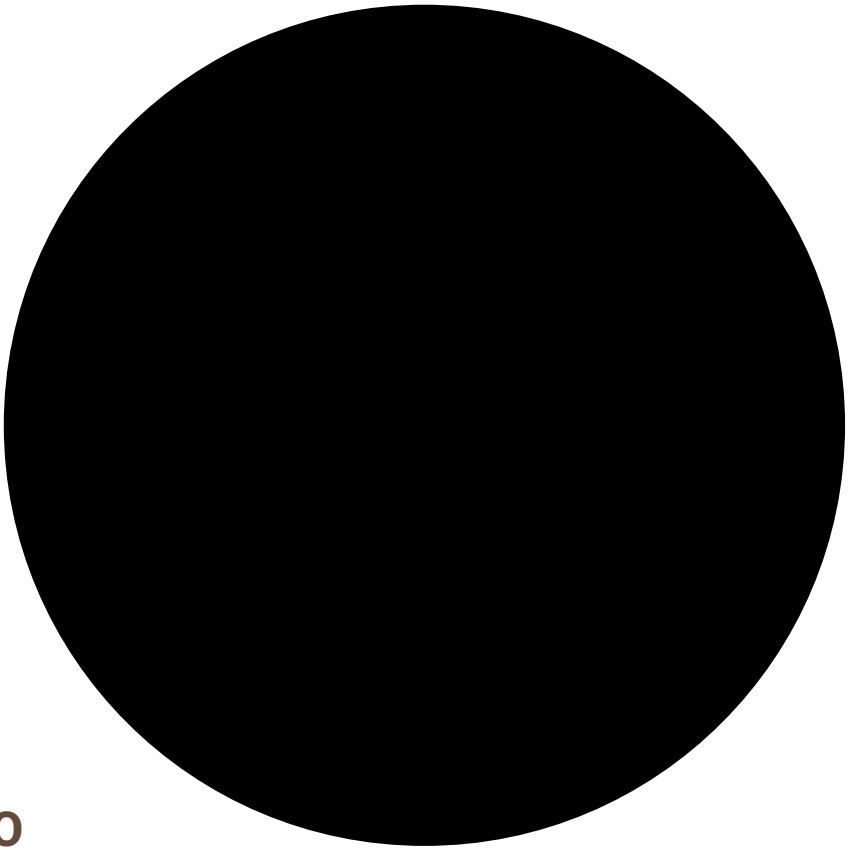
# City Management and Administration

## The First Second Third Book



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This publication is one of the outcomes of the project “Improvement of Systems and Processes for Permitting New Construction in Prague: Availability of Housing” (No. TL01000423), supported by the Technology Agency of the Czech Republic and undertaken by a consortium of the Czech Technical University, the Institute of Planning and Development of the Capital City of Prague and Headhand Architects Ltd. in 2018–2020.

Dedicated to my wife Marie
and sons Tomáš and Eduard.

ISBN 978-80-88377-16-0

# City Management and Administration

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# Preface and acknowledgments

For several years, I have started my university lectures when teaching in Prague with a simple question: “What would you do and change first in Prague if you had unlimited power to change things?” I have gathered several hundreds of answers from my students after I posed this question. Students’ solutions included: introducing tolls, reducing the amount of traffic in the city center, building more parks, increasing spending on athletics, improving student dormitories, completing the ring road, adding P+R (Park and Ride) parking, preventing developers’ construction, solving the problem of homelessness downtown, and increasing safety and reducing crime, among other things. We always analyze in detail each of the students’ answers at the seminars and discuss the pros and cons of each topic.

Our discussions usually look something like this: Why do you want to have bike paths in Prague – do you personally have a bike? No, but I would definitely get one if we had bike paths. Well, and where do you go during the day? From Karlín to Žižkov and then also to Vinohrady. So, you want a new bike path from Karlín to Vinohrady? Actually, yes.

There is also a lot of discussion about greenery in the city: So, in the area where you live, are there not enough green areas nor parks? No, there are actually a lot, but in the center. And when and where did you last go through the center and wanted to take a breather and could not find a park? I did not mean it like that. And so what exactly did you mean by that? Well, that there are not enough green areas along the sidewalks.

The most frequent topics include addressing problems of public spaces and transportation. Those make up a third, often up to half of all answers. The topic of public transportation always quite makes sparks fly in the auditorium, because students are usually fairly evenly split between those who would prefer making it easier to drive around the city by car and those who would restrict or even prohibit cars to varying degrees. On the topic of transportation, groups directly affected by traffic – “non-resident” students commuting to school by car, and locals who need a car less, or who want to

respond to the need for some community and overlap — are often in dispute. It is a fight between students who commute to school daily and local students who walk to school but read about the needs of commuting students.

I always welcome this debate, because it is important in and of itself to realize a certain contradiction in opinion. After a short discussion, we often find that the measures proposed by the students might even cause their quality of life in the city to deteriorate.

At each of our opening lessons I see surprised faces just learning that, for example, the number of car rides in Prague has not risen too much for some years, Prague is one of the greenest large European cities, that Wenceslas Square is a very safe place, that almost nothing new has been built in Prague in recent years and that although we should have a train to the airport perhaps to increase the prestige of the city, buses can, for the time being, handle the volume of passengers in a similar time. What is also interesting is the fact that the most important issue, which will primarily affect the vast majority of today's 20-year-old students – the skyrocketing rise in property and apartment prices as a result of stopping new housing construction – is mentioned only recently, and already in 2011 it was felt with a heavy head at the Prague City Hall with regards to the future development in this direction and, therefore, we initiated an extensive reform of the city's territorial development policy.

My students always split between those who will think and say something they feel is a problem, and those who, based on the information around, get an impression that something is wrong and should change. The first ones are always right, their feeling is true, their opinion cannot be argued with. However, it is necessary to discuss with them the time and especially the territorial limitations of their experiences. The others argue very much, defend their opinions and impressions, but after three questions it is usually clear that their reasoning stands on water rather than on firm ground.

However, our discussion has another important goal. My intention is to make students think and consider whether their idea is feasible and what efforts need to be made to realize it. In which way and how it is possible to realize this through a tangled web of relationships among people, officials, and politicians, but also between norms and laws. Therefore, we always try to quantify very roughly the opposing ideas: in other words, what their idea is against – let's say, for example, in Prague which has about a million inhabitants. And that's when this idea is just a thought in their head.



The basis of this natural resistance of the city, in the case of Prague, is about a million rather distrustful inhabitants. However, they are usually very intertwined in civic associations, housing cooperatives, companies and social groups interacting with one another and held relatively tightly in relation to others' opinions. There are several tens of thousands of civic associations in a city with a population of one million and more than a hundred thousand companies. It is almost impossible to estimate social bubbles. Within each such group, only one negative mention of a new idea is sufficient and the whole group is likely to take a rather negative attitude towards it. Moreover, formally and informally institutionalized traditions, customs, decrees and laws are also often opposed to innovation. Every system with its feedback mechanism always very intensively resists a foreign idea – the more foreign it sounds, the more it attacks closer to its foundations. If we wanted to quantify our size or rather smallness in relation to the whole city of Prague, we would reach numbers extremely small, much smaller than the mere 1 : 1 million ratio. In other words, we are almost helpless in view of the forces of the big city in a static perspective, not considering further development. And paradoxically, it does not matter if one is an ordinary citizen or the mayor of the city. This not very well-known fact can be illustrated in two examples – first in a small measure and then in a large project.

For example, planting a tree on a street corner can be a small project. First, from the perspective of a resident of the city: A citizen interested in planting a tree goes (alone or as a representative of an association) to the chairman of the city district, the mayor of the whole city or some official, and submits his application. This goes to the director of the Department of the Environment. He will consider whether this is realistic, obtains an opinion from other departments that may be affected by the given situation (transportation, land use planning or building authority as well as others), and if so, provides feedback to the local authority and confirms that the tree can be planted. A politician usually has no reason to delay or block such a praiseworthy intention and therefore the tree is planted within a few months. And now let us look at this same example from the viewpoint of the mayor. The procedure is exactly the same. The same rounds take place through the director of the department to figure out if the planting of a tree in this place is really nonsense, or if, on the contrary, it is easy, in which case the result will be the same as in the case of a citizen's request. However, it will be a little different if friction surfaces due to the fact of the permitting system being overly

stressed or if there are some obstacles that make individual decisions difficult. This is also why political functions are often abused – it is, indeed, easier for a mayor to push his small things through. Everything depends on the culture of society, mutual trust and the choices of responsible city managers.

In the case of a city with a million inhabitants, however, it is somewhat pointless to address the mayor's ability to push through the tree. The mayor's strength does not rest on the fact that he can plant a tree somewhere – an ordinary citizen can do it just as quickly. The mayor is supposed to work out how to plant trees in the city in general and whether to plant them at all. A little more of his power needs to be used to set up processes so that trees are planted automatically when, for example, a wide city boulevard or square is being reconstructed. Or when building a ring road around the city. That can now be used as our second illustrative example.

Since 1970, in the capital city of Prague, virtually every Mayor of Prague wanted to complete both the outer and inner ring road and connecting radials. And let's ignore for a moment whether this ring road is actually being built by the city or by the state, or by both together in coordination with each other through the land-use plan and land-use management as well as the construction itself. Since the beginning of the planning of both ring roads and connecting radials (originally the so-called "ZÁkladní KOmunikační Systém" (ZÁKOS – Basic Communication System)) to this day, more than a dozen Mayors and no fewer of their deputies for transportation have taken the lead in Prague. Everyone wanted ZÁKOS and its later updates and advocated its completion, yet it is far from being finished. How is this possible? Apart from the slight discrepancies in their decision-making, it can generally be stated that their power is simply too small for this project.

