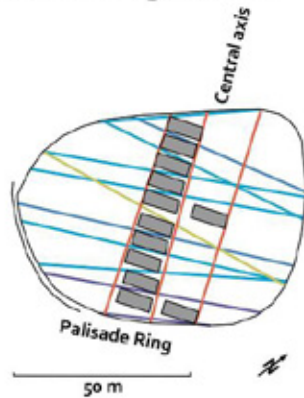


Figure 3 - Fewest line axial line map of Sutz-Lattrigen, Hauptstation innen SW, 3596/3595 BC (confirmed buildings black shaded) and reconstruction of the village in 3576 BC (Stapfer et al., 2016, p.28, Abb. 12).

2.2 'XY-CONFIGURATION' OF EARLY HORGEN PERIOD (C. 3400/3300–2800 BC)

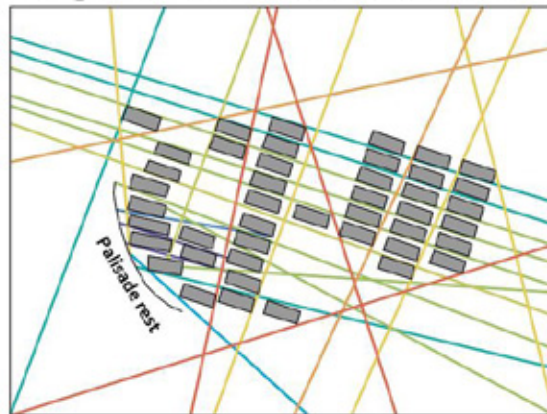
Horgen Culture emerged in Eastern Switzerland and South Germany at around 3400/3300 BC. Typical for this culture was a rough, low fired pottery. Wide spread spatial configuration of Early Horgen Culture villages were almost chess board-like arranged 'primary cells leading onto open spaces' of narrow lanes ('Xy-configuration' or z3).

Initial Configuration

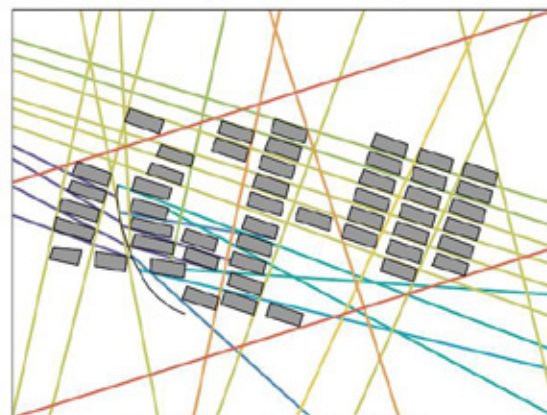


3202-3182 BC (only confirmed buildings)

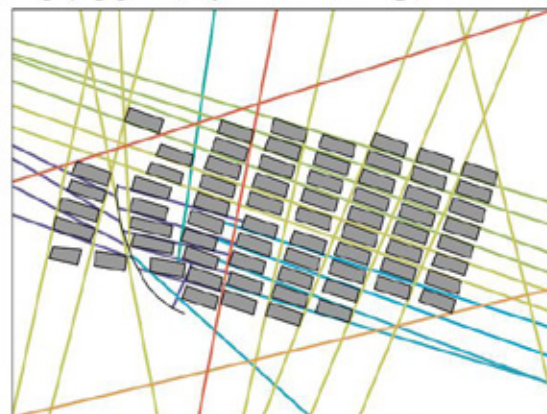
Horgen Culture Influence ,Over Print'



3172-3153 BC (only confirmed buildings)



3140-3138 BC (only confirmed buildings)



3138 BC (including further expected buildings)

Figure 4 - Sutz-Lattrigen, Hauptstation and its 'over print' through the influence of Early Horgen Culture.

The spatial influx of developing Early Horgen Period can be seen in Sutz-Lattrigen, Hauptstation at Lake Biel/Bienne. The village seems to have at first followed the spatial 'XX o y-configuration' of Cortaillod Culture (Figure 4, left). Good visible in this stage (3202–3182 BC) are the most integrated axial lines along the house front and what was supposed to become the future central lane. The only difference at this stage to the Cortaillod Culture configuration discussed above was the central lane now oriented perpendicularly to the shoreline (compare with Figure 3).

However, with new houses of uniform size being built from 3172 BC onwards and until 3138 BC, the settlement was completely overprinted with the 'Xy-configuration' of Horgen Culture (Figure 4, right side series). The integration core shifted parallel to the shoreline and open spaces within the village centre were replaced by narrow lanes. Integration was rather uniform with a high 'intelligibility' index of $R_2=0.97$. Only a remaining stretch of the initial palisade created a more segregated section in the south-western corner of the settlement.

Another thoroughly investigated village of Early Horgen Period is Arbon-Bleiche 3 at the southern shore of Lake Constance. Tree ring data of every single structure allow a detailed view into this village's development, which started with a 'pioneer building' erected in 3384 BC (Leuzinger, 2000, p.158–161). New houses were added almost annually for another seven years before the entire village was destroyed by fire in 3369 BC (Figure 5).

Axial line analysis reveal how the spatial configuration followed a pre-defined pattern throughout the village's development. The most integrated axial lines stayed along the eastern lane leading towards Lake Constance. A shallow terrace edge resulted in a slight off-set of building alignments and separated a more landward northern section from a less integrated, lower laying southern part.

Striking in the case of Arbon-Bleiche 3 is that in 3379 BC respectively one year later, two small houses were added along the most integrated axial lines (Figure 5, black shaded). These were much smaller and are not considered normal residential buildings. Economic purposes are discussed but neither their construction technique nor finds distribution reveal what for or by whom these buildings were used (ibidem, p.78–79, 85).

