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**Urban Morpho- and
Semiogenesis: Analysis of
Four Harbour Towns**

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Semiotic preliminaries

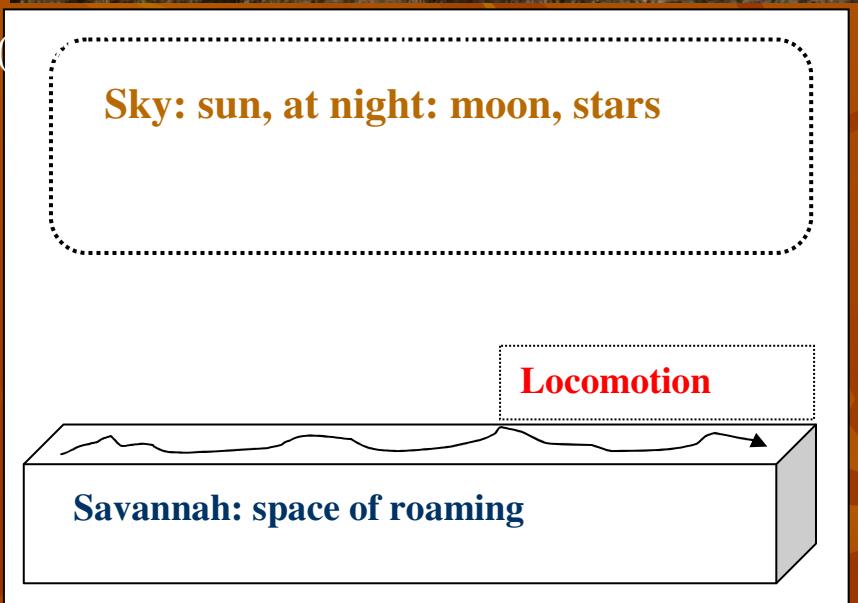
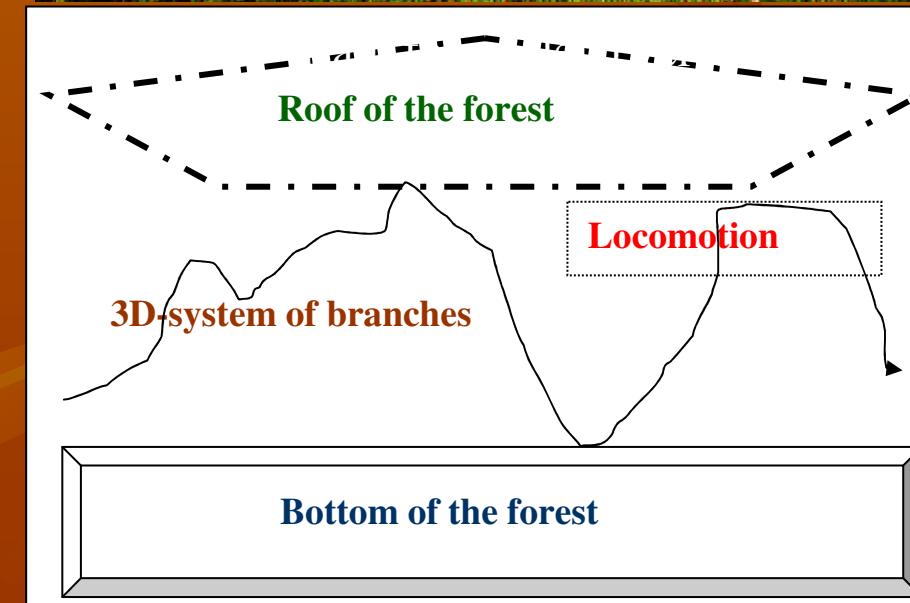
Any object or event may become an object of (human) perception and gain (human) significance based on species typical neural anatomy and the typical ecology (the survival and reproduction context of the species). This constitutes the **basic semiotic level 0**.

Two further levels of semiosis have to be considered:

- If the object is produced, i.e. if it is a tool or an artefact, the basic perceptual/significant impact is imprinted on this object, which becomes a sign-object in itself. This constitutes the **semiotic level 1** (for other living beings it may stay at the semiotic level 0).
- If the production and use of the object is collectively accepted and standardized, it gains a first level of symbolic existence, which may be linked to a “collective mind”, (compare the concept of: ‘représentation collective’ in Durkheim’s sense), and to social conventions (Saussure’s ‘arbitraire du signe’). Collectively valid signs establish the **semiotic level 2**. We may call these sign-objects *symbols* in the spirit of Peirce (a sign-system controlled by a social law or convention).

First and most dramatic change of human ecology

- The rain-forest, i.e. the ecology of our common ancestors with chimpanzees, was like a large cube with the forest floor and its roof (the canopy of big trees) as delimitations. The migration routes were defined by trees and their branches in the quasi-fractal structure between floor and roof.
- In the savannah, where the Australopithecines had either to find some prey or a carcass left by larger predators some 4 my before present (BP), this vertically delimited “house” was lost. Single trees, rocks or seashores served as temporary shelters.



Rain forest (left) versus savannah (right): examples and schemes

Evolutionary aspects of early settlement patterns



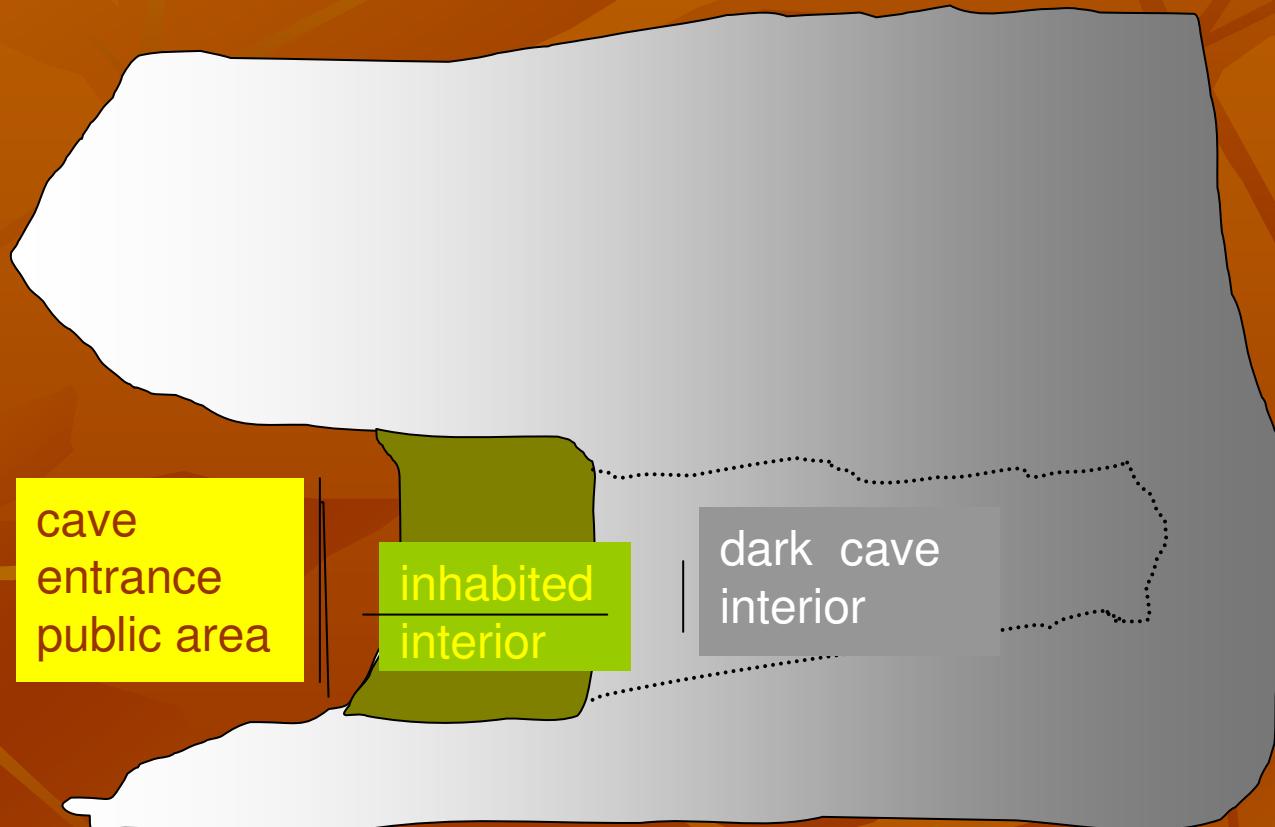
- Archetypical shelters at Pinnacle Point, South Africa and abri Thaurac, France