But how could one make it bigger? And do we want to enlarge it at all, or will we live better if no one decides about our more or less common intentions? And how will it be in the future, when we will be even more intensely connected with everyone – will we respond more and more sensitively to even small differences in phenomena or even our own opinions?

Obviously, any change in the current situation not only in the capital city of the Czech Republic, but generally in our surrounding socio-economic space raises countless questions and generates a number of new problems. In the following text, based on the interconnectivity of my academic work at universities and, at the same time, the practice of being the First Deputy and Mayor of the capital city of Prague (2011–2014), I will try to gradually respond to the above and many



other questions concerning city administration within human society using many approaches, illustrative examples, models and analogies.

However, I had to divide a rather broad topic into three parts, three books. The first is devoted to the search for general principles of development, i.e. the issue of unchangeable limits, or to the contrary, limits determinable by society for decision-making of responsible politicians in self-government. This is necessarily a very generalized excursion into the deep foundations of our surrounding reality and the processes that shape it. The second book describes how human and urban decisions are made during the decision-making process. The essence of good governance and planning is also explained there. All this in the conditions of the Czech Republic and with a focus on large cities. Finally, the third book is dedicated to our capital. There I try to describe today's biggest problems of Prague arising, among other things, also from the bad system of decision-making. It also includes a description of what was and was not done in 2012–2014 as part of the reform of territorial development policy. Its final part is devoted to the direct recording of the situation from the management of Prague during the floods in 2013, including a certain generalized view of the crisis management of a large city.

Although all books together form one whole, each of them is targeted to a slightly different kind of reader. Therefore, I would like to ask especially those interested in looking under the cover of addressing the flood situation or realistically implemented reform measures in our capital in the recent past to reach immediately for the third book. And only if they subsequently have a desire for deeper knowledge of the decision-making of the city, I would recommend to them the first book and the second book. On the contrary, to university students in the fields dealing with cities and their functioning, i.e. in fact, future decision makers, I recommend especially the second book, the content of which, in my opinion, constitutes a certain minimum of knowledge needed to enter the city administration management or directly the self-government. To all the others longing for proper anchoring (in no way easy) to issues of the management of society, in this case especially our big cities, in other words to those who want to understand where the human ability to change the surrounding set order comes from, I cannot but recommend reading individual books in the presented order.

At this place, please allow me to highlight the role of people without whom I believe this book could not emerge in this form.

First of all, I would like to thank from all my former teachers, later colleagues and now friends to two professors, namely Vít Voženílek, whose trust in me was at the beginning of my academic career, and also Martin Hampl, who accepted me for doctoral studies at the Faculty of Science of Charles University and thanks to whom, among other things, I started at first little, later on more and more to penetrate into the essence of the complexity and general development of our world.

For a completely different help, I would like to thank countless people with whom I had the opportunity to cooperate in the Prague City Hall. Especially my two main collaborators from my then office of the Mayor – Ondřej Boháč and Jitka Bendová – who shared with me, probably to the greatest degree, both the good and especially the bad, what emerges in the natural course of events – but oftentimes, unfortunately, also intentionally – in political and representative activities.

I would like not to forget to thank also a large number of experts, thanks to whom I could successfully work in the city hall. In the area of territorial development, especially Vít Máslo, Roman Koucký, Jan Jehlík, Jiří Plos, Petr Hlaváček, Tomáš Ctibor, Jaromír Hainc, Marek Zděradička, Jiří Čtyroký, Pavla Melková, Kamil Kubiš and many others.

For the opportunity to responsibly manage the city at the City Hall of Prague, I would like to express my thanks especially to several of my closest political colleagues – Eva Vorlíčková, Zdeněk Tůma, Václav Novotný, Lukáš Manhart, Pavel Richter, Helena Chudomelová, Milan Růžička, Martin Dlouhý and others, whether from our then representative club, political party or Czech politics in general.

I would also like to thank a few personalities for their direct contribution to this book. First of all, the Rector of the Czech Technical University in Prague, an excellent teacher, scientist and friend, Petr Konvalinka, who enabled me, after finishing my service in Prague administration, to restart my academic career. And also the director of the Masaryk Institute of Advanced Studies, Associate Professor Lenka Švecová, among other things, especially for creating a unique environment for such a type of activity as the work on such a comprehensive and extensive publication regarding its content and focus. Many thanks also to Marcela Uhrová, Ph.D. for proofreading the Czech version of the book and its translation to English, to Nicole Rudolph, M.A. for proofreading the English version, and Martin Odehnal, M.A. for graphic design.

With great respect, I would also like to mention the contribution of many professors and great people with the necessary range of knowledge, detached view but also with humor, thanks to whom the complex problems of evolution of complex systems, nonlinearities, physics, chemistry, biology, sociology, economics, demography as well as geography, cybernetics, computer science and countless other scientific disciplines gradually became less and less mysterious for me and later directly merged into a well-established picture of the outside world in my consciousness, which I tried to embody in my book. Apart from countless authors whose articles, books and lectures I had the opportunity to see and study, I would like to thank several personalities for their help directly: Prof. Helena Illnerová, Prof. Jiří Bičák, Prof. Jan Sokol, Prof. Petr Slavíček, Prof. Petr Moos, Prof. Miroslav Bárt, Prof. Petr Dostál, Prof. Miroslav Svítek, Prof. Vítězslav Kuta and in this place again Prof. Martin Hampl, Prof. Roman Koucký and Prof. Jan Jehlík.

However, the greatest thanks go to my family, especially my wife Marie, for her support, understanding, and therefore especially for the time that should have belonged to her.

The First Book

# City, People and Society: A Contribution to General Systems Theory

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**The First Book**

**City, People and Society:**
**A Contribution to General Systems Theory**

# Introduction

In the first book, we will try to look at cities, their internal and external environment, using a system approach. This is not at all new, as its early beginnings can be found already in the works of Greek philosophers. Aristotle presented his metaphysical form of hierarchies in nature[1], and from him comes essentially the fundamental postulate of holism and complexity – "the whole is more than a mere sum of its parts". Today's modern beginning of system science dates back to the publication of its basic work, *General System Theory*, by the biologist and philosopher L. von Bertalanffy[2] in the second half of the 20th century. And later, at the turn of the millennium, the system science was still enriched by the so-called new kind of science[3], i.e. the science of complexity, which is the development of the system approach by non-linear development in complex systems.

The general system theory is not the only comprehensive theory, as its name might suggest. Specific system theories as well as definitions of systems can be found in addition to the aforementioned fields of natural science also in the management of business corporations, economics, noosphere, informatics and cybernetics, and many other fields of human activity. Rather, it is a set of theories (increasingly larger) with certain common elements and approaches. And it is also a bit logical because, for example, a biologist and chemist enter the common room of system science through a different door than a psychologist, sociologist and economist, engineer or expert in the field of management and governance.

These days, system science plays an extremely important role as a certain ceiling of knowledge at a time of increasingly differentiating science disciplines and a growing number of scientific disciplines. It forms an important link between them, as it was earlier in the case of philosophy, as it is becoming increasingly clear that concepts originally defined in certain scientific disciplines – such as adaptation, self-organization, chaos and non-linearity, flexibility and firmness and many others – have universal validity.

[1] in summary e.g. Störig (2000)

[2] Bertalanffy (1968)

[3] e.g. Wolfram (2002) or in the case of cities Batty (2013)

How this interconnection of various processes, systems and especially their behavior is possible at all was perhaps best and at the same time illustratively and humorously described in 2012 by the chief economist and one of the Bank of England Executive Directors, Andrew G. Haldane, ranked in 2014 by *Time* magazine among the 100 most influential people in the world. In his opening address at the 366th economic policy symposium organized by the American central bank in Kansas City, Missouri, he pointed out the strange relationship between the extreme complexity of the movement of a levitating frisbee toy and the ordinary ability of an ordinary dog to catch this toy in flight[4].

It is really strange. Let us consider a rotating disk reacting to the slightest turbulences in its surroundings, whose every other moment of flight would be a tough proposition for no matter how powerful a computer, and on the other side a bouncing and playful dog, who has no problem jumping up and catching the object when looking at it "from a distance". Even the great complexity of dynamic systems appears to have simple behavioral features when viewed from a distance, which, although the essence of these systems is a black box for their users, allows them to handle them.

It's like looking at a complicated object from different distances, for example, a ball of wool for knitting. From a great distance we see only a round black dot. As it gets closer, it begins to grow larger and appear more and more colorful, more interesting in shape, and perhaps some of us will already see that its structure is becoming quite complicated. By looking closely, we find out that its complexity has become impenetrable for us. We will start talking in long complex sentences about its previously simple round shape and describe hundreds of inequalities. We will not be able to say which parts of the fibers are connected to each other, whether it is one or more fibers tangled together. However, if we do not stop zooming in and continue all the way to the point when we are able to move inside, we will find out that there is still enough space around us and that we understand whatever is around a little bit again – for example, we can move along the fibers back and forth and we will always see a bit ahead of us.