Different aspects allow a glimpse into the social organisation of Arbon-Bleiche 3. The slight horizontal offset in the building rows is reflected in their inhabitants' diets. People living in buildings on the terrace consumed more meat while those in the lakeside part turned more to fishing (Marti-Grädel et al., 2004, p.173, Fig. 15 and 16).

Arbon-Bleiche 3 had also long-distance contacts along the River Danube. These reached as far as the area around today's Vienna as forms of pottery vessels originating in those areas but made locally illustrate. It is therefore discussed, whether two groups with different cultural backgrounds lived together in Arbon-Bleiche 3 (ibidem, p.175).

2.3 STRONGER SPATIAL CONTROL DURING LATE HORGEN PERIOD?

During Late Horgen Period (last quarter of 3rd millennium BC) a number of lakeside settlements emerged following a particular spatial configuration. Common was a central, 'jetty-like' elevated access way with perpendicular standing houses on both sides (Figure 6, top).

Settlements at Lake Constance following this configuration were Sipplingen-Osthafen (2917–2855 BC, Billamboz et al., 2010) and Allensbach-Strandbad (Fischer, 2006). The same configuration was also found in the Swiss Midlands (e.g. Horgen-Scheller (Achour-Uster et al., 2002, p.118); Sutz-Lattrigen, Kleine Station (2756–2754 BC, Hafner and Suter, 2004, p.22) and Sutz-Lattrigen, Rütte (2726–2704 BC, Suter and Francuz, 2010). However, despite being often included, Seekirch-Stockwiesen (Schlichtherle, 2004, p.22–33) does not belong to this category of "Strassendorf" [street village] since its walkway was at ground-level and more open space available beside it.

The overall 'walkable' interaction space of these village proves difficult to reconstruct. At Sutz-Lattrigen, Rütte (2726–2688 BC; Figure 6, bottom) e.g. beams supporting house floors may have protruded irregularly from these stilted houses. While these may not have constituted a 'walkable' surface along building sides, they must have supported connections linking buildings and central walkway. However, constructions of these links cannot be determined and may have been anything from a single plank to a forecourt as part of the houses themselves.

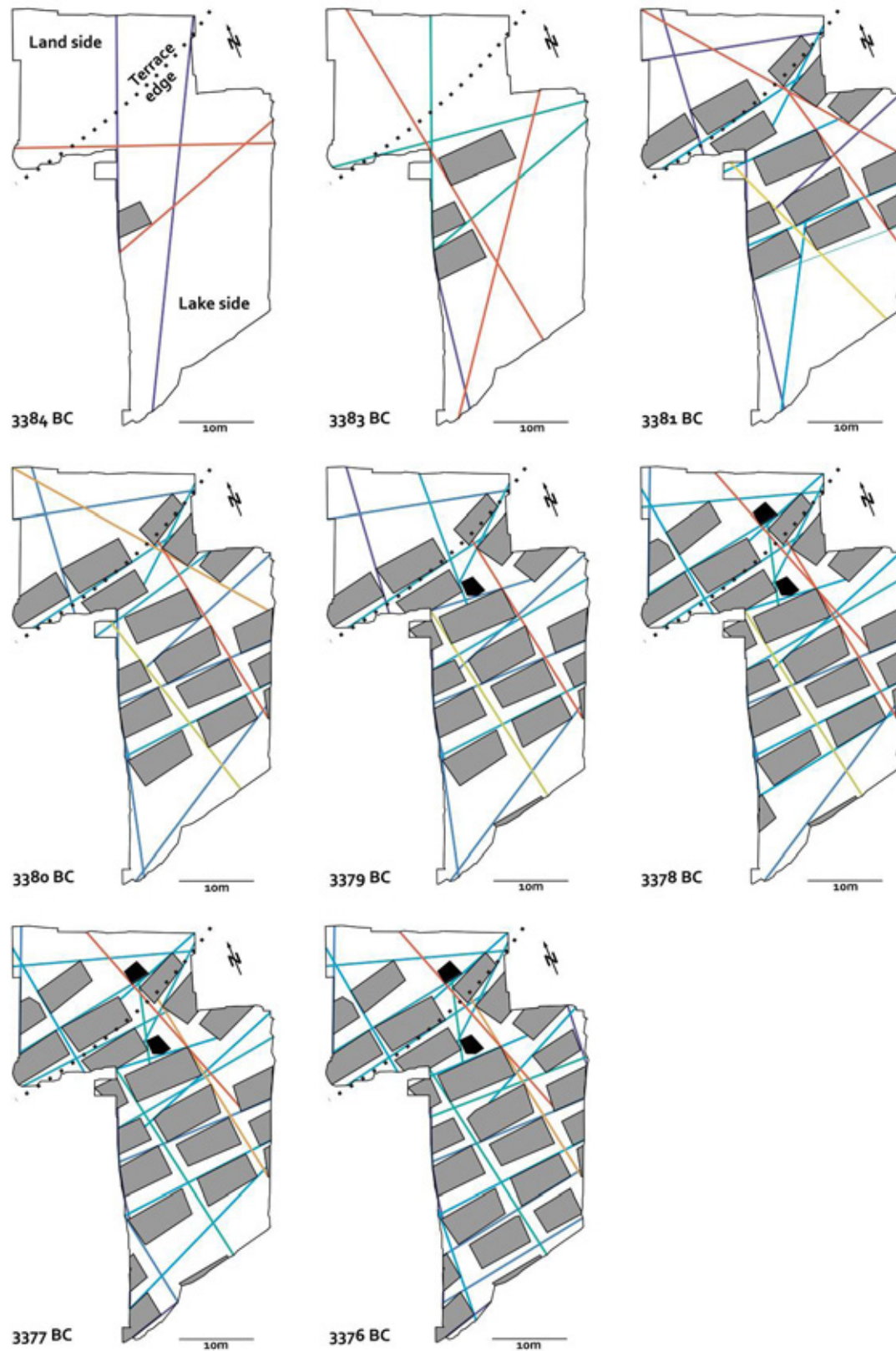
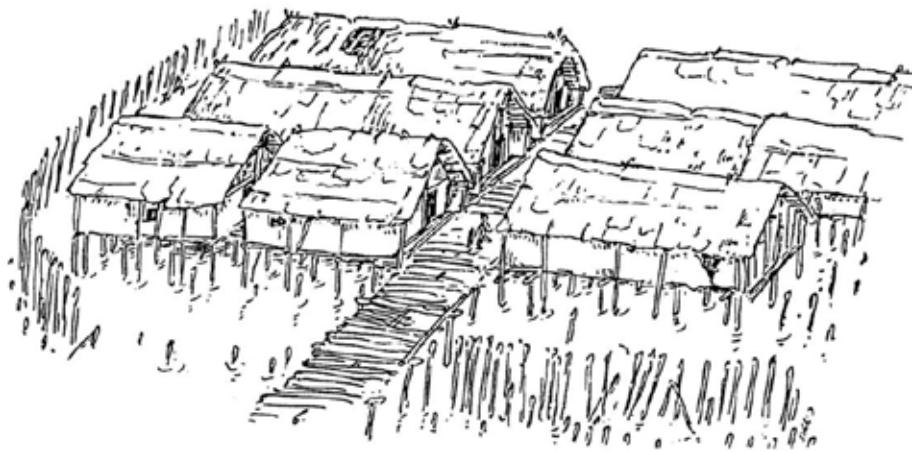