The prototype of a shelter survival was a cave entrance, not far from the shore, a lake, a river and possibly on the slope of a hill for a good overview of the surrounding area. This site will be found along the migration routes of *Homo heidelbergensis* (neanderthalensis) and *Homo sapiens* (following shores and rivers) and in the caves which document the social life of *Homo sapiens*.

The prototype for the (mostly seasonal) dwellings had the following zones:

- Cave entrance (often under some rocky roof) with an external zone for social life, manufacturing of tools, and distribution of prey and harvest products.
- Cave (still with light from the entrance or from fire) for family life and sleep.
- Possibly a cave interior for more rare events like initiation rituals, etc.

Schema of inhabited cave



- Zones of an abri (cave)

First towns

- The first towns emerged, e.g., in Jericho 10.000 B.P., Çatalhöyük (9.500 y. BP), Eridu, Ur, Byblos (between 7.000 and 6.000 y. BP). These ‘towns’ already contained a large population (ca. 3.000 inhabitants in Jericho) and had a wall which limited the town area and later provided defense. Special derivations of the abri (cave) and the town are burial sites, graves and graveyards (grave villages and towns).

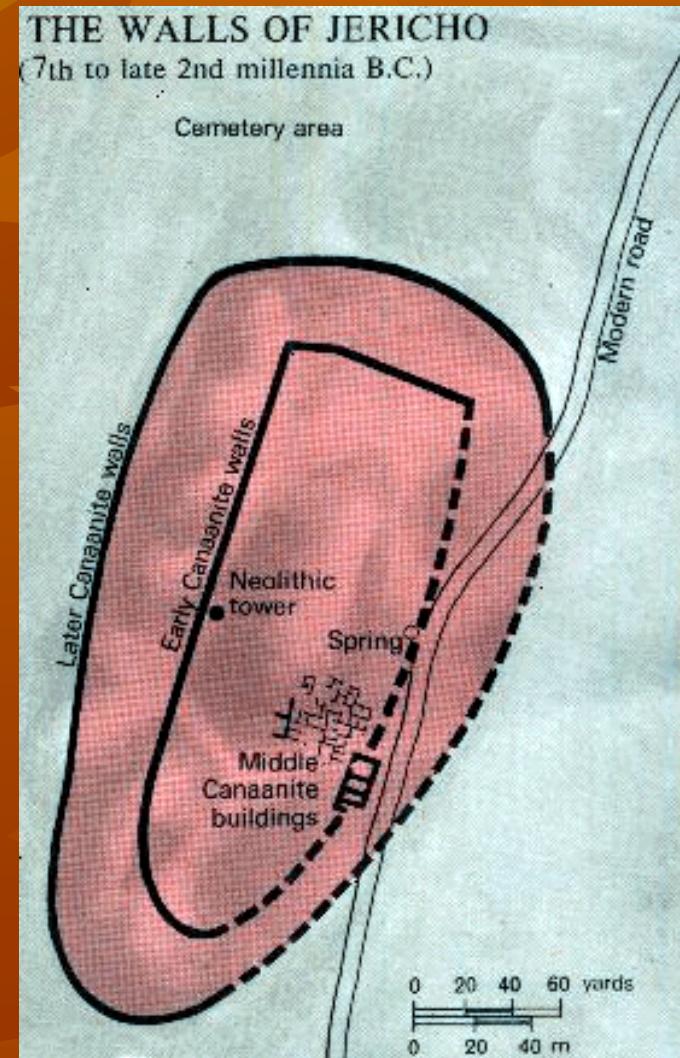


Fig. 3 Map of old Jericho following excavations

The morphogenesis of the town is governed by two forces which define its shape:

- The individual houses and their use by the owners/builders.
- Collective protection (against enemies) and communal functions (market, political decision, religious practice).

The need for fortification was rendered necessary by the accumulation of goods and wealth in Neolithic societies, i.e., it is basically economic. This led also to social segregation inside the town and to corresponding differences in the style of house building and defense.

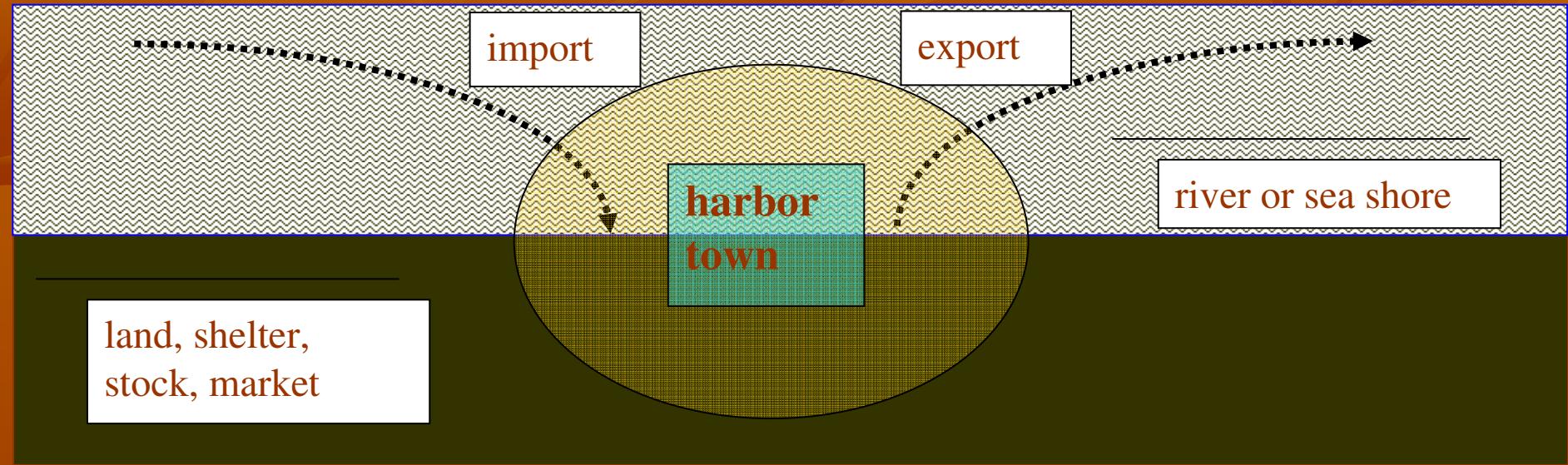
The next stage is reached, when the local type of self-organization, which is only globally controlled by the protective wall, is replaced by a central plan. This can be shown in the case of rectangular grids in towns. The first grid-pattern in towns probably emerged in the Indus Valley approx. 2.000 BP and Herodotus reports that Babylon had large straight avenues intersecting at right angles.