This is exactly how we can look at any system, object or problem in our reality. Therefore, we can look in this way also at the city. From a long distance, we don't even know about it. If we come a little bit closer, we will have only little information and everything will appear very clear: population, size, main sectoral focus, total expenditure and revenue, and a few other aggregating indicators[5]. If we now skip that problematic zone

[4] in the original "The dog and the frisbee", Haldane a Madouros (2012)

[5] The visual limits are similarly specified by Danish architect Jan Gehl and he demonstrates them by, for example, our ability to recognize people up to about 1 km, to distinguish with some degree of certainty their sex up to 100 m, to see features in their faces within 30 m and within a few meters we can have conversations (e.g. Gehl 2000).



of complexity and increase the city to our real level – that is, as we naturally live in the city – although we will not evaluate this life as simple, we still manage it as people for over 10,000 years quite well.

However, a problem arises when we want to describe the city as if we had it in front of us; as if we were lecturing about it to students. If we want to describe all the participants, relationships and processes that exist in it, are realized, interact with one another, etc., we will face the extreme complexity of the dynamic system. By the way, the city administration and mayors stand unfortunately right in this problematic approach zone. And many times, they also take advantage of this problem. Because it is always possible to disregard phenomena and problems in such a way that they disappear from our sight, although in reality they still do exist and grow.

Therefore, the limits of our human knowledge are always defined from two sides – at the general level of the whole as well as at the level of the elements of each system, everything seems to have a certain order that we are able to detect. However, there is too much chaos in the gray zone of the mid-range approach to the system that prevents our understanding.

However, this approach to complexity is not new to man; on the contrary, it is quite natural. In fact, it is natural even for the dog's brain, as shown by A.G. Haldane. However, in his thinking man can use it both subconsciously and consciously. We are able to step away from problems and dive deeper into them again, and it is a necessary procedure for us to understand the state of the given matter and set goals leading to our next action.

Therefore, it seems appropriate to comprehend this "method" more generally, preferably as a certain law. Law of distance. A basic system science tool that enables the unification of processes and systems[6]. In this first book, it will help us find the common ground of the different systems and phenomena around us.

[6] However, the fact that from a distance all objects appear small, round, smooth and, moreover, black in the white daylight, and thus actually the same, does not mean that when viewed from a close range, they behave the same way. Only when we get much closer to the level of common (small) elements of these systems, will they be similar again. Thus, for example, all cities grow according to the same principle, but no two are the same. And the same is true of individual places within them, which may vary infinitely in detail and have a completely different genius loci (Norbert-Schultz 1994).

# Part I
# City as a System

The city is a complex system with a number of subsystems. It is an organism, a new species, and not very developed.

The elements of the city are we – the people. Capital, money or the economy are only means of exchanging information.

There are six basic substances of urban metabolism: goods, services, people, money, energy and information.

An analogy for biological homeostasis in cities would be resilience.

In today's interconnected world, cities lean on one another in the same way that trees support each other in the forest.

Urban organisms show passive, active as well as creative types of reactions. They are able to learn from their own mistakes as well as from the experience of others.

We will never fully understand cities. Before the city says: "a big bridge", a huge number of changes must take place in human life.

# 1. City as a system and organism

"The city should be like a big house and a house like a small town" is a description of an ideal city from the time of Leon Battista Alberti (1404–1471) and Antonio Palladio (1508–1580), considered to be the most influential figures of Western Renaissance architecture[7]. And although it has been quite a long time since then, (some) cities have grown quite a lot and almost all have changed greatly, even these days the city is a place where we are close to one another and where we live together just like in the house. Despite the development, there is still the same essence of the city, and that is density. Population density. The city is a cluster[8] of people, which is, compared to the surrounding area, characterized by increased population density and human activities. Previously, centuries ago, residents had an easier role to play in this respect. The city was made up of what was inside the walls. Nowadays, however, there is a particular problem with spatial delimitation of cities[9]. Cities form agglomerations and metropolitan areas, often extending beyond national borders. And, furthermore, different states determine differently the minimum size and importance of a settlement unit so that it can subsequently become a city. Despite all this, the term city is very intuitive for us. When it is uttered, the populated center of a city with apartment or high-rise houses and crowded squares almost immediately comes to mind.

In terms of urbanism and architecture, cities can be viewed as a beautiful human creation. Or, from the engineering point of view, as a functional technological unit. For a geographer, the city is the core of the wider region. For an economist, it is a place of concentration of economic goods and activities. Anthropology, sociology, demography and other social disciplines describe the city as a place of life for its inhabitants. An environmentalist will assess with a critical perspective the sustainability of cities within global space. Legal and political sciences will evaluate the city according to decision-making processes, decrees and the level of public administration. And thus we could go further. Generally, cities as places of concentration of people and their activities can be found on

[7] the basis of the theory of urban development by Palladio and another Italian architect Leon Battista Alberti (Cowan 2015, p. 53)

[8] Jehlík (2016), p. 77

[9] The European Statistical Office and the Organization for Economic Co-operation and Development have relatively recently started to map the geographic surface using population density raster maps (OECD 2018). With the help of the so-called FUA (Functional Urbanized Area) indicator, European statistics somewhat unified the view on the definition of cities – as urbanized territories – some time ago.

the border, but rather of unification than the intersection of all three major scientific areas – natural, technical and social. On top of that, it should not be forgotten that cities, as engines of innovation, are a catalyst for human artistic creation. Thus, even for art and creative sciences, cities are a necessary context for their focus.

Therefore, there is no single (correct) view of the city. Only broadly interdisciplinary, integral, systemic approaches can comprehend this phenomenon in its complexity. It is therefore advisable to view the city as a system, especially if we want to deal with its administration and governance.

The term system is based on the Latin "systēma" and is a composite of the words "sún" and "hístēmi" meaning "to be together". Therefore, it denotes an organized whole, a body. Each system, including the city, is a whole composed of parts that communicate and interact with each other. A certain problem in terms of the complete definition of the system is the fact that each part and element of the system is again a system. Thus, each system is a subsystem of some supersystem, and each subsystem is, at the same time, a supersystem of its subsystems. A systemic approach in the natural but also in managerial, economic, social and technical sciences works with the terms "environment" and "system elements" rather than with the words "supersystem" and "subsystem".

In the most general view, everything that exists around us – every thing, but also every thought or a computer program – is called a system. This is how a system is viewed e.g. by the biologist Paul Weiss, according to whom a system is everything that is unique enough to get a name[10].

[10] Skyttner (2005), p. 57

System theory divides systems into simple and complicated (so-called complex)[11]. In general, we perceive something as difficult if we cannot describe it simply. Unlike simple systems, a complex system cannot be disassembled into parts and re-assembled again without losing anything. The complexity of systems therefore means their complete non-degradability. Computer scientists talk about so-called computational irreducibility, developmentally backward unpredictability[12].

[11] from many e.g. Janíček (2007)

[12] Wolfram (2002), p. 737

Complex systems usually have more elements and a greater amount of more complicated links among them. They consist of many different and, above all, differently behaving subsystems, among which there is feedback of different intensity. Some combinations can be described on a general level simply. Such cases are described, for example, by the German mathematician and futurologist Harold A. Linstone[13] and they can be, for example, a combination of natural and technological systems – water wheel, connection of

[13] Linstone (1984)



man and society – legal system, a combination of nature, man, society and technology – city. Some bond combinations are extremely stable over time, for example, atoms, molecules, or living cells that form the building material of other systems.

The city is also such a complex system and, like any other complex system, has a lot of subsystems – these can be, for example, the subsystem of parks, schools, administrative structuring, transport and technical infrastructure and countless others. These subsystems are always easier to study than the whole city. They can be individually described, modeled and given suggestions for their improvement. Their inclusion in the whole, however, always affects their behavior in some way.

The basic subsystems of the city, therefore, the elements of this complex system, are us – people. They are neither capital nor money and the economy, those are "only" the means of exchanging a certain kind of information[14]. Nor are they technologies that make building, transportation or other human activity possible. These, in turn, are all secondary, rising, thus so-called emergent manifestations of a cluster of people in space and the tangle of all sorts of ties among them.

[14] In this spirit, Adam Smith himself mentions money as a means of trade and exchange in his now legendary work *The Wealth of Nations* (Smith 2004).

More than 30 years ago, a notion similar to a system, namely ecosystem[15], also started to be used occasionally for the city. However, the concept of ecosystem is associated more with the environment than with a spatially defined phenomenon. Comparing cities to ecosystems means narrowing this phenomenon to its only aspect, albeit a very important one, which is the urban environment. The advent of this concept is partly understandable as cities grow and cease to have clear boundaries, but such abandonment of the city borders is a largely undesirable phenomenon, especially from an environmental point of view. Most importantly, however, people still claim to at least partially control and manage cities. And by designating a city as an ecosystem, we are largely getting rid of our potential influence on cities. In short, we accept that there are cities and we live in them and exercise very little influence over them and participate in their creation to very little extent, too. No mayor or city manager, but not even any architect would call the city an ecosystem. Therefore, as long as there is a city administration, and it is able to exercise at least some form of power over the entrusted territory, it is appropriate to consider the designation of the city as an ecosystem as incomplete.

[15] see e.g. Douglas (1981) and many others

On the other hand, what phrase needs to be discussed more, is the city as an organism. The word "organism" is derived from the word "organized" and thus means a very advanced structured system. Architects called the city an

organism already at the turn of the 19th and 20th centuries, such as Otto K. Wagner, an Austrian architect and urban planner and one of the founders of modern European architecture[16], but after some time this designation was again slightly abandoned. However, we are not interested only in the designation but in a scientifically based opinion, and that is not easy to pronounce based on today's knowledge and definition of life. Humans are organisms. But what about the cities that are made of and made up by them? They are undoubtedly full of life, but is it enough for designating them as "organism"? We will try now to find some clues that could help us to get to know the truth more closely.