Figure 5 - Development of axial lines in Arbon-Bleiche 3.

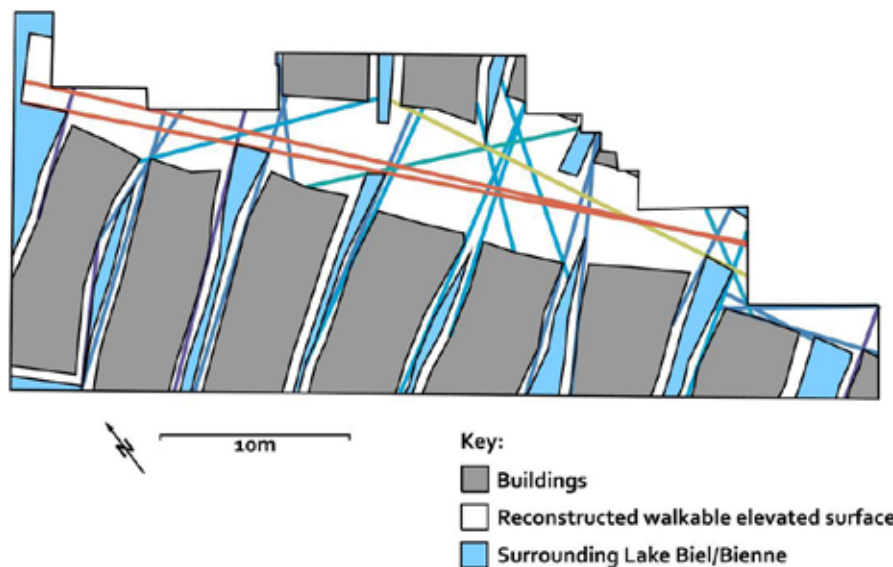
Therefore, fewest line axial line map of Sutz-Lattrigen, Rütte shows most integrated axial lines along the central walkway (Figure 6, bottom). In extreme cases, the resulting integration core of these villages may have consisted of a single axial line running along a narrow central walkway.

Interesting in these lakeside settlements is further their lack of sufficiently big open convex spaces for gatherings of large groups. The principal of the 'Xy-configuration' or 'houses leading to open spaces' discussed for Early Horgen Period was further reduced to 'all buildings leading to one shared open space'. Their jetty-like access ways were merely for movement. Therefore, although being in good locations to serve as 'inhabitant-stranger-interface' (Hillier and Hanson, 1984, p.121–122), such function of central walkways has to be questioned as their width-length-ratios were most unfavourable to encourage such interactions.

The end of Horgen Culture was marked by the emergence of the Pan European Corded Ware Culture (c. 2900–2350 BC). Recent DNA-analysis revealed that Corded Ware Culture was genetically strongly related to Yamnaya Culture and may be the result of large-scale migrations from Eurasiatic steppes towards west (Haak et al., 2015; Kristiansen et al., 2017).



Reconstruction of Sipplingen-Osthafen, Lake Constance.



Fewest line axial line map of Sutz-Lattrigen, Rütte, Lake Biel/Bienne.

Figure 6 - Artist impression of Sipplingen-Osthafen (top; Fischer, 2006, p.39, Abb. 42) and Sutz-Lattrigen, Rütte fewest line axial line map (bottom).

2.4 SPATIAL 'RESET' DURING CORDED WARE CULTURE?

Typical for Corded Ware Culture was their gender specific burial practice. Both genders were buried in a flexed position facing south but with men resting on their right side and women on their left (Figure 7, left). These burials may also suggest a different 'space-time-identity' of society (Porshansky et al., 1983), which found its expression in new settlement configurations.

Spatial configurations of many Corded Ware villages showed a pattern similar to previously illustrated Early Horgen period settlements. Houses were again arranged in more loosely but still orthogonal grids. More detailed axial line analysis allows e.g. the Corded Ware phase of Zurich-Mozartstrasse (Figure 8).

No pedestrian counts can be conducted in prehistoric settlements. It also remains in Zurich-Mozartstrasse impossible to identify equivalents to modern retail businesses. However, a correlation between strong integrated axial lines and expected pedestrian movements can be concluded indirectly.