The final outcome is mostly a compromise between:

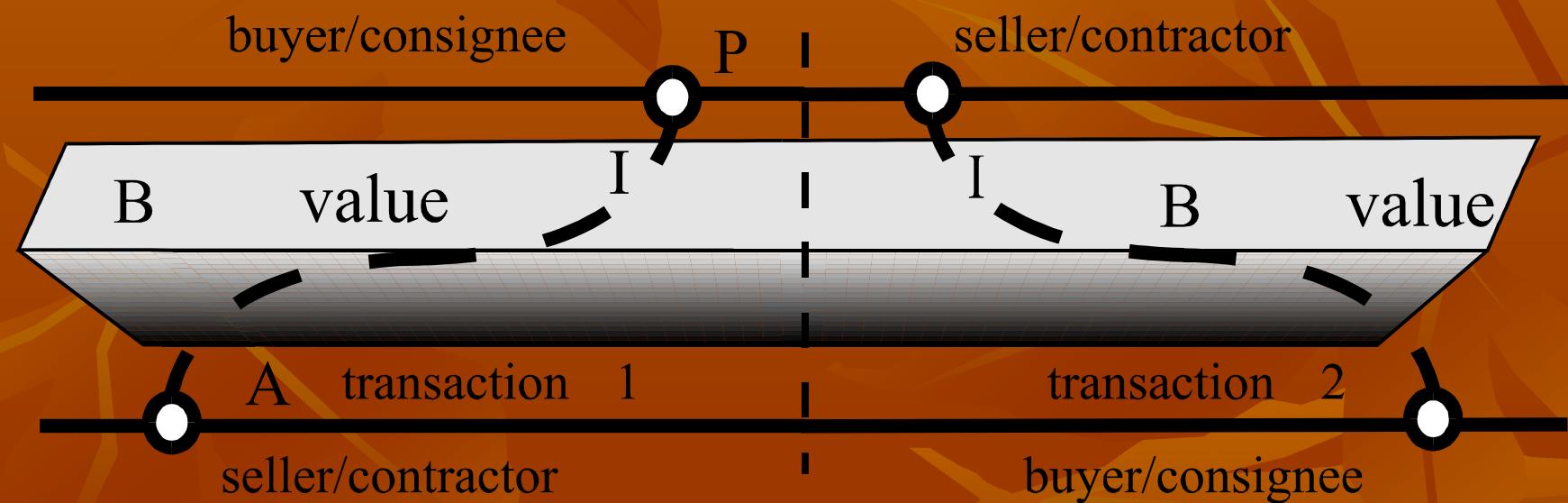
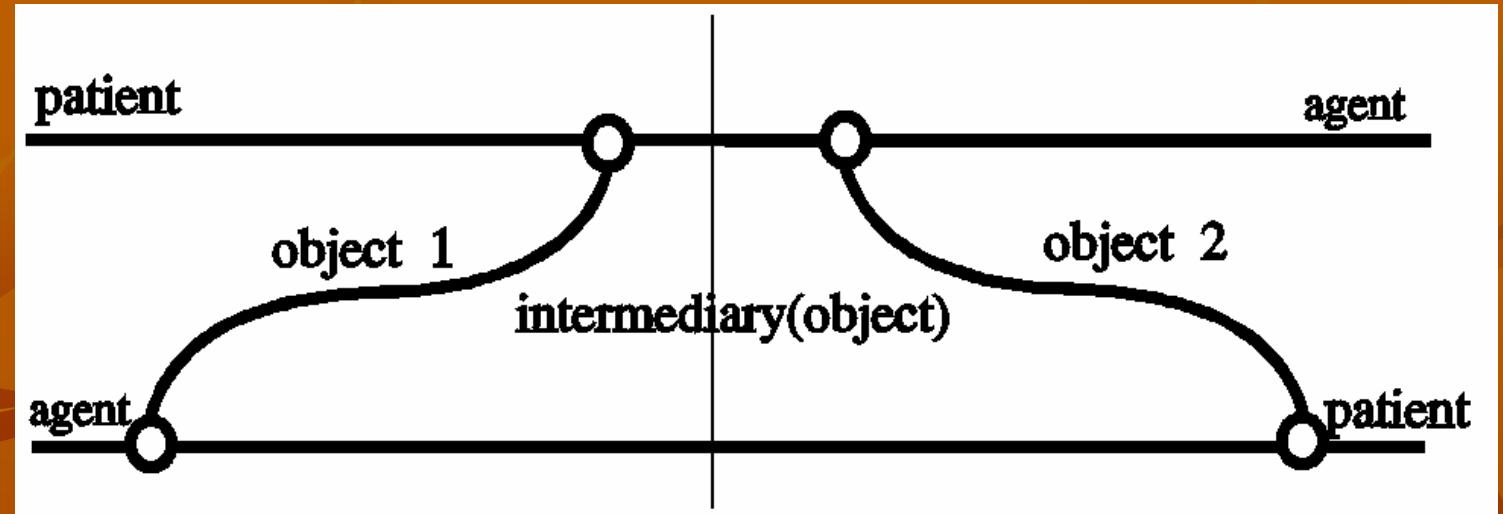
- *Individual* goals and values and *collective* ones (often represented by some institution or leader).
- Specific *natural* conditions which may change in time and *traditional* forms which have gained some credit (fame).

Upon this rather basic substratum, several symbolic levels could be grafted. They communicate differences of power and wealth or religious/ideological values. The question of how such compromises are reached is difficult to answer, because many alternatives may exist and chance factors may influence the final outcome. This situation can be modeled dynamically in *synergetics*, which analyses the cooperative effect of many subsystems and focuses on simple rules which can reduce their complexity. Another choice is *chaos-theory* and *fractal geometry* where irregular patterns can be understood more easily.