Only some complex systems are called organisms, and thus, vice versa, all living organisms are complex systems. The boundary between an inanimate, albeit complex system, and living organism is being discussed more and more passionately as the biology and molecular chemistry of today are increasingly revealing more and more detailed regularities in the function of organic compounds and molecules. Norbert Wiener, Nobel Prize laureate in Physics and founder of cybernetics, wrote the following words about this problem already in the middle of the last century: "Whenever some new phenomenon, in our opinion, does not match all relevant aspects of life, we have a choice. Either we extend the meaning of the word 'life' to include also these aspects, or, on the contrary, we give a narrower definition of life that simply excludes them"[17].

From many perspectives, the city really looks like a living organism. It is full of movement and life, growing and evolving. The counter-argument, that as we walk through the streets we can see a lot of inorganic and thus a bit less of the living, cannot be accepted. After all, even the human body is made up of 70% of inorganic water and the rest is also a composite of inorganic material.

At first glance, however, the city does not look like a representative of the animal kingdom, because it does not move. That is, with very few exceptions – the transfer of small mining communities in undermined regions, such as Kiruna in Sweden[18] – this has never happened in human history. Therefore, the city is much more like a plant kingdom. For trees and plants move only in part of their lives in the form of seeds. Once they germinate under appropriate conditions, their movement ceases and the geographical position stabilizes. The city also resembles plants by its hierarchy (i.e. a graded system) of streets and technical and transport infrastructure, by decreasing the intensity of activity from its center to its periphery.

16 more e.g. Gerentsegger and Pentner (1980)

17 Wiener (1963, p. 44). On the one hand, scientists cannot agree unequivocally whether, for example, the tiny viruses that need their host are alive or not. But even on the other side of the size spectrum, scientists do not unanimously view the Gaia theory – of the organism in the form of the whole planet (Lovelock 1994). Biologists are particularly opposed to this theory, which is understandable. The theme of life is their domain and the generalization of this concept is difficult for them to admit. According to them, the biosphere cannot be subject to biological evolution and therefore cannot be considered a living organism (Flegr 2005, p. 117).

18 Wainwright (2014)



Plants, however, grow only in their area of growth at the tip of the stem or trunk and during their growth they grow massive. Once a tree is infected, for example, with a fungus, it will no longer change its stabilized wooden parts, while cities are able to repair and restore their "damaged" inner parts. Therefore, anthills or other insect colonies seem to be closer to the city. There are obvious differences even there, though. The diversity of people and the variability of their activities is somewhat different from the conformity of genetic equipment of insect colony members. In addition, even insect colonies are not uniformly accepted as organisms.

Therefore, it is necessary to accept the fact that a city, if it is an organism, is its brand new type, not yet realized in nature. However, it is similar in many aspects to other living creatures. It spreads its "ideas" around itself, such as the urban way of life[19], building standards and many others. Quiet hours of the night and daytime traffic jams resemble biorhythms. In today's interconnected world it is not much to be seen anymore, but when looking at history, one can see that cities are born and die. For these phenomena, however, we use other terms, namely foundation and extinction. However, in any case, they reproduce and multiply within a larger whole. Not only that cities originated naturally, they were also founded after the establishment of the principality, kingdom or some other form of state system in a similarly large number, sometimes even literally from scratch. The art of urban building has spread and is still spreading through knowledge, images or written words among people and schools, just as genetic information is spread through genes.

In cities, for example, infrastructure, streets and squares and even parks[20] are growing in a fractal, structured and hierarchical way, as in living organisms. And similarly, material, capital and information flows are differentiated. In the city, life functions manifest themselves in a similar way as in organisms. It undergoes metabolism[21], constant exchange of substances and the resulting production of a certain new value. Both basic types of metabolic reactions – catabolic and anabolic – can be identified in the city. A type of catabolic reaction that generates storage energy from food organisms is, in a city, for example, building houses or other type of creation of a suitable environment for people to live in. An anabolic reaction is then the subsequent use of this created environment and, thanks to that, the creation of other, higher values, such as culture or ideas.The basic substances of urban metabolism are six[22]. They are the streams of goods, services, people, money, energy or information that are transforming, mutually combining,

19 That is how we named some differentiation of our stereotypes from those we observe in less populated rural areas. This is characterized by greater conditionality by the natural rhythms that the (large) city overwhelms by its inner life (e.g. Temelová, Pospíšilová, Ouředníček (ed.) 2012). In this context, the prominent Czech geologist Václav Cílek states that "the countryside has no history" (Cílek 2010, p. 97). On the other hand, social life and its regulation in general today are much larger in the countryside than those in towns many decades ago.

20 more e.g. Batty (2005) etc.

21 Biological metabolism = metabolism taking place in each cell. It is a set of chemical reactions enabling the cell to obtain energy (Markoš 1997, p. 44).

22 according to the Resilient Regions Association (Resilient Regions Association 2018)

interconnecting, and creating more complex products, knowledge or value-added information within a city. The ability to maintain a certain level of all these currents, which in turn is analogous to biological homeostasis, is called resilience of the urban organism. Surprisingly, it is not at all small, which is mainly due to today's interconnection of the world. That is why these days, with a few exceptions, cities do not disappear. They lean on one another in a similar way as trees in a forest support one another[23].

However, this does not at all mean that they cannot decline in the long term as their fundamental currents deteriorate over time in the event of repeated wrong decisions. For example, the former pride of the American automotive industry, Detroit, was forced to declare bankruptcy in 2013 after a series of bad political decisions. In spite of the first slow, later already noticeably quicker decline of the old and uncompetitive branch of industry, instead of into its own transformation, it has invested considerable sums into expensive, large (and unnecessary) infrastructure projects, instead of developing human capital[24]. A large part of it became a ghost town after the collapse and it took some time before there was at least some indication of development again[25].

However, it is true that it is not always in the power of the city itself to get out of the vicious circle. New York, for example, succeeded. American economist and professor at Harvard University Edward Glaeser describes that in the 1970s New York was heading in much the same direction as Detroit, but its socio-economic transformation into the financial center of the world was successful. Similarly, Manchester in England has succeeded in becoming a modern city of services and commerce[26]. In the Czech Republic, the Ostrava and Northern Bohemia regions are still waiting for some fundamental transformation and springing upwards. It is important here to avoid a series of bad political decisions.

However, the need for a high resilience[27] of the city must be discussed also in the reverse case – with unprecedented growth. They are communicating vessels with the decline. As the city grows, it needs to be better protected against changes in external as well as internal conditions. Overloaded technical infrastructure can, for example, lead to frequent breakdowns, and to electricity blackouts, which nowadays affect also advanced parts of the world relatively often and are one of the most feared threats in big cities nowadays[28]. Dangerous infections of long-eradicated diseases often go around big, overpopulated Asian or African cities.

[23] This fact is well documented and interestingly described by the ecologist and long-time forester Peter Wohlleben in the German region of Eifel in Rhineland in the publication titled *Wohlleben* (2016).

[24] Glaeser (2011) p. 63

[25] Ferreti (2018)

[26] Elliott (2018)

[27] Resilience is in this respect a relatively well-defined "sub-concept" of a kind of too broad a concept of sustainability.

[28] on the example of Prague e.g. Hudeček, Juránek, Pejčoch (2015)



Every problem, whether a natural disaster, damaged technical infrastructure, traffic congestion, terrorist attack or social unrest, has to be actively addressed by the city, otherwise there is a risk that the problem will emerge later and on a much larger scale. Thus, cities show their ability to adapt. And with this ability, we will pause for a moment.

With evolution, the ever-increasing variety of types of reactions, and thus the ability of complex systems and organisms to adapt to external changes, is something that, like a silver thread, stretches through the evolution of both inanimate and living matter. The ability to respond to external stimuli is an indicator of a certain "cleverness" of a system or organism. Even the essence of intelligence (of a person) is closely linked to our ability to respond to stimuli from our surroundings. Intelligence is generally defined as a learning and development ability[29].

We are logically interested mainly in the possible extrapolation of this direction further to cities, which, on the other hand, is not yet much explored. Thus, the question, with some exaggeration, is: "What IQ does the city have?" The intelligence quotient is, of course, an artificial, psychological, more or less successful construct designed to compare intelligence in humans. It is not suitable for comparing organisms with cities, but the essence of the question is probably obvious. Therefore, we can ask in terms of reaction capabilities, to what extent today's cities are "smart".

The issue of increasing complexity in systems was also addressed by the leading Czech geographer and co-author of the current regional as well as micro-regional administrative division of the Czech Republic, Professor Emeritus of Charles University, Martin Hampl. In his work[30] he classifies systems into a certain "taxonomy" according to the type of their reactions. In this taxonomy the inanimate matter is the lowest (knowledge about dark matter and dark energy was not too widespread outside physics at that time), e.g. a grain of sand or a rock, which is only a passive recipient of electromagnetic waves. That vibrates it on the most elementary basis of micro and nanoparticles, thus increasing its energy and heat. In that process occur some variations in the properties of the matter. However, as soon as the burden in the form of the supplied external energy ceases to act, the inanimate matter will return to its original state, hence the passive reaction.

Moreover, living matter is able to react actively to this passive reaction (M. Hampl uses the term "semi-active" to further distinguish it). After the strain, the living matter creates a certain "surplus" of energy or, in some more advanced form, also

[29] Petterson (2018, p. 103). Since the time of significant developmental psychologist, Harvard University Professor Howard E. Gardner (e.g. Howard 2011, 2018), human intelligence has been viewed already in a more colorful and ambiguous way.