In Zurich-Mozartstrasse, a great number of thin round willow posts were unearthed (Figure 8, bottom right). Although construction details remain unknown, these posts are interpreted as possible supports of an elevated walking surface (Bleicher pers. communication; Ebersbach et al., 2015, p.162). However, the cumulated number of these largely un-dated posts corresponds well with the most integrated axial lines at the last stage of the village in 2598 BC.

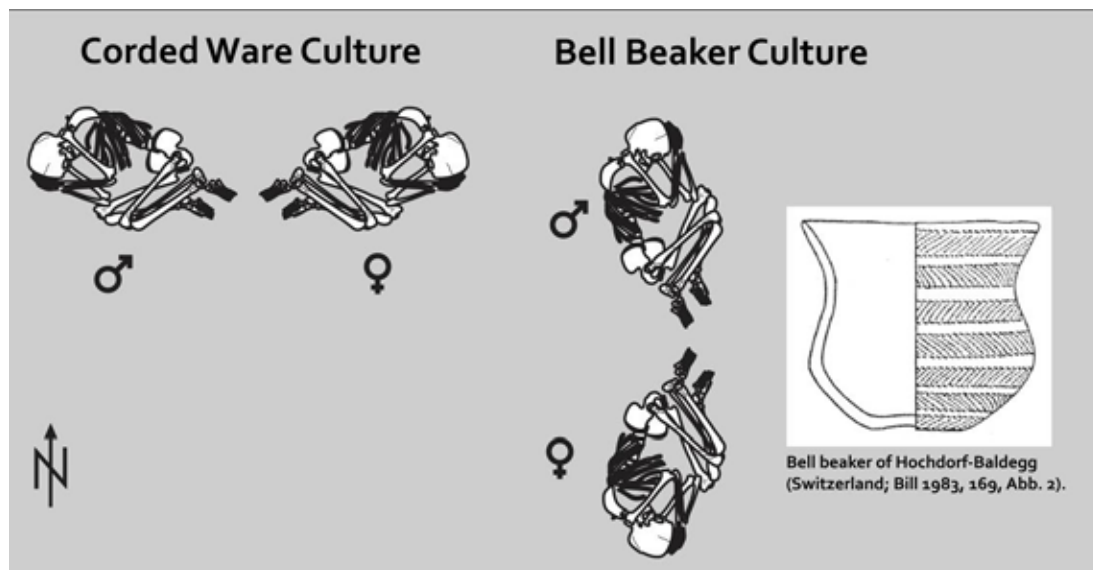


Figure 7 - Bipolar gender-specific burials of Corded Ware and Bell Beaker cultures.

During Corded Ware Culture (c. 2900–2350 BC) – and almost as a kind of 'contra-concept' – emerged Bell Beaker Culture (c. 2800–1800 BC). With this culture developed a possibly very different spatial concept of their settlements.

2.5 BELL BEAKER CULTURE WITH A NEW SPATIAL CONCEPT

While Bell Beaker Culture is widely known through its gender-specific bipolar burial practice and distinct bell-shaped drinking cups (Figure 7, right), knowledge of settlements remains vague. To date, only Cortaillod, Sur-les-Rochettes-Est, Switzerland (von Burg, 2002), Klobikau, Saxony-Anhalt, Germany (Balfanz et al., 2015) and Castenaso, Italy (Cadeddu et al., 2011) have revealed results allowing to use Space Syntax.

Cortaillod, Sur-les-Rochettes-Est was a small settlement with five houses (Figure 9). Distances between buildings varied from 10–15m or between 1–1½ house lengths (von Burg 2002, p.52, Abb. 60). These were about the same relative distances as in Castenaso (Bologna), Italy (Cadeddu et al., 2011, p.635, Fig. 2). With 50m or twice the building lengths even greater relative