The morphogenesis of typical harbour towns



- The basic feature of a harbor town is the opposition: land (shelter) versus water (motion). It implies the use of boats and ships, i.e., boats arrive and depart, ships are built (repaired), goods are transported and are commercially exploited (stocked, sold). A market place emerges, eventually factories and habitations for manufacturers are built

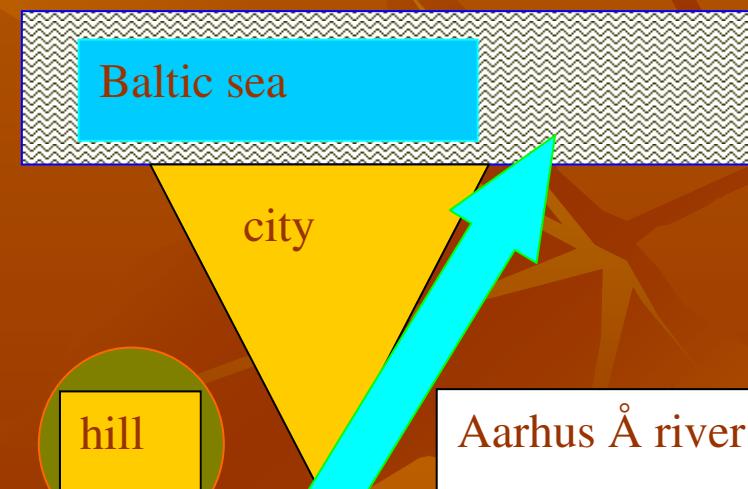
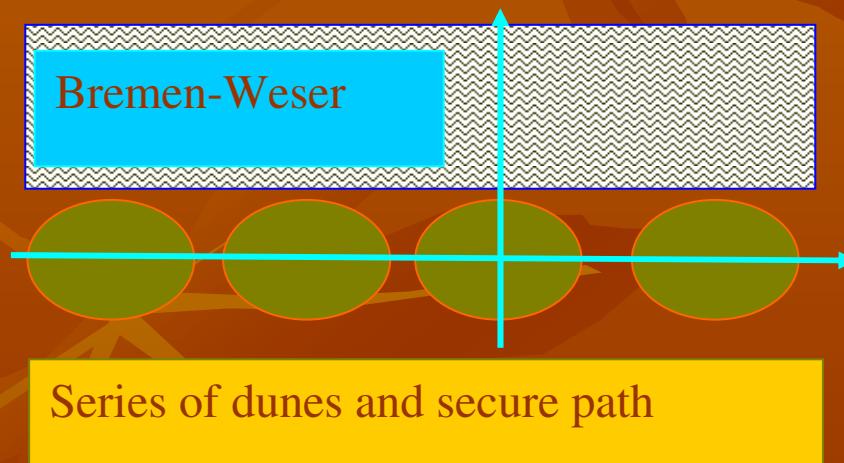
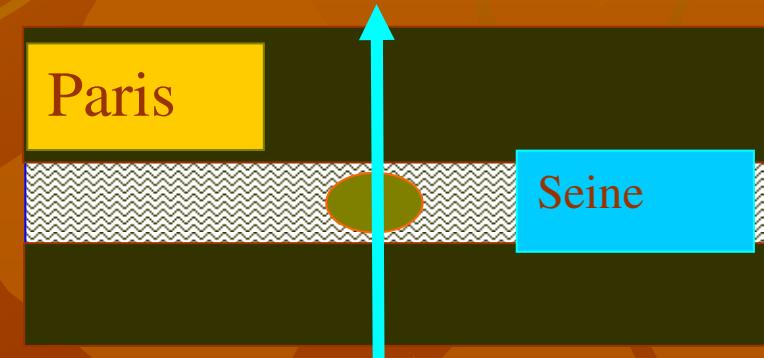


- The schema of mutual exchange (above) and of mediated exchange (below)

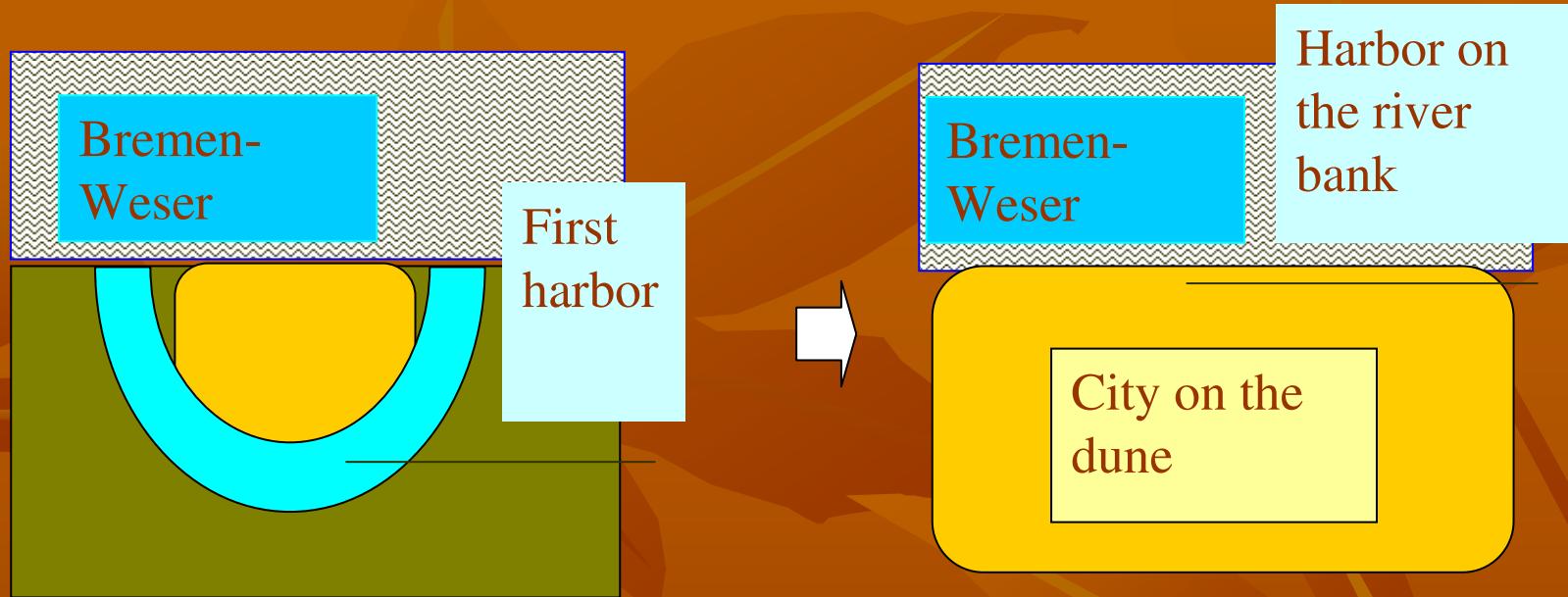
Comparative morphodynamics of harbor towns

In our four examples we have always a shore (of the sea) or the bank of a river (with access to the sea) and a simple or double singularity of paths:

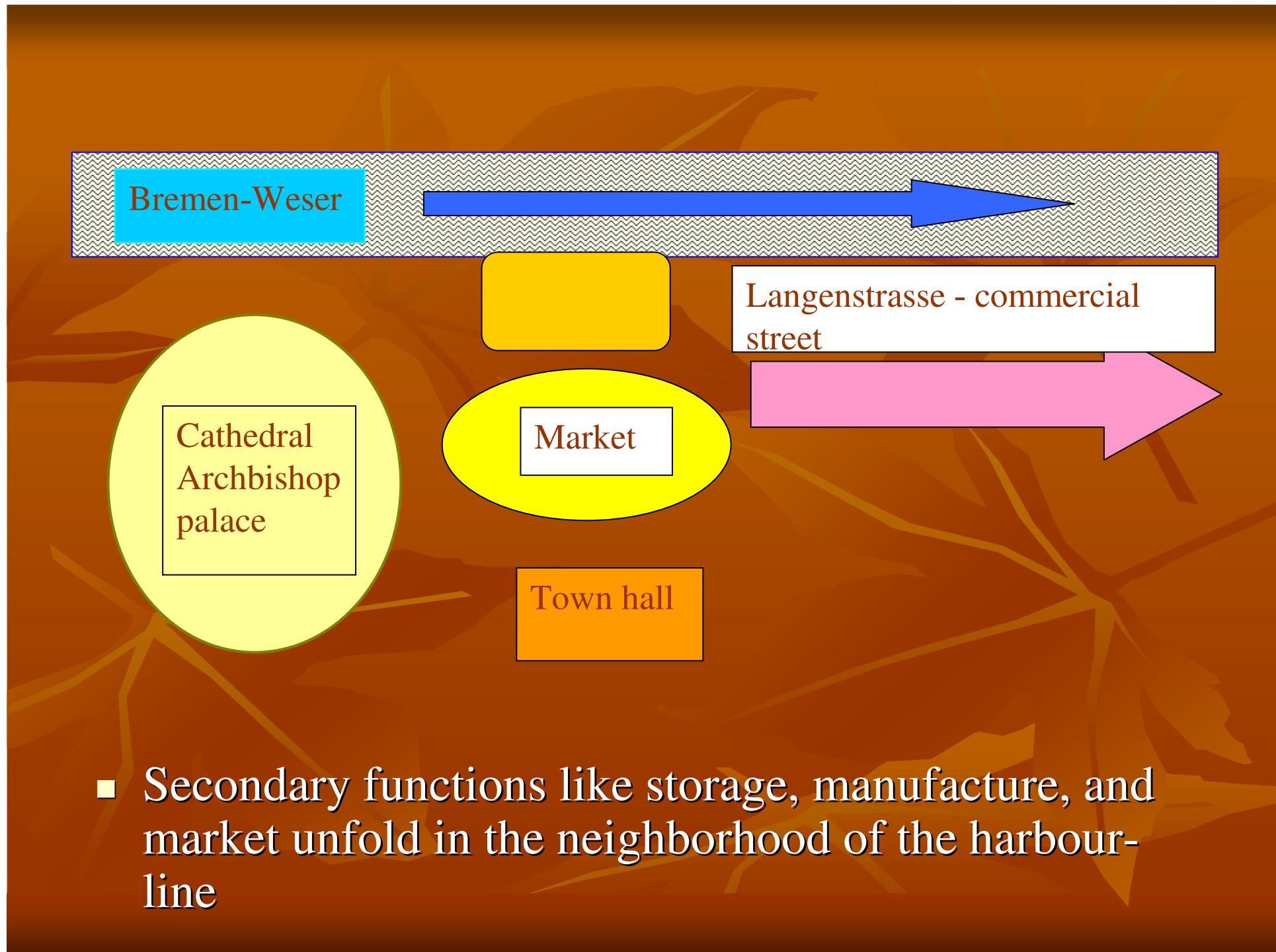
- Lisbon: Two creeks going to the shore between higher banks shaping a plain (actually the Rossio). The river opens to the sea.
- Paris: An island in the river Seine leading to the sea and several hills around a flat and wet area. A road crossing the river via the island on it (Ile de la Cité).
- Bremen: A dune along the river, a tributary river forming an island and two long distance paths/roads, one of them crossing the river near the island.
- Aarhus: A shoreline and a river mound. Neighboring heights delineate a flat area.