[30] e.g. Hampl (1998)

the ability for the event of future strain. The charge for these higher abilities compared to inanimate matter is the narrowing of the constraints for one's existence. A moderate load stimulates a living cell or muscle to grow and improve its properties, while an excessively high load has already devastating consequences. Thus, in contrast to the passive inanimate matter, according to the current practice in science, all living matter has the ability to form a new order in certain limited boundaries.

From living matter it is possible to separate man as a separate group. His inanimate component, of course, still has the ability to react passively, and likewise also the biological component has the ability to react in a semi-active way. In addition, man sometimes possesses the ability to create e.g. art or culture. M. Hampl calls this type of reactions active. However, it might be better to call them creative abilities. However, the important word is "occasionally". One does not possess creative abilities continuously, 24 hours a day. On the contrary, rather in exceptional moments during the day or week. As scientific advances grow, it is becoming increasingly clear that human exclusion is certainly justified, but less pronounced than previously thought.

Of course, Hampl's classification is not very subtle, and especially the knowledge of ethology has progressed somewhat since then. Living nature and responsiveness of individual animals are now further divided. It is easy to recognize lower-level reactions among animals – insect instincts that, for example, drive moths towards death, if we turn on the light in front of them. Or in higher animals, higher-level responses, which we call emotions, and even in them we distinguish many levels[31] today. Emotions allow their bearers to learn from an unsuccessful reaction and change it next time, of course, unless the first attempt had fatal consequences, or, on the contrary, in the case of a successful reaction, fix it in the future. The existence of conditional reflexes in dogs was proven already at the end of the 19th century by I.P. Pavlov[32]. Through a minor genetic mutation, and especially thanks to social life, man has crossed a certain threshold and, in the interests of a higher goal, is able to better cover his emotions compared to animals in certain situations. Under certain circumstances, man is able to overcome his own urge, while evolutionarily inferior animals do not have such an ability. Man is able to weigh his actions more thoroughly than animals. Man can regulate rage, fury, anger but also joy through his consciousness, for example, with the use of humor[33].

[31] There are many models, e.g. Plutchik (1991).

[32] collectively e.g. Pavlov (2003)

[33] elaborated, albeit popularly, e.g. by Petrák (2016)



Thus, we can mark the taxonomy described by M. Hampl with some adjustments as shown in TAB. 1. However, we are interested in the fact whether also the city happens to be a successor of such a development series.

If we observe cities from a sufficient distance, which is a method we will use extensively, especially in the second part, we will see that these do not only react passively as inanimate nature. They are able to learn from the failed coping with the crisis situation and, for example, after the flood, provide for a better flood protection in the future. They are also able to adapt fire or building regulations after a fire. Based on a change in the structure of the waste substances of its metabolism, they are able to move towards technological innovations and start, for example, to better sort and treat waste. In the field of transport, with increased commuting, they can either distribute it to a larger territory using either the activity of traffic police officers or more modernly using telematics systems, and with the use of state-of-the-art neural networks and artificial intelligence to better prepare for a higher future traffic load.

In addition to this all, cities can respond partly in a creative way as well. This means that they can learn not only from their own experience, but also from the experience of others. As they grow, they learn possible urban concepts from one another, copying urban patterns and structures. They are able to combine even previously unthinkable or even non-existent types of systems in order to innovate existing processes or goods. For example, without experiencing the flood, the city can have tailor-made flood barriers, mobile information and communication systems created and installed. Or if, for example, in the center of some city the closing of roads for cars or discounts on public transport have turned out well, or if the revitalization of brownfield or the development of a new development zone have proven successful, the successful concept will easily transfer to other cities as well.

A good example of the borderline between active and creative responses is urban marketing. Cities are able to self-promote. Of course, this may also happen somewhat

| System | Type of reactions |
|---|---|
| Inanimate matter (atom) | Passive |
| Living matter (cell, but rather plant, insect, animal) | Active |
| Man | Creative |
| City | … |

TAB. 1 – Classification of systems according to their reaction capabilities, source: Hampl (1998), adapted

"unconsciously". For example, the 2005 Korean series *Lovers in Prague*[34] attracted and still attracts millions of tourists from this country to Prague. However, self-promotion in cities is also conscious and targeted, even though the impact of expensively developed urban slogans and brands ranging from informal such as "Berlin is sexy"[35] to those marketing processed, such as "Fall in love with Warszaw"[36], "Prague – pure emotions"[37] or "Ostrava!!!"[38] is difficult to quantify. Oftentimes, there is really no effect on the outside and it is more of an encouraging slogan for its own inhabitants.

Urban organisms could therefore appear to be the next in our evolutionary range of systems. They are composed of a complex of human organisms. In their behavior and decision-making, it is evident that they exhibit some holistic behavior, respond to external stimuli passively as well as actively, learn from their own mistakes and show also creative skills as they learn from the mistakes and experiences of other cities. However, each new level in our development line of systems also controls some new, higher, and more advanced type of reaction capability. Therefore, cities should have, in addition to the above-mentioned three levels, also a certain "above and beyond creative" ability to react, from our point of view some perhaps incomprehensible "realization of their own awareness". However, we do not see anything like this in cities, for which there are some logical explanations.

We humans are elements, something like small cells of the urban organism, and therefore we should not be able to understand the ongoing processes at the level of the whole. The larger the whole is to its parts and elements, the less these levels understand each other. And vice versa. A large whole has only superficial information about its small parts. As a rule, it "knows" about them only if something is not working. This can be outlined with a somewhat inaccurate but very illustrative analogy to our body: "What does, for example, our liver cell think about the fact that we are reading this book now?" Nothing. It doesn't know about it. It kind of doesn't matter to it. Yet, along with other hundreds of billions of our cells, it is involved in our ability to read at this moment. During the reading, the liver cell is solving its own problems. Yesterday's celebration means work for the liver, and if there are a lot of cells busy in this way, we perceive their work – as a hangover. After an average of 150 days, our depleted liver cell is then replaced by its successor, about which the liver knows a bit, but the whole organism does not.

The whole and the parts do not understand one another, especially because they act or "think" in different time

[34] Aktualne.cz (2013a)

[35] Neate (2014)

[36] Warsaw Tourist Office (2018)

[37] Culture brand (2018)

[38] Ostrava (2018)



horizons. This can be seen very well in the city in relation to its inhabitants. Years or several decades will have passed before the city says "a big bridge", if we count discussions, commissioning, construction, its completion, testing as well as the final inspection[39]. For example, the Prague backbone road communication system[40], consisting of two ring roads, the Prague circuit and the City circuit, and a radial system, has been on the table since the 1970s. In 2018, a little more than a half of it was completed, while by that time, statistically speaking, half of Prague's population has died. The deeds and acts of the city and their preparation – one can afford a certain euphemism: the "ideas of the city" – are much longer than the changes in the life of each one of us. As elements of the whole system, therefore, we can never fully understand them and especially their consequences, even though many of us have the opposite feeling.

However, already here, at this point, we have to make one comment – it is not always so. In fact, in life or, better even more generally, during the existence of every system, there are also periods when its elements and parts think as quickly as the whole. In a city, these are periods of floods, fires, terrorist attacks, in general – periods of crises. Large amounts of water require an evacuation which is ordered and carried out within a few hours. A large fire activates all the emergency services that extinguish, treat and possibly divert traffic. In a few hours, the fire is resolved, and the regeneration phase of the medium-term thoughts follows, and then again to the long-term ones. Many times in the following chapters and sections we will deal more with this issue. But let's go back to the non-advanced capabilities of urban responses.

Another reason why we do not observe any extra-creative ability of reaction may be due to some under-development of cities. Unlike inanimate matter (13.7 billion years[41]), living matter (around 4 billion years[42]) and man (less than 0.5 million years[43]), cities have been here for only about 10,000 years. This is a fairly short time to create a new and much larger number of control layers intertwined with feedback.

And related to this point is probably the most important factor of the absence of more advanced abilities of the urban organism, which is a certain scale error in our analogies. The human body is estimated to be composed of $3.72 \times 1013$ molecules[44]. Thus, we are in the order of tens of trillions. Large molecules – macromolecules, which include, for example, even our DNA – then contain about 1011 atoms. So, these are hundreds of billions. However, even the world's largest cities have only about a dozen, or a few tens of millions of inhabitants (and

[39] However, there are also extremes, such as the construction of the "Golden Gate" Bridge in San Francisco, which took 4 years (1933–1937), an incredible pace given the time and dimensions (Perino, Faraggiana 2007).

[40] formerly known as the so-called ZÁKOS – ZÁkladní KOmunikační Systém (Basic Communication System)

[41] e.g. Weinberg (1998)

[42] Research studies still quite differ in their conclusions, of the last ones – e.g. Tashiro, Ishida, Hori (2017) – report 3.9 billion years.

[43] E.g. the Antón, Swisher (2005) study dates ancestors of anatomically identical individuals to today's man in the African region from 315,000 years ago.

[44] according to Bianconi et al. (2013)

all of us on Earth today would fit into a city the size of Texas). In short, there are not enough of us in cities, so that, as in other organisms, new, integrated layers of feedback could sufficiently develop, which would enable truly intelligent thinking.