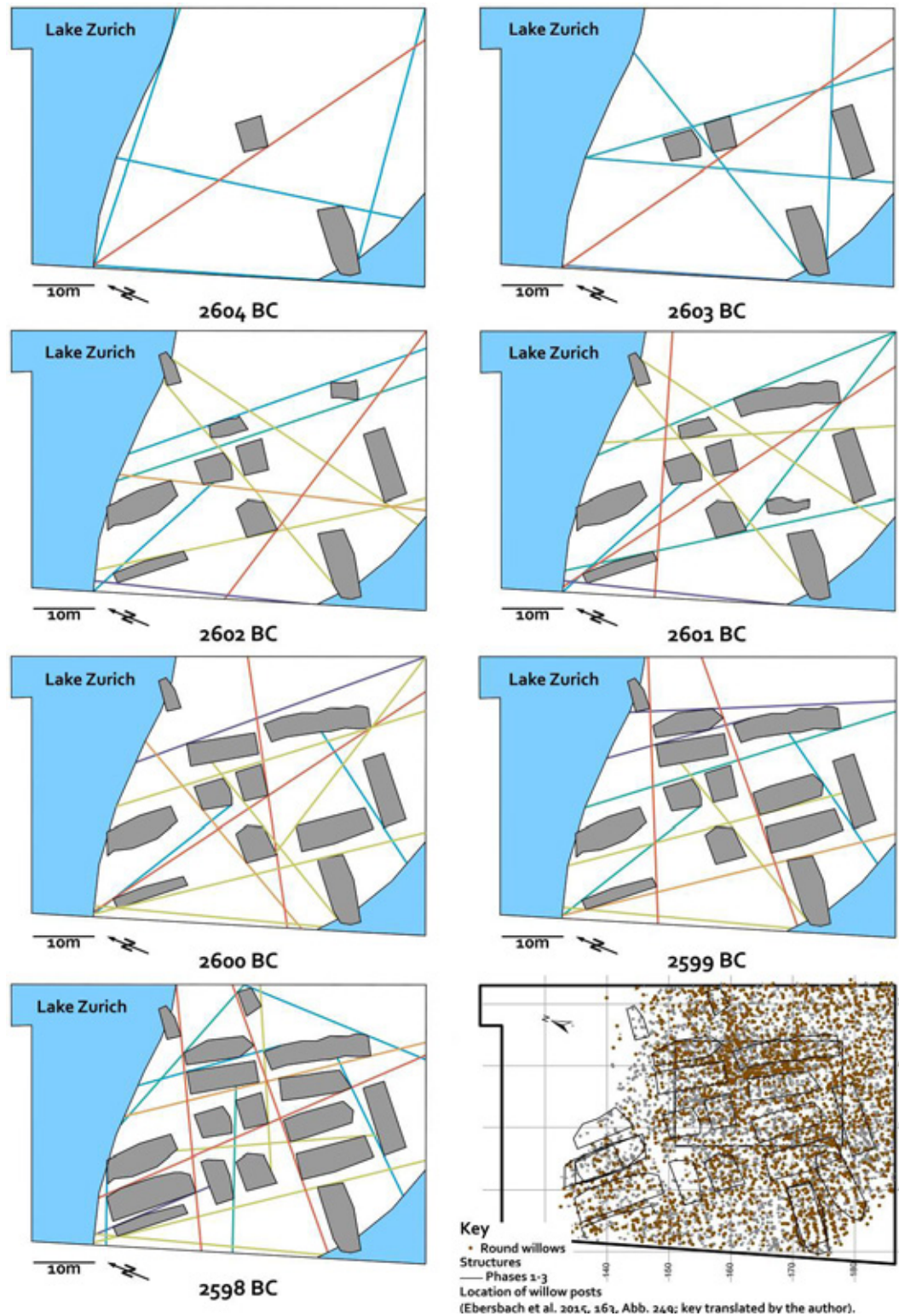
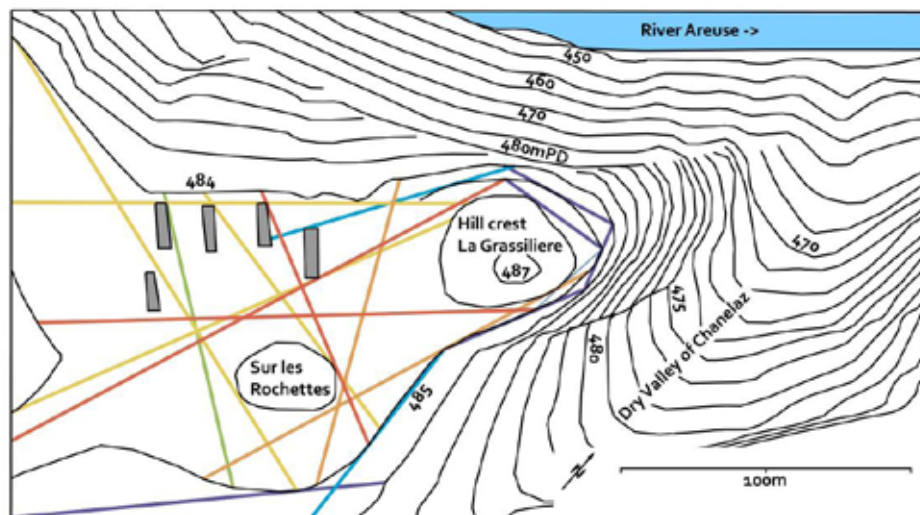


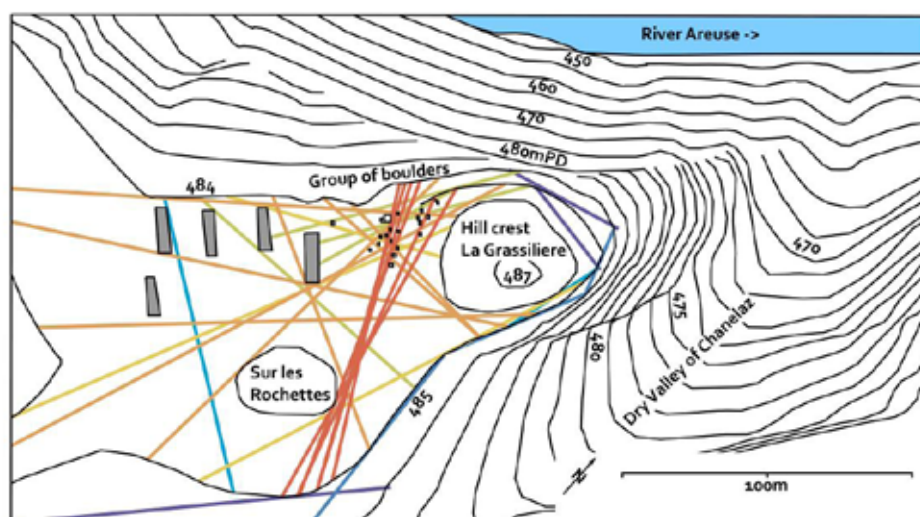
Figure 8 - Development of axial lines in Zurich-Mozartstrasse, Corded Ware Period.

distances were found in Klobikau, Saxony-Anhalt, Germany (Balfanz et al., 2015, p.750, Abb. 3 and p.751, Abb. 4). Therefore, the spatial concept of Bell Beaker settlements may cautiously be described as an 'open space containing a primary cell' or 'y o X-configuration'. However, some houses in «Derrière-le-Château» (Géovreissiat et Montréal-la-Cluse, Ain (France) may have stood closer (Besse, 2003, p.25, Fig. 8b).

This spatial description as 'y o X' is in contrast to the 'Xy-configuration' ('a primary cell leading to an open space' or z3-syntax) but may be justified as there are indications that these open spaces between houses played an important role in the 'space-time-identity' of Bell Beaker people. Such importance can be assumed from the fact, that in Cortaillod buildings 4 and 5 were rebuilt as houses 6 and 7 while keeping their respective original locations even though no spatial constraint could be found to do so (von Burg, 2002, p.52, Abb. 60). Location-constant rebuilds can e.g. also be found in Late Horgen Period settlements of Hünenberg-Chämleten ZG, Strandbad (Switzerland; Hafner et al., 1996, Abb. 109; 110) and Allensbach-Strandbad (Germany; Fischer, 2006, p.38) but with much smaller open spaces in between.