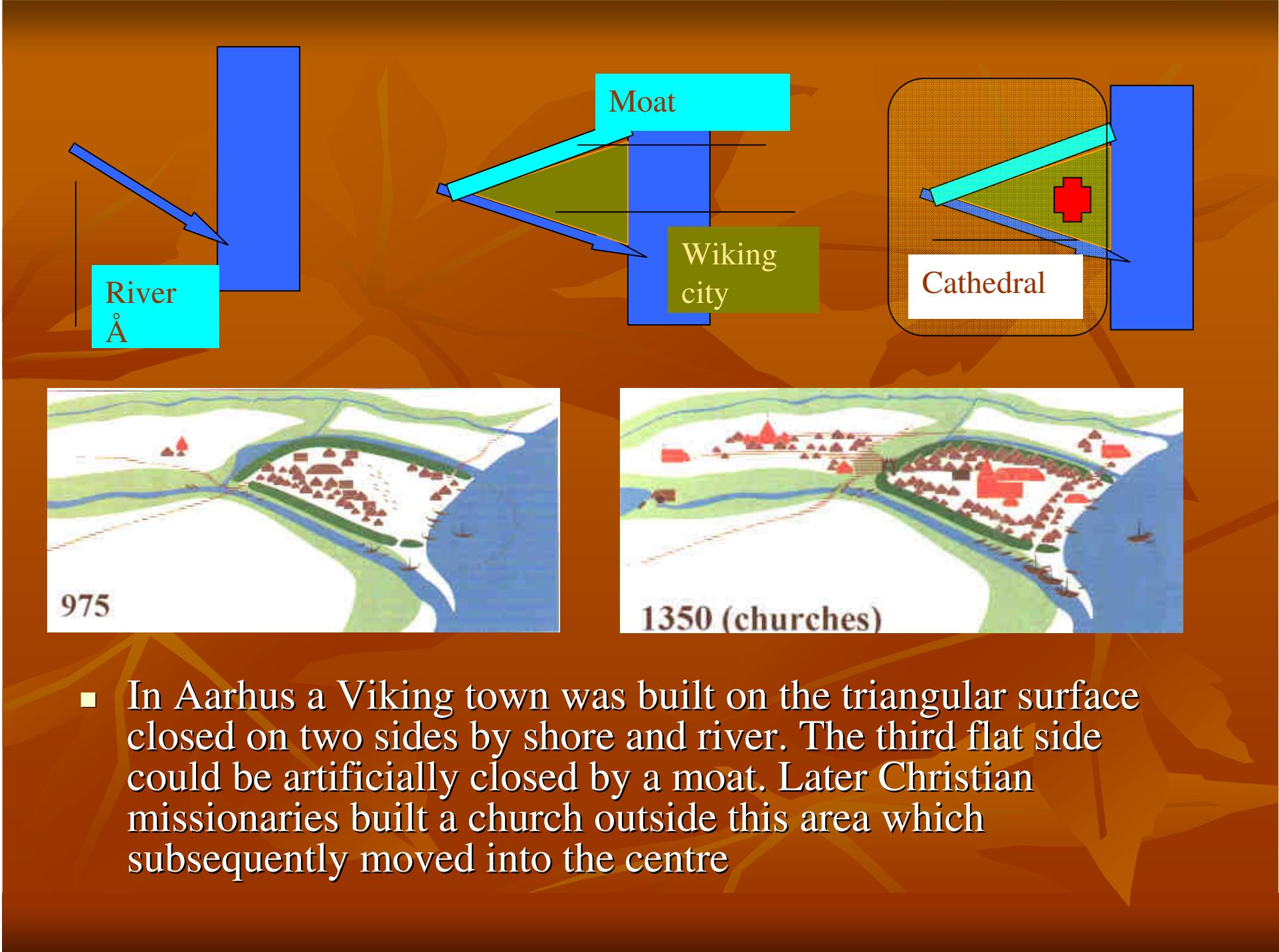


- Germs of urban morphogenesis in Lisbon, Paris, Bremen, and Aarhus

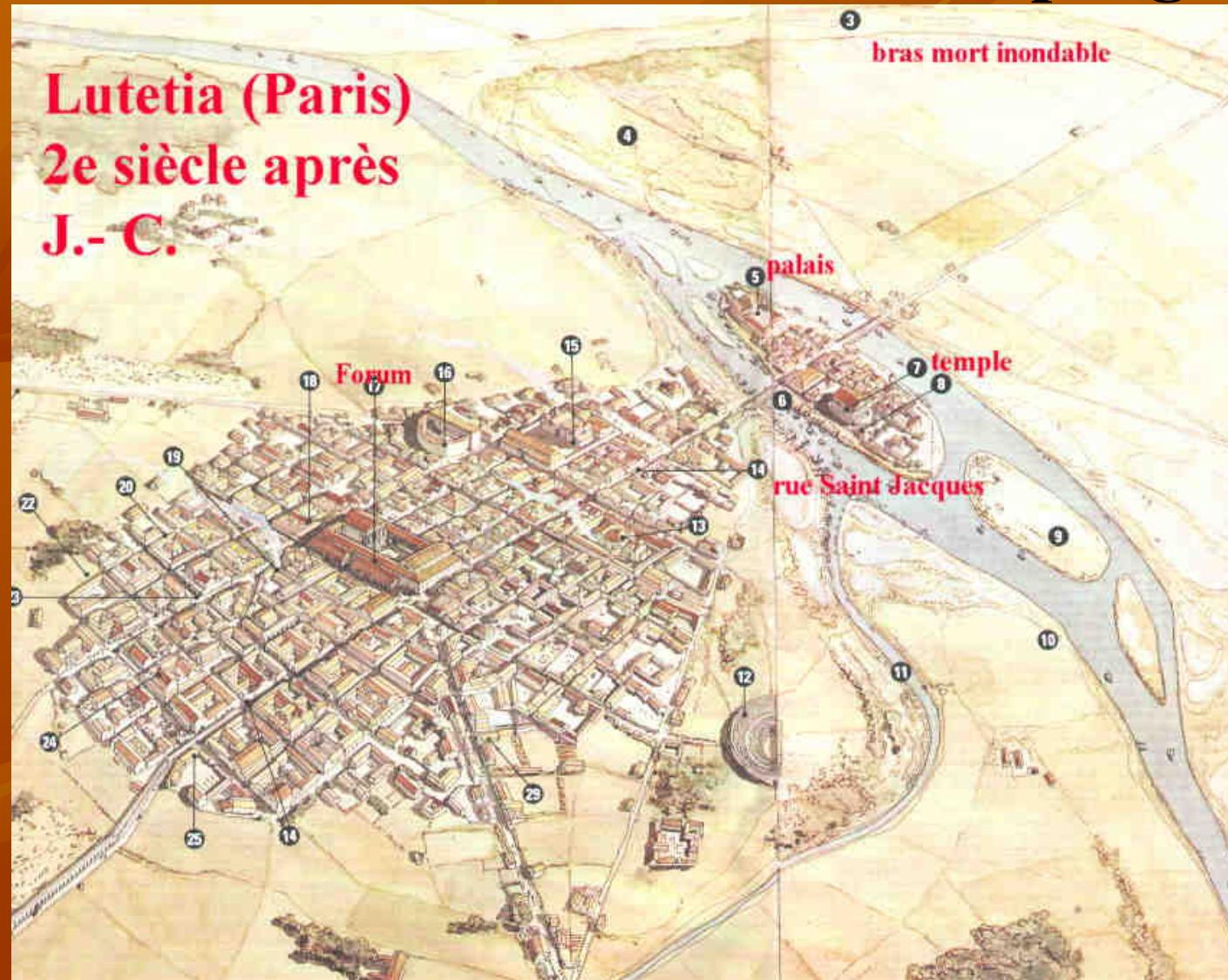


- The unfolding of such a germ exploits gradients of the basic function. In the case of Bremen the transition line water/land for ship-berthing and shipbuilding expands first from the tributary river (Balge) to the main riverbank (Weser), then to its opposite bank (including an island), and further towards the sea (inclusion of the next dune “Stefanistadt“, the harbor of Vegesack some 20 km west, and the founding of Bremerhaven at the river mound in 1832).





Morphogenesis of Paris



Paris as a Roman town (map in: Velay (2000: 1-2)

The Romans built their town on the heights of the Southern shore (today Quartier Latin). The central road ('cardo') of the roman city corresponds to the boulevard St. Michel and the streets of the 'quartier latin' still show the roman grid.

Its prolongation led to the towns in the north of France and to Lyon in the south.