However, what physical concentration of people has failed to do, and perhaps never will, has become a reality in the digital environment. The Internet is increasingly connecting virtually the entire human species on planet Earth, with over 7.3 billion individuals today[45]. Processes in a digital environment at the level of our entire world, based on bigdata analyses about each of us, can evoke such a "super-creative" ability. Employees of Internet companies, such as Google or Facebook, who are able to observe our behavior from a certain "detached view" through data, could tell their experience of it. Even reputable scientists such as the recently deceased leading physicist and one of the most famous scientists at large, Steven Hawking[46], are starting to worry about a certain planetwide artificial intelligence capable of robbing the planet's population of freedom. However, we will stay with our contemporary cities further in the text, and in the next chapter we will have a look at their surrounding environment.

[45] According to the UN, 7.3 billion were reached in 2015 (United Nations 2018a).

[46] transcript of his statement Rutschman (2018), more about the topic in general e.g. Bostrom (2017)

The city develops systematically as a settlement as one becomes a person in society.

Cities exert a gravitational force similar to the physical one on their surroundings. The basis of the attractiveness of cities is their importance.

As the world shrinks, three processes take place: the significant becomes even more significant, the insignificant disappears from the map, and broader relationships emerge.

If there is such a thing as a desire of cities, it would be defined as an effort to preserve itself on the world map.

Cities at the same hierarchical level usually compete.

We have a responsibility to the city: the city as a task.

## 2. City among other cities

Just as man becomes human only through his integration into society, so cities could grow into their present form only thanks to their surroundings, the larger whole (e.g. a state), whose essence, which will be of interest to us in this chapter, is the settlement system. In it, cities grow and develop together, mutually learning how to build, what buildings in which places to prioritize, how to use space and height efficiently and economically, or how to avoid the devastating effects of the surroundings, such as floods and fires. No newly established city is created without experience from the creation and growth of other cities. We, the people, are the carriers of this "DNA" of the city.

The settlement system is the result of a long evolution in the mutual relationships of cities because every city within the settlement system is exerting some force on its socio-economic environment, not unlike physical gravity. It manifests itself mainly, but not exclusively, by the movement of people commuting to cities from their hinterland and can be modeled using a certain analogy of Newton's gravitational formula[47], which was done in the first half of the 20th century by American economist William J. Reilly[48].

The gravitational formula shows that the magnitude of the attraction force is inversely proportional to (the square of) the distance, or some kind of travel costs. Even though its effect is the same in all directions from the city, the geographical space is very heterogeneous. It is full of obstacles in the form of, for example, mountains that are difficult to pass, wide rivers or other objects. Therefore, physicists would probably call such a force "gravity with friction". The two basic costs of commuting are time and distance, and the importance of each has changed in epochs. Today, due to the very low transport costs, the commuting time distance plays a much greater role in most cases than the distance measured in kilometers. In this respect, it is more than interesting that the willingness of a person to travel daily, i.e. to commute daily, does not change much across epochs and despite the development of the means of transport, and is roughly equal to an hour[49].

47 $F = G \times m1 \times m2/r2$, more e.g. reprint of the work – Newton, Motte (2008)

48 Reilly (1931)

49 Marchetti (1994)

At the heart of this attractive power of cities, their attractiveness to other potential residents or visitors, is, in the simplest case, the population of the city. However, the extensive work of Anglo-American polymath Geoffrey West carried out at the multi-scientific workplace, The Santa Fe Institute in New Mexico, shows that the population and other socio-economic indicators – be it the wages of the population, number of companies or cultural facilities, patents and others – are largely related[50]. All of them can therefore also be used as the mass of the city in gravitational modeling. However, when trying to describe the behavior of cities in the settlement system, we should correctly assert their importance as the mass of centers. And here we have to pause for a moment.

[50] West (2017), p. 29

The importance of a city is usually somewhat related to its size, but it may not always be so. There are many influences. For example, Mexico City or Asian cities are much larger than New York City, but given the economic (but also cultural and other) power of the United States, New York is undoubtedly a more important city in the global settlement system. Population-small, literally "meccas" of religions, or globally famous tourist towns, are also a good example.

The real proof that size is not the same as meaning is the fact that cities can increase or decrease in meaning without increasing in size. Sometimes changes happen in the hierarchy of the settlement system. This is usually the result of a decision at the level of a higher whole, a state or a supranational institution. For example, the city of Brussels has undergone a significant increase in its significance relatively recently without any size growth as it became the capital of the ever-expanding European Union in the mid-20th century and managed, by some aspect of meaning, to skip in the hierarchy of larger and richer metropolitan areas in Europe – Frankfurt or, in a way, even Paris. And likewise Bratislava, with the division of Czechoslovakia in 1993, reached the level of the capitals of European states, which did not belong to it within the Federation.

Some specific cases of different significance and size are, for example, the cities of Budapest and Vienna, which before the Paris Peace Conferences in the 1920s were the central centers of much larger territories controlled by them than today[51].

[51] Particularly in Vienna, the fact that, for the past 10 years, it has been at the very top of the rankings of quality of life (Trojan 2018, p. 31) is a sign of its certain "superperformance".

However, determining the importance of the city is not easy and not at all illustrative. During a detailed analysis of history, any significant deviation of the importance of the city from its size can be quite well described – it was usually at a certain historical moment a city large enough according to the surrounding conditions, which through some exceptional achievement and subsequent good coincidence continued in



the future years and centuries and retained its uniqueness – but the effort to quantify the importance of cities generally requires the use of a complex multifactor analysis, where there is always a problem with setting individual parameters. At the level of the Czech Republic, the already mentioned professor Martin Hampl[52] was quite successful in this area. At the level of world cities, English political geographer Peter J. Taylor has been quite successful in this for some time now. He divides the major world centers according to their importance into categories alpha, beta, gamma, etc. He identified New York, followed by London and Tokyo as the three most important alpha cities in the world[53]. But now let us go back to the influence of the size or importance of cities on their surroundings.

[52] from many of his publications e.g. Hampl et al. (1996)

[53] These are headquarters of the world's largest stock exchanges and centers of finance and trade. In later work (e.g. Taylor 2006), among others, within the organization established by him – Globalization and World Cities Research Network (abbreviated as GaWC) – cities are divided already into several levels.

The attractive power of cities is the cause of the creation of their hinterland. People commute to work to every sufficiently large or significant town and thus, each town through commuting serves its own region, the so-called micro-region, at the lowest level. It is characterized by the inner polarity of the core: periphery, more densely versus less densely populated territory and in a developed settlement system such regions cover its entire territory. The boundaries of the regions of two neighboring centers are formed by the saddles (minimums) of their relationships, whether commuting at the lowest level of the settlement system or other, qualitatively higher relationships. These borders are places of temporary equilibrium between the mass of neighboring centers and they are the basis of the so-called regionalization, which is often the basis for administrative division – such as regions or municipalities entrusted with the administration.

However, the regions are even larger than for commuting. The state, with its national settlement system, is also a region, the so-called macro-region. Or, a transnational grouping, such as the EU, is in a way also a type of region with a relatively interconnected settlement system. The essence of exercising the power of the largest center here, however, is no longer a daily commute, but rather qualitatively higher relations: administrative, economic, cultural and other, such as customs, currency, language, religion, constitution, etc.

With the development, regions are transforming, expanding and interconnecting as a result of two seemingly very different manifestations of one single process (which we will focus on later): increasing the "mass" of the city and shortening distances.

The world, i.e. the geographical space, has been shrinking most and fastest since the industrial revolution due to the courage of people and technological progress. While the first

circumnavigation of the Earth took 3 years for the seafarers in the 16th century[54], by plane we managed it in less than 8 days in the 1930s[55]. Moreover, all these were pioneering and heroic achievements very far from the general population. Today, however, it is already possible, without any problems, to be able to be on the opposite end of the planet within 24 hours using regular airliners, even at relatively affordable prices, with the skillful use of Internet intermediaries of airline connections. These days, for residents outside large cities, the most time-consuming parts of the journey are, paradoxically, to the departure hall and then from the airport to the destination place.

The shrinking of the world is easy to mark with a map (FIG. 1), and this phenomenon is truly analogous to the process that must be undertaken when creating a scale map[56]. Neither what we perceive with our senses nor the map created according to real space is an exact copy of reality. We select information that comes to our senses in such a way to survive in the surrounding complex world and be able to focus on the essentials. In other words, we generalize[57], universalize. These days, this issue is intensively studied not only in medicine and psychology, but also in many other scientific disciplines, because it affects virtually all spheres of human being, be it engineering or, for example, marketing. Already in 1960, the American urban theorist Kevin Lynch[58] described this in his famous book *The Image of the City* on the example of the city and our behavior in it.

Especially the consequences of generalization in reducing space are essential to us now. There are three: the important becomes even more important, the insignificant disappears from our view and wider relationships, topologies emerge as well. In the example of the reduced, or generalized map (FIG. 2) these processes are clearly visible.

In the shrinking of the world as a result of faster transport, this in other words means that important centers increase their importance in reducing (the map of) the world, small towns are disappearing and the settlement system is increasingly expanding and more and more cities are being integrated into it. These processes can be illustrated in certain hypothetical historical examples.

If our progenitors were to go from Prague to Berlin in the 16th century, they would have to go through every village on the way, and that would usually take them more than a week. Later, in the 19th century, they would still have to travel for many hours by train, but they would only stop at places that lay "on the track". At the end of the 20th century[59] during

[54] e.g. Opatrný (1994)

[55] Sterling and Sterling (2001)

[56] The subject of the scientific discipline called cartography – map – is defined as a reduced and generalized picture of reality. The rate of this reduction is determined by the scale of the map, unless we consider distortion due to the curvature of the Earth's surface. The maps of the world have a small scale, the city plans have a large scale (the scale is discussed, for example, in Bláha and Hudeček 2008a).