Fewest line axial line map without group of boulders.



Fewest line axial line map with group of boulders.

Figure 9 - Bell Beaker settlement of Cortaillod, Sur-les-Rochettes-Est, Switzerland.

The fewest line axial line map of Cortaillod, Sur-les-Rochettes-Est reveals a rather disperse integration core away from the building cluster (Figure 9, top). Using the whole settlement terrace to generate an 'intelligibility' scatter gram, axial lines within the building cluster and such from its environment resulted in a very coherent point cloud. This continuity in the scatter gram renders the settlement 'readable' even from its surrounding. Consequently this Bell Beaker village somehow 'disintegrated' and 'became part of its surrounding', an observation with far-reaching implications as later will be discussed.

Striking in the case of Cortaillod is the influence of a group of big boulders north-east of the building cluster (Figure 9, bottom). Even though their cultural significance is unknown, they concentrate the integration core and shift it further away from the buildings. The dominance of these boulders also distorts the 'intelligibility' scatter gram completely. Compared to the rest of the hill terrace the settlement was built upon, the location of the buildings themselves is rendered by these boulders to one of the less integrated parts. As a result, the wide scattered building cluster of Cortaillod and the more prominent features in its vicinity 'weakened' the settlement's grid and its ability to generate movement.

This dispersal into smaller, and possibly more autarchic, Bell Beaker units are also reflected in other studies and can e.g. be traced on an economic level as Lechterbeck et al. worked out for the Western Lake Constance region (2013).

2.6 EARLY BRONZE AGE – SPACE AS PART OF TRADE NETWORKS

More dense spatial settlement configurations can again be found during developing Early Bronze Age in the first half of the 2nd millennium BC. This period was influenced by the emerging copper-tin-metallurgy. Due to spatial scarcity of the main alloy components copper and tin, trade networks formed, spanning the entire European continent. These networks were in the hands of influential and wealthy 'elites'.

The influence metal trade networks may have had, can be seen in the spatial configuration of certain lakeside settlements. One example is Concise-sous-Colachoz at Lake Neuchâtel, Switzerland with its most complex and extended phase E12 between 1645 and 1619 BC.

Axial line analysis of Concise-sous-Colachoz, phase E12 was conducted with neighbouring stilted houses and elevated central walkway interconnected, thus resembling a multi-room building (Figure 10, top). With access to all parts of the settlement allowed, most integrated axial lines concentrated on the elevated central access way to the living quarters within the inner palisade ring. Integration was equal within houses of each row but decreased towards Lake Neuchâtel. However, access to this walkway was most likely controlled by a 'special structure' next to the inner palisade (black shaded) and therefore possibly restricted (Spring, in print).

In case, access to the village centre was denied, most integrated axial lines shifted towards the western part of the beach platform between inner and outer palisade ring (Figure 10, bottom). They concentrated around three houses standing perpendicularly to the rest of the buildings (grey shaded). Very obvious for today's archaeologists, isovist analysis reveal that these buildings could not be seen by a prehistoric visitor coming from landside. On the other hand, they were prominent features when arriving by boat across Lake Neuchâtel. Next to these houses was the only big convex space available for large group interaction, while the elevated walkway was merely for movement.

Insight into the social organisation of Concise-sous-Colachoz, phase E12 give distribution analysis of vessel remains. These showed that groups with different regional trade connections lived in the village. Some may have come from Eastern Switzerland, while the ones residing on the opposite side of the walkway had connections to the French Jura region (Burri-Wyser, 2013, p.306).

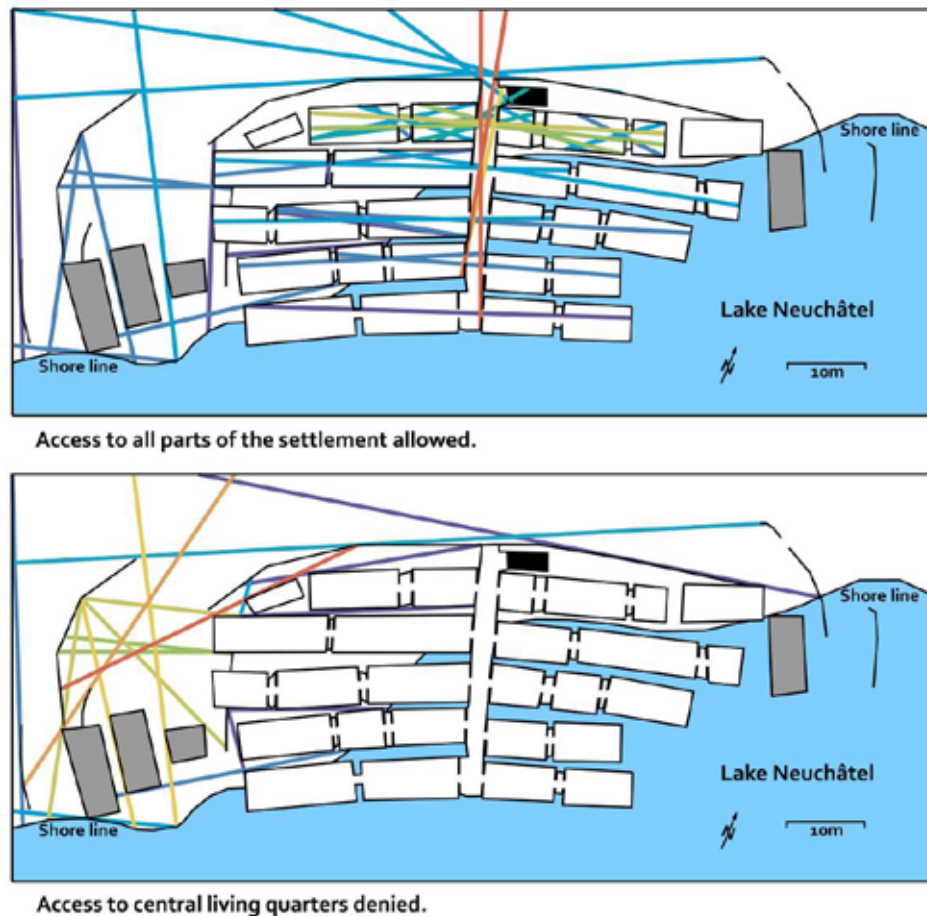


Figure 10 - Concise-sous-Colachoz, phases E12 (1637-1619 BC) fewest line axial line maps.