Morphogenesis of Lisbon

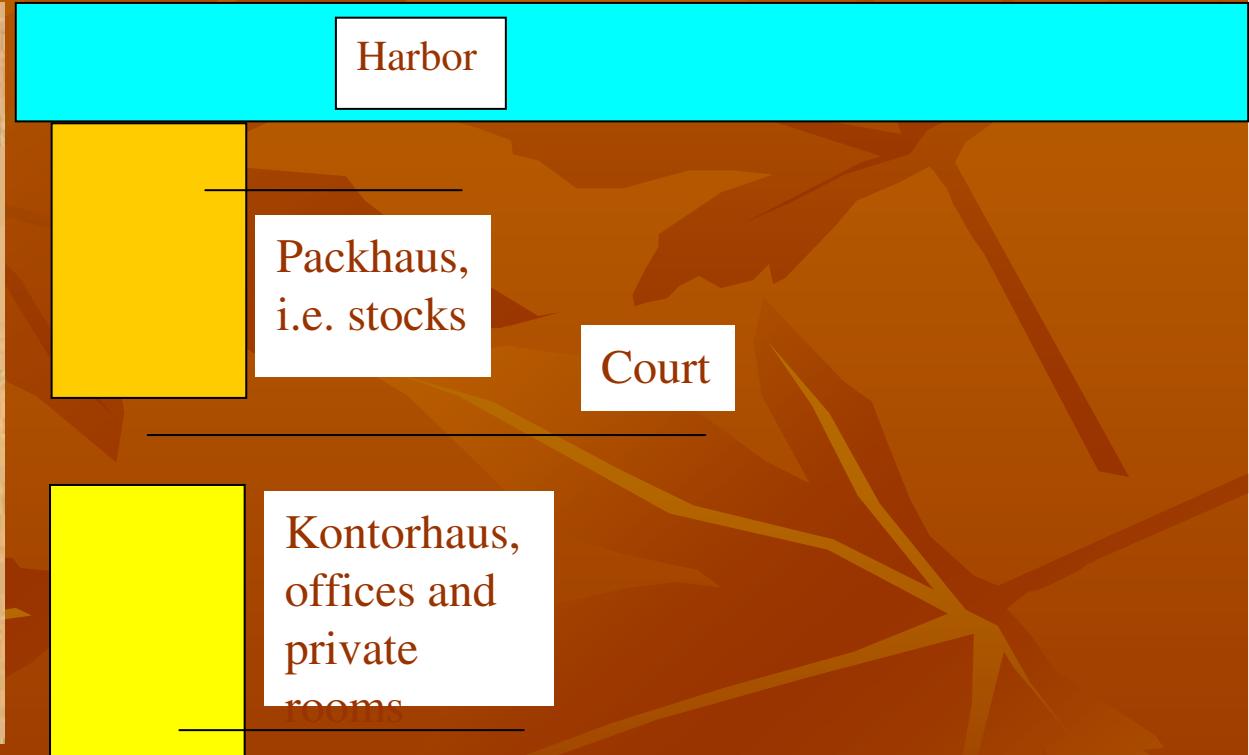
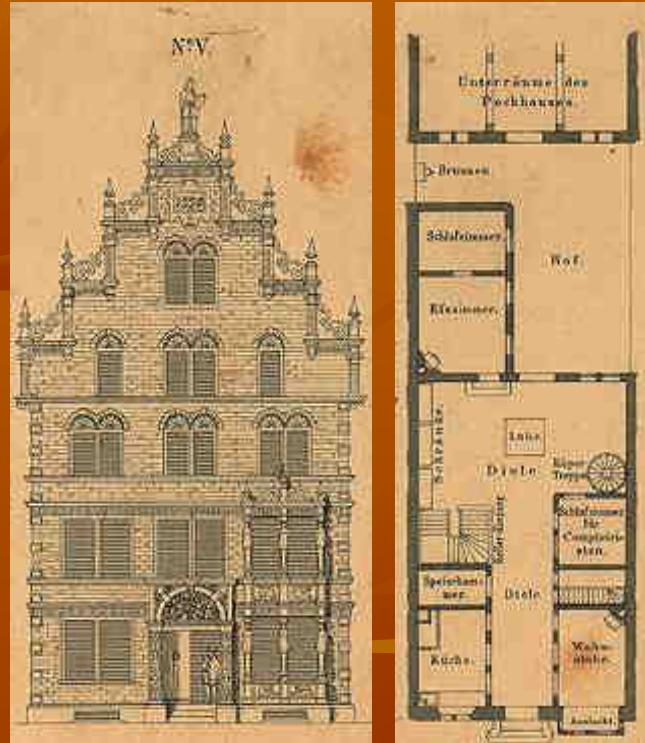


Map of Lisbon in 1137
(with modern grid) and
view at the end of the
16th century



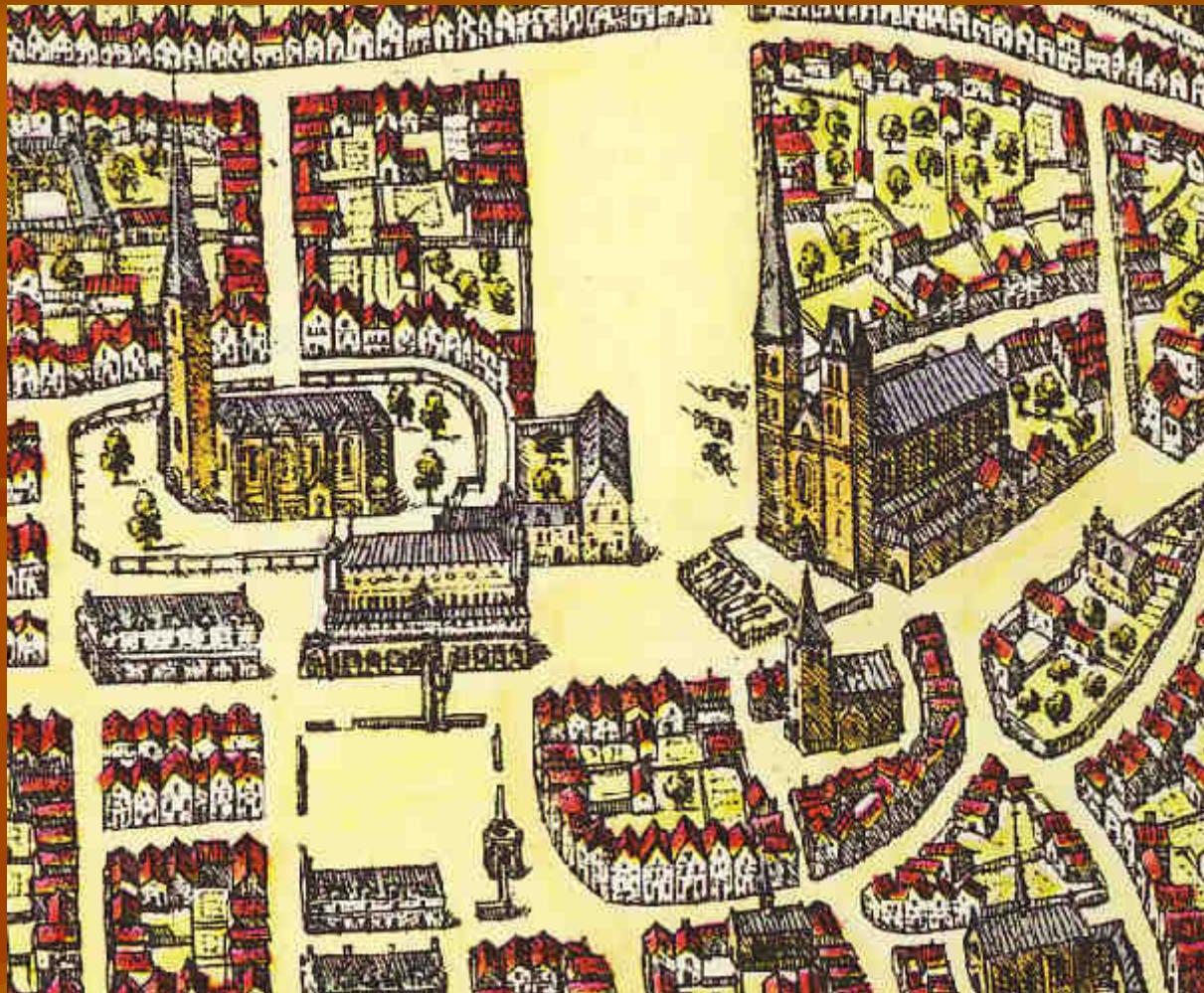
- In Lisbon many different cultures used the location, but the wet plain between the high grounds and the bank became, after its drainage, the centre of the harbor (ship building) and of commerce. Its protection was afforded by steep fortified hills. Religious functions were established on the heights.