[57] The purpose of cartographic generalization is, based on the cartographer's knowledge of the depicted territory, to select only the essentials from reality, to suppress the other elements or to transform and generalize them according to their common, usually more deeply hidden essence (see more e.g. Töpfer 1974). As a result of that, as the map shrinks, the important geographic objects get relatively larger with respect to their surroundings, thus transforming themselves into even more important and significant ones. Reverse counterparts are places or phenomena.

[58] Lynch (2004)

[59] or, in the case of the last approximately 25 years or after the turn of the millennium or even in the second decade of the 21st century (Lídl, Pospíšil, Svoboda et al. 2009)



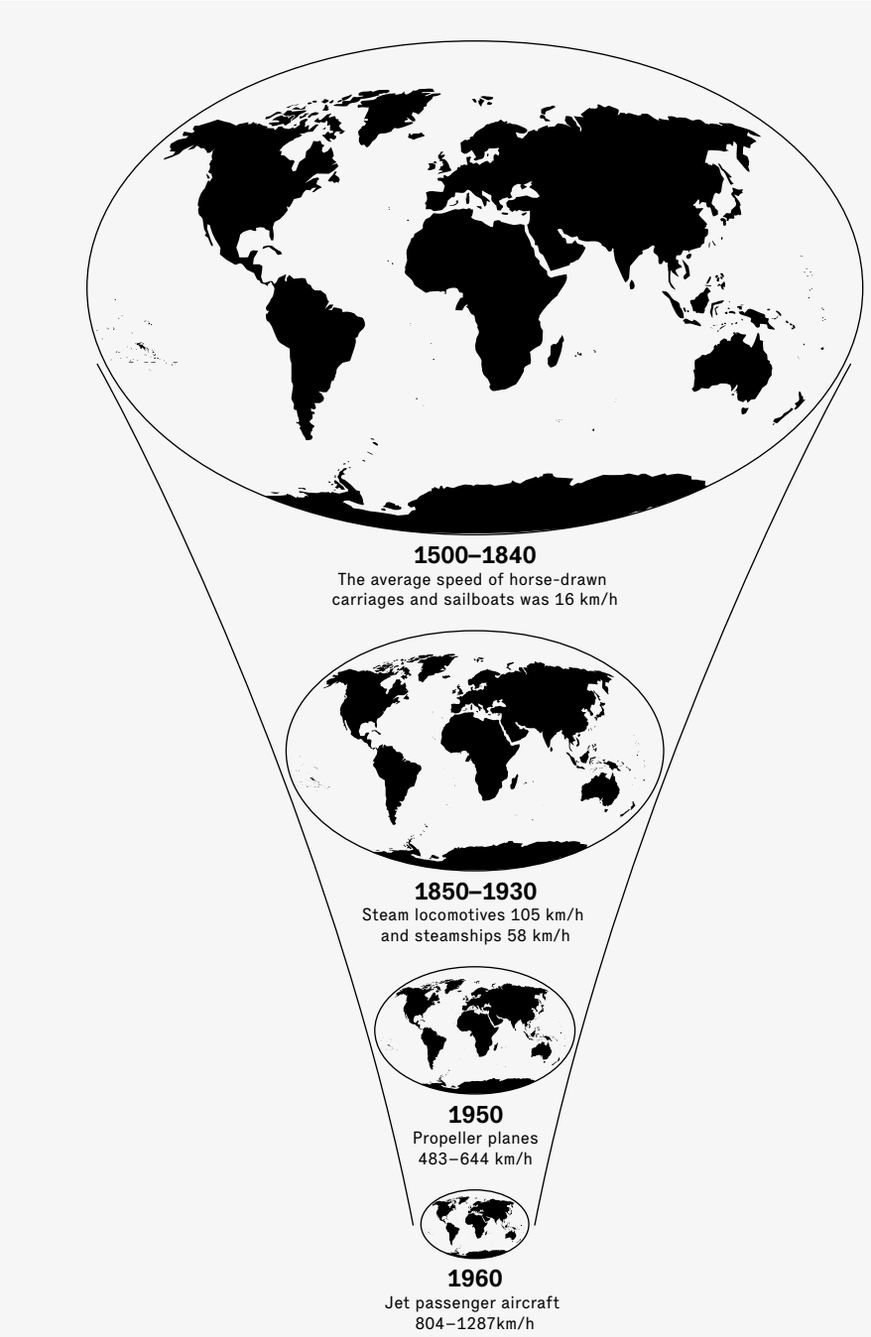



FIG. 1 – Shrinking the world in modern times, source: Geographypods (2019), taken and adapted from Harvey (1991)

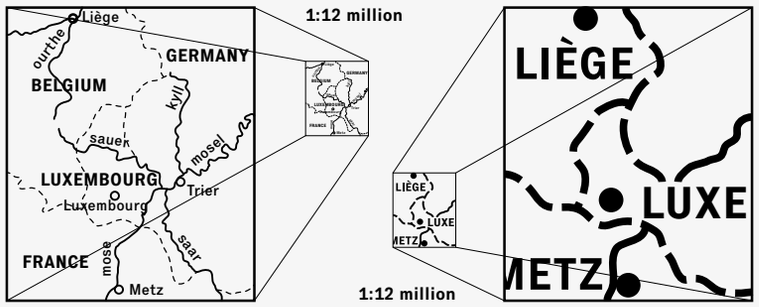



FIG. 2 – Scale and transformation of the map during generalization, source: elaborated by the author

a several-hour drive by car on the highway, even cities with the population of hundreds of thousands on the road – Ústí nad Labem and Dresden – would be only motorway exits. And today, after travel costs – prices of air tickets – have fallen even further, we fly by plane and thus "jump" directly from Prague to Berlin. The villages and towns that used to be on the way have disappeared completely for us, and at the same time there is no problem at all to get farther.

The same situation happens when we travel from Prague to Ostrava today using the Pendolino high-speed train. We only stop in two "villages" – in Pardubice and Olomouc[60]. These days, fewer and fewer people[61] know even such previously important stops like Česká Třebová or, for example, Zábřeh na Moravě[62].

Whenever traffic is somehow speeded up, distances are reduced in terms of time and the availability of places on the Earth's surface generally increases. This always leads, among other things, to strong competitive pressures at the borders of regions. Larger and more important cities, with their greater attractiveness and influence, gradually overshadow the influence of smaller neighboring centers. Gradually, by their gravity, they are removing parts of the commuting area from the region of a smaller city, thereby amplifying their influence and diminishing the influence of their smaller competitor. By the end of the unequal struggle, they take away so much of their rival's hinterland that it has nothing else left to do but to submit to the influence of a larger city as well, cooperate with the larger center, and within its commuting region to partly functionally specialize. With the addition of a smaller center to a greater center, the initially competitive relations transform

[60] Czech Railways (2018)

[61] on the history and development of Czech Railways more e.g. Bek (2018), also Hudeček (2009) and others

[62] Shortening of distances in the Czech Republic in the last 100 years has been dealt with, for example, by the publication Hudeček (2011) or Hudeček (2016). The future and further intensification of the whole process – if high-speed lines are built – is presented, for example, by Šlegr (2012).



into co-operation and specialization. The region of the larger center will grow by the mass of the connected center, now already of a lower level. The city thus strengthened, once again at the borders of its enlarged region, will subsequently begin to compete for territory and inhabitants with other cities, and thus over and over again, creating a multilevel interconnected settlement system through complex links.

One of the interesting consequences of the diversification and creation of a hierarchy of cities is that, except for exceptions, no large cities emerge around big and important cities and their strong influence. The attractiveness of such a large city will cause a timely "dismantling" of other nearby population concentrations. Therefore, the weak position of Jihlava, located on the border of two extremely strong larger cities in the Czech Republic, is not surprising. Or, a good example in this regard in general is the absence of another larger city in the vicinity of Prague (with two exceptions – Kladno and Mladá Boleslav[63]) or also (with one exception – Hradec-Pardubice agglomeration[64]) the relatively even distribution of cities with 100 thousand inhabitants in the Czech Republic.

Even at the continental level, this is clearly evident. For example, when looking at the map of the USA, there are obvious heavily urbanized areas on the east and west coasts. And also at the world level, considering the global settlement system, all the three most influential cities of the world – New York, London and Tokyo[65] – are very far apart. The same effect can be perceived also from the geopolitical point of view on the border line between the superpowers, where the Czech Republic somewhat unfortunately belongs. However, it is possible to go also beyond the social sphere – for example, in the same way astrophysicists explain the existence of a belt of asteroids near the planet Jupiter. Attracting forces have the ability to create, but in the places of their clash also to destruct.

The whole process of creating a hierarchy in a settlement system can be outlined by a simple thought experiment. For it we need a flat table top on which lie unevenly large marbles. These represent cities and their population. The table top is a geographical space. Standing, not touching one another and unequally large marbles we begin to push together, simulating the shrinking of the world (FIG. 3A). After some time all the marbles will touch (FIG. 3B). If we persist in the pressure, the larger marbles will easily swing over the smaller ones (FIG. 3C), and increase their vertical position. As long as the marbles did not touch one another, it was not yet possible to talk about a system (settlement) – that is always made up of

[63] Kladno is a temporary result of a very exceptional situation caused by the mining industry. In the more or less distant future, it will become one of the city districts of the enlarged Prague. The second one could grow into its present form thanks to its location on the industrial axis Pilsen, Prague, Liberec. The largest of these cities – Prague – is fully in line with the assumptions in the middle of this axis.