Early Bronze Age settlements with a similar two-partite spatial distinctions were Sévrier-Les Mongets at Lake Annecy, France (Billaud and Marguet, 2005, p.176, Fig. 5a) and Zurich-Mozartstrasse, phase C1A, Switzerland (Schmidheiny, 2011, p.79–90).

The first part of this paper looked at spatial configurations of Late Neolithic and Early Bronze Age villages. However, the author is obliged to admit that his initial aim to trace developments which could be compared with the 'law of natural movement' conceptualised by Hillier et al. could not met. To make up for this deficit, it is necessary to include further archaeological and socio-spatial aspects to find answers why this failed.

3. RESULTS

The previous part of this paper looked at spatial developments of prehistoric settlements between 2nd half of 4th and mid 2nd millennium BC. One remaining problem to trace the 'law of natural movement' in these settlements is their relatively short live span. The use of open fires in wooden houses covered in reed posed a constant fire hazard and far too often resulted in devastating incidents. However, natural science and spatial analysis allow a glimpse into social and economic organisation of these societies.

Interesting to notice is the rather strict spatial configuration – almost some kind of 'cultural fingerprint' – during Cortaillod Culture in western Switzerland. With the recurrent growth pattern of 'a pair of houses including an open space in between' ('XX o y-configuration') it could be argued that these open spaces were 'private', while the central lane e.g. found in Sutz-

Lattrigen, Hauptstation innen SW (Figure 3) and only suitable for movement, could be seen as 'public space'.

Arbon-Bleiche 3 was discussed for its two special structures along most integrated axial lines (Figure 5). It remains impossible to attribute these structures to anything comparable to retail businesses in the widest sense. However, pottery remains indicate long-distance contacts down the Danube River and suggest inhabitants of different origins and with various organisational strategies living together at Lake Constance.

Already in Early Horgen Period during the last third of 4th millennium BC, open space within settlements seems to have been reduced to narrow lanes only suitable for movement. Convex gathering space, important for reproduction of society has to be expected outside villages. However, those areas are seldom excavated due to financial restraints as well as political pressure, and may not reveal much structural remains.

In Late Horgen Period (beginning 3rd millennium BC) many lakeside settlements saw their integration core reduced to almost a single straight line. Indications of a reclusive society can also be found in the limitation of imports from other areas. During this period many villages were built onto hilltops or hill promontories (Biel, 1987). Although none of them is suitable for more detailed Space Syntax Analysis, their defining segregating outline, further underlines a more reclusive background of their construction.

Space Syntax has provided comprehensive studies into spatial configurations and power structures (e.g. Markus, 1993). While these Late Horgen Period settlements reveal justified graphs comparable to prisons, there is no archaeological evidence of any central decision taking authority. However, the residential buildings are all dead-end-spaces with the same 'programmatic label'. Therefore, these villages followed a 'strong program' in how their social script was embedded in space through a pattern of distribution, affordances and labelling (Capillé and Psarra, 2014, p.24). But what was the reason for their inhabitants to live there in the first place?

Latest DNA results indicate large scale migrations from the Pontic-Caspian steppe towards western Europe. Furthermore, a decline in Neolithic activities around 3000 BC could indicate a social crisis (Kristiansen et al., 2017). Even an early form of plague (Rasmussen et al., 2015) may have triggered such reclusive reactions.

Although 'prehistoric information propagation' of such events and resulting psychological reactions of the recipients cannot be reconstructed, the author thinks, that 'fear' can be assumed as one. Consequently, inhabitant-stranger-interactions may have been controlled and could well have taken place on dedicated locations outside settlements.

A symbolic link between living quarters and their surroundings during Late Horgen Period can be found in Sutz-Lattrigen, Kleine Station (2849–2754 BC). This lakeside village had a central access way pointing straight towards a huge cup-marked boulder on dry land (Hafner and Suter, 2004, p.22, Abb. 8). If inhabitant-stranger-interactions indeed took place 'extra mural', the 'law of natural movement' would not be traceable within Late Horgen Period settlements.

Little new input on spatial configurations could be traced during Corded Ware Culture (in Switzerland c. 2750–2400 BC). The spatial layout of e.g. Zurich-Mozartstrasse seems to appear almost as some kind of 'reset' to Early Horgen Period level.

The migration background to the emergence of Corded Ware Culture has previously been explained. Strontium isotope, genetic and dietary analysis on skeletal material suggest for a time slot parallel to Zurich-Mozartstrasse high mobility and "stable female exogamy" in Corded Ware societies of southern Germany (Sjögren et al., 2016, p.27/33). Although some of these women came from non-Corded Ware groups (ibidem), it would on the 'receiving end' call for

'sufficiently permeable' Corded Ware settlement configurations to encourage encounters, which could explain this 'spatial reset'.

On the other hand, fundamental changes occurred during Bell Beaker Phase (c. 2900–1800 BC). Although the current data base leaves much to wish for, spatial configuration of this phase seems to have been somehow 'reversed'. Striking are great distances between buildings. These were at least the length of a building apart, while in Horgen Period only narrow lanes separated houses.