Architecture of harbor towns



- The morphogenesis of the harbor town leads to specific architectures. For a long period the dominating type of commercial housing in Bremen was defined by the river-land opposition, where the commercial houses and storehouses were aligned in a long street (Langenstraße) parallel to the harbor/river.

Further unfolding of the prototype



Map of the inner city in Bremen (1588); at the right side the ‘bishop town’, at the left side the ‘council town’, in the center the town hall and the palatium of the archbishop (detail of the Braun/Hogenberg map)

With the growing independence of the ‘market-town’ from the archbishop (who controlled the ‘bishop town’) a strong structural opposition emerged which is still visible in the dividing line between:

- Cathedral – churchyard – (former) palace of the bishop.
- Town-hall – market with Roland statue – guildhall.

The semiotically motivated architecture the town hall

- A high roof (after 1610) dominating the market in opposition to the tower(s) of the cathedral.
- A large hall on the first floor for assemblies (all deputies could sit along the sides of the hall) and for festivities (for rich and powerful citizens).
- A market hall on the ground floor, where expensive and delicate merchandise was sold with a portico for public court sessions.
- A cellar, where the wines imported from France and Portugal were stocked for further distribution and a restaurant (Ratskeller) to provide food and beverage to the assemblies and festivities in the upper hall.

Variation of the morphodynamic patterns in urban structure

The four towns compared can be classified in two groups according to their different networks and areas:

- The north European network is linked to Viking trade routes (around 1.000 AD) and the hanseatic trader league (1200-1500 AD). Aarhus and Bremen are examples of this evolution.
- Paris and Lisbon are mainly influenced by the urban patterns of the Roman Empire (its colonies), the medieval Arabic and Christian reorganization, and by modernizations since the 17th century. Both towns were either the model imitated by modern European capitals (Paris) or were exported to oversea foundations (Lisbon).

- Aarhus developed, after its Christianization in medieval times, similar patterns in its centre as Bremen. The original town hall was constructed with its back to the facade of the cathedral and a central market place opened in front of it. The town-hall was later destroyed and moved twice to the periphery of the historic centre. In this respect Bremen preserved its tradition, (probably due to its political autonomy; Aarhus fell under the rule of the Danish kings who resided in Copenhagen). In contrast to Bremen the harbor in Aarhus is still near the city-centre.
 - In Lisbon the Visigoths fortified the steepest hill, which was further fortified after the Arabic conquest (719), to become the “Alcáçova” and after the reconquest (1147) to become the fort S. José. The Arabic mosque at the centre of the Arabic Almedina became the (rebuilt) Christian cathedral Sé. Large monasteries and churches were placed on top of the neighboring hills, thus occupying the significant (“prégnant”) hills, which punctuate the urban pattern. The commercial city moved to the flat part (former river bed) and to the banks of the river Tejo (Praça de Comercio). From the shipyards on the Tejo, the expeditions to Africa (1419) and India (1488) opened the era of colonial expansion. An earthquake and tsunami in 1755 destroyed the city (mainly the Baixa) which was rebuilt by the Marquês de Pombal with a rectangular pattern.

- In the case of Paris the island was already inhabited in pre-Roman times. The Romans founded a new city on the higher grounds in the South and built a road going from South to North and defining an axis on the island: West (administrative) – East (religious) which persisted. In the early Middle Ages the centre moved again to the island. In the 17th century the city walls were replaced by broad roads (boulevards) and in the 19th century Haussmann (1809-1891) destroyed many medieval quarters and modernized their structures.

In general urban morphogenesis unfolds in a permanent process in which the geographical and geological conditions are rather stable. The characteristics of a harbor town may be lost if the sea-level changes or if new demands invalidate former affordances.

Value dynamics and urban semiotics

- The dynamics of values have their grounding in ‘saillance’ and ‘prégnance’ (cf. section 1), but every society develops its own system of values, often codified by religion and law. Such a system of values can be visualized in architecture and urban structure. Even contradictory value-systems may be exhibited. The value-system of the commercial town, as a member of the Hanse (north European commercial league) is expressed by the oversized statue of the Roland (with sword and gold-braided coat, built in 1404) and, at the climax of urban wealth, by the Renaissance decoration of the town-hall (refurnished in 1610).

Urban value dynamics



- The Renaissance facade of the town-hall in Bremen and detail of the arcades

Two specific features

The specific features of value dynamics are of two kinds: firstly, they exhibit a strong *memory effect*, e.g., those values valid for earlier times and generations are conserved with preference and value changes are suppressed. Secondly, there is a *negativity effect*. If a value-based structure is destroyed, the void (*Nichts*) has the tendency to be filled by structures with similar values (of similar type).

- An example of the first tendency is the reconstruction of historical city centers in Western Germany after the bombing of World War II, which had destroyed 70 to 80% of the buildings. As a compromise between memory and modernization a mixed style emerged. This had already been an architectural trend in 19th century historicism.
- If a traditional structure is voluntarily destroyed, the feature of a “positive nothing” can show up.. Following the religious Reform most of the monasteries in Northern Europe were destroyed or left in ruins. In Bremen the citizens destroyed an independent monastical city in their immediate neighborhood (Paulskloster). Later even the dune on which its church stood was removed to build a modern rampart. Thus nothing remained. After the opening of the city wall (1848), new quarters were created, which by preference followed the principle of straight rows. Nevertheless a kind of continuity was preserved because theatres, galleries, restaurants, etc. created a new ambiance which in 1966 was successfully defended against the plan to cut this quarter by a 41-m-broad motorway.

Dynamic system theory and urban semiotics

- Dynamic system theory and more specifically *morphodynamics* in the spirit of René Thom (cf. Petitot, 2003, and Wildgen and Brandt, 2010) open a field of research and model building which unites material systems (physics, chemistry, and biology) with conceptual/symbolic systems (language, art, religion, etc.). The principles of catastrophe theory can be used to model very basic morphodynamic processes (cf. Figures 1 and 2). Other techniques, e.g., Prigogine's *dissipative systems* or Mandelbrot's *fractal geometry* are useful, if spatial and temporal pattern formation is the primary topic. Although these patterns and principles remain the backbone of dynamic semiotics, we have shown that semiogenesis and the dynamics of value systems can rather freely disrupt this basis (with however, a risk of instability or even chaotic outcome,). The mathematical nature of dynamic models opens the door to technical and computational implementations. To exploit this potential, quantitative and statistical methodologies must be further developed in urban semiotics.

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