Particular care seems also to have been taken to keep open spaces between Bell Beaker buildings when houses were rebuilt. Therefore, the recurrent growth process of these settlements could best be described as 'a primary cell within an open space' or 'y o X-configuration'. Possible keys to this particular spatial behavioural can be found on different levels, of which some have started much earlier.

During the 28th century BC existed several long lasting villages parallel in the same micro region of Lake Biel/Bienne (Hafner and Suter, 2004, p.20) and Lake Constance (Billamboz et al., 2010, p.265, Abb. 7). These villages were in viewing distance from each other and are likely to have caused an augmented awareness of co-presence. While large open grassland did not yet exist in the hinterland of Lake Constance (Lechterbeck et al., 2013, p.12), this increased awareness of co-presence along lake shores may not only have encouraged interactions but, in stress situations, also increased competitive fears among different groups. As a result, an enhanced 'group awareness' may have developed.

Added to this, houses were now more often repaired and renovated. During 35th century BC, several attempts to found new villages around Lake Biel/Bienne failed and houses were abandoned shortly after being constructed (Hafner and Suter, 2004, p.16, Abb. 2; 17, 18). In the 28th century BC existed villages over three or four generations (e.g. Vinelz-Hafen, 2774–2701 BC; Hafner and Suter, 2003, p.29) and buildings were maintained of longer periods (Suter and Francuz, 2010, p.202), house 2 in Saint-Blaise/Bains des Dames, Switzerland even over a century (Gassmann, 2007). Therefore, people having grown up in such long-lasting houses may have developed a personal 'space-time-identity' closer related to these buildings and handed it down during the socialisation of their own descendants.

Corded Ware Culture introduced from 28th century BC onwards with its burial practice of single graves – at least on a gender level – a new concept of 'self identity' or 'individualism' in the widest sense. Even though there were differences between these two culture, aspects of 'self identity' developed further among Bell Beaker people and can best be seen in their children's graves. Even burials of very young children already followed the adult practice of gender-specific, bipolar inhumations (Figure 7). It is therefore discussed, whether Bell Beaker children were born into pre-destined roles of e.g. man/woman, husband/wife, etc. (Nadler, 2006; Turek, 2000).

In these changing social contexts, also the primary cell of a house would play an important part. It may transform its role from 'a simple shell', which provided shelter from the inclemency of the weather, to a physical symbol of a social entity – we may call 'family' or 'clan' in the widest sense – for which the house it occupied was the physical manifestation (Coudart, 1999, p.537).

This tangible symbol of 'family' would consequently have to be 'displayed' by its inhabitants to mark their distinction to others. Therefore, the open space surrounding Bell Beaker houses previously discussed had to be maintained and distances kept to neighbouring buildings. Such distinctions would occur until the understanding of 'family' had become an established part of 'space-time-identity' in the entire society.

Indications of when the concept of 'family' may have been entrenched in society are individual burials arranged in grave groups. Such burial groups can be distinguished at the transition from Bell Beaker Culture to developing Early Bronze Age period. Graves e.g. in Singen, Nordstadtterrasse, Germany (c. 2150 BC) still followed the Bell Beaker pattern of flexed bipolar inhumations but were arranged in different groups (Krause, 1988; Stockhammer et al., 2015, p.20).

Such burial arrangements shifted the focus from the still relatively fleeting duration of settlements to more 'generation-spanning' environments of cemeteries. It consequently 'freed' the spatial configurations of Early Bronze Age settlements from the 'obligation' of keeping distance to neighbouring buildings and 'allowing' to return to clustered villages. Earliest Early Bronze Age settlement at Lake Constance revealing such configuration was Bodman-Schachen I, Bauphase 1 with nine buildings in two irregular rows and radio-carbon dates of the 19th century BC (Königer, 2006, p.94 and p.95, Abb. 85).

In later Bronze Age periods and with the idea of 'family' or 'clan' further developing, grave clustering in huge burial mounds became a more dominant expression of social structures. Such widening familial relationships and social differentiation with more or less successful agents, as well as resulting contractual dependencies, eventually formed the basis for the development of bigger political and economical entities across Europe.

And from an archaeological research point of view, the 'y o X-configuration' of Bell Beaker settlements may actually hold the key why no lakeside settlements of this culture have been found so far. Although the author does not want to exclude this possibility, Bell Beaker settlements following a 'y o X-configuration' and built onto beach platforms or into lakes themselves, would most likely have consisted of single houses built in considerable distance to each other and being connected to dry ground by individual elevated walkways. However, to identify such structures it would be necessary to survey large underwater areas and tree-ring date each and every single wooden post. To identify more Bell Beaker settlements, the author argues that it may therefore be necessary to abandon the idea of 'typical clustered villages'.

4. CONCLUSIONS

The author had to admit that he failed in his initial attempt to trace the 'law of natural movement' and its subsequent economic feedback-loop in prehistoric settlements. However, with a more spatial based focus on social changes, the transition from Late Neolithic to Early Bronze Age was revealed as very important.

Fundamental social changes took place during End Neolithic. Migrating people from the east brought not only a new language, economic background and burial practices but also different 'space-time-identities' with them. They fused with local groups into Corded Ware Culture, a gradual process of acculturation and integration, which took several hundred years.

It cannot be excluded that the 'law of natural movement' may have developed in Late Neolithic. However, social changes overshadowed these spatial developments and "it was only on the advent of the Middle Bronze Age that cultural homogenization prevailed" (Kristiansen et al., 2017, p.338).

It is therefore likely that only from Middle Bronze Age onwards, socio-economic conditions with 'individually acting producers and consumers' in a more modern sense may be found. And it may be worth to analyse settlements of younger prehistoric periods with Space Syntax to trace the 'law of natural movement'.

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