[64] An exception to this rule is also in the Czech Republic unique proximity of two large cities in East Bohemia – Hradec Králové and Pardubice. It is a result of running the Northern State Railway in the mid-19th century. The main task of this railway was to connect Vienna via Prague with Dresden and even though the chief civil engineer and designer Ing. Jan Perner enforced the longest and the northernmost of the proposed 7 variants (but technically relatively the simplest), even this did not reach all the way to Hradec Králové (Volfík 2017). To achieve this, it is therefore necessary to change trains, which then industrialists in Pardubice subsequently recognized and cleverly used the new transport connections.

[65] Given the large mix of influences in the form of nation states and multinational groupings, this cannot clearly be still unambiguously considered functional and organic. All 3 mentioned megalopolises, however, fall politically and in value into a similar part of the world.

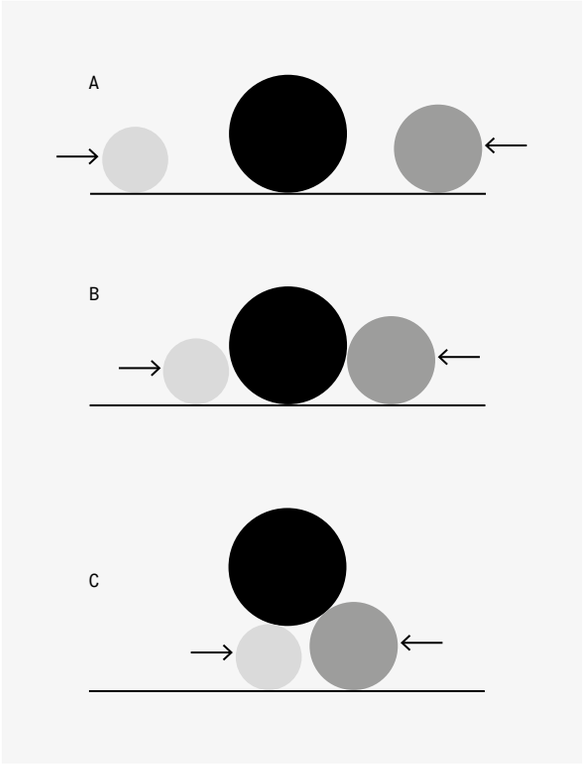



FIG. 3 – Model of reducing geographical space and settlement system, source: elaborated by the author

a set of mutually interacting elements. We can talk about the system already in the moments when the marbles are pushing one another – a competitive relationship has been established between the elements of the system. The swinging of the larger marble over the others is the moment of internal diversification of the set, the transformation of the relationship into cooperation and specialization. The underlying marbles become carriers and the marbles at the top of the pyramid are carried.

Like all models, also this one shows many inaccuracies and simplifications. It is better to describe some of them. First, while the marbles are very precisely delimited, it is not easy these days to delimit cities on the Earth's surface. Cities are no longer restricted by walls. Suburban development and urban sprawl disintegrate the city more or less smoothly from its center until the edges. Also, the administrative boundaries of cities vary too much from state to state or even region to region. For example, Paris is administratively defined as a city with 2 million inhabitants, although it is a densely populated area



with about 10 million inhabitants. Conurbations, metropolitan areas, overgrown agglomerations or mere pairs of towns also make it very difficult to have a comparable definition of cities. So far, we can imagine that marbles represent an urbanized area with a significantly higher population density than in the surrounding area, just as the EU and OECD today use an indicator reflecting population density.

And furthermore, the size of cities is changing over time. Therefore, our marbles should rightly change their size in the course of our thought experiment. Also the table top itself is a great simplification of reality because the geographical space is far from Euclidean. However, we will keep returning to our experiment many times and gradually remove inaccuracies.

If we, with some simplification, which we will deal with later, imagine a pyramid of marbles created by our lateral pressure, it is clear that large marbles due to their new higher hierarchical position have become more exposed, while small towns disappear in the pyramid base under the marbles lying above them. Thus, for example, formerly self-contained small towns near a large city became with its extension its city districts[66].

Each city competes with other cities at its level of hierarchy. Regional centers compete with one another in regional competitions, small municipalities then in local games. Therefore, in this respect, Prague is competing with its comparable competitors – Vienna, Munich, Warsaw, Kiev, Budapest and partly also with Bratislava, Dresden and the densely populated region of Silesia.

Those cities that have a certain advantage or larger size in the event of a direct competitive conflict with a neighboring center, or who are able to exert a greater amount of effort in a certain respect and at a crucial moment, will most likely come out victorious from the competitive struggle and they will succeed, for example, in transforming their airport into an international hub for long-haul flights, persuade some major international company to locate its all-continental headquarters there, move the high-speed rail line, get the organization of major cultural or research events, etc. In the past it could have been, for example, obtaining the right to brew beer, permission to establish a school, etc.

Those towns that will not stand the competition with others will have a relatively lower impact on their surroundings. Earlier, in antiquity, in the city-state period, this meant basically their end. Today, when cities are no longer fighting with one another for bare survival in the interconnected co-operative

[66] And, of course, this is true in an even more detailed scale, i.e. assembling areas and cadastres into city districts – this is how the moat separating the Old Town from the New Town (Palacký 1983) was filled and subsequently paved in 1781 and today both areas are part of Prague 1 City District.

settlement system, it means subordination and specialization. The largest and most important cities of any settlement system (national or even global) need not specialize in a particular aspect of their own activities, whether sectoral or functional. They are more straddled and in case of external shocks (economic and social) they have a greater ability to replace each of their tripped support legs by transferring the weight to the next leg. Regions structurally affected by severe unemployment as a result of reduced demand for a particular type of industry, ailing tourist regions without tourists, or the bankrupt city of Detroit in 2013 are, on the contrary, good examples of malignant specialization.

If, in the spirit of the past chapter, we attributed to urban organisms also the ability to respond to the above-described development, they would show some energy to remain in the process of the shrinking of the world on the map (of the world, state, region). In the following sections we will see that this corresponds to the natural effort of each system to maintain its integrity and existence. This is inherent in inanimate matter. Moreover, to organisms we attribute also a certain amount of "desire" to endure, as a result of fear of extinction, as well as a desire for uniqueness. And cities behave in the same way in the basic scheme. Against the decline in the hierarchy they use their meaning, which manifests as their attractive force. The need for people, capital, goods and other types of means, energy and information is counterbalanced by the attractive power that cities exert on their socio-economic environment. This can be imagined as a funnel where, from one side, the inhabitants and their activities are attracted, and on the other side, the size and importance of the city grows from it. However, this does not happen "by itself". The key essence of this action is the energy of the people[67] who inhabit and shape the city. We create the city and the city is here just for that. The city is a task for us. In the next chapter we will describe how we fulfill it and how this activity leaves its mark on us.

[67] and also their companies or institutions

We create the city, and then because our shared civic life, the city in return transforms us.

In cities, we have to adapt our ways due to congestion of inputs from our surroundings. We select our perceptions in the same way as we select people.

New technologies and social networks have brought us even closer in cities.

Increasing closeness transforms us socially, psychologically, physiologically and in the future... perhaps even on the biological level.

We do not perceive the gravitational force of cities. We describe it as a desire to live in the city.

Cities attract young, active and creative people the most.

## 3. City and us

The development and growth of cities in the settlement system, i.e. the growth of the proportion of the population living in cities, and thus the transformation of the way of life from rural to urban, is called urbanization[68]. This "citization" worldwide reached a breakthrough of 50%[69] in 2008 and by 2050 the global urbanization rate is expected to be 68%. In Europe, in some countries the values already exceed 80% or even 90% as, for example, in Belgium[70]. FIG. 4 shows the expected development of urbanization for individual continents.

Our moving into cities and shortening distances has a retroactive effect on us. Just as the shrinking geographic space translates into the structure of the settlement system and affects the size and importance of individual cities, so subsequently also the increasing population density (in terms of area or time availability) in our cities or urbanized areas translates into the cities themselves as into us, their inhabitants. We are changing, both on the collective and individual levels but also on our internal physiological as well as possibly biological levels in the future. But, one by one.

In addition to the all-embracing sociology[71], also the less broad scientific discipline called urban psychology deals with the theme of our behavior in cities. It has seen its greater development only in the last few decades, and the urbanization process in some European countries is already approaching 90%. On the other hand, the same "contemporary" permeation of psychology into other scientific disciplines does not happen only in urban sciences. For example, the Nobel Prize in Economics was awarded to American economist Richard Thaler in 2017 for his contribution to behavioral economics[72].

American psychologist Stanley Milgram is considered to be the founder of urban psychology, among other titles author of a legendary experiment[73] demonstrating how most people are willing to listen to authority and thus do evil, who incorporated this issue into the system theory, which will be discussed in more detail in the next section of this book. Renowned American urban planner Jane Jacobs also contributed to this a bit,

[68] UN definition (United Nations 1997)

[69] according to the World Bank methodology (The World Bank 2018b)

[70] United Nations 2018b

[71] From many, e.g. the comprehensive work *Sociology* by British sociologist Anthony Giddens (Giddens 2013) can be recommended. In the Czech conditions then Prof. Jiří Musil's publications, e.g. *Sociology of the Contemporary City* (Musil 1967) or *People and Housing Estates* (Musil 1985).

[72] Strnad (2017)

[73] Milgram (2009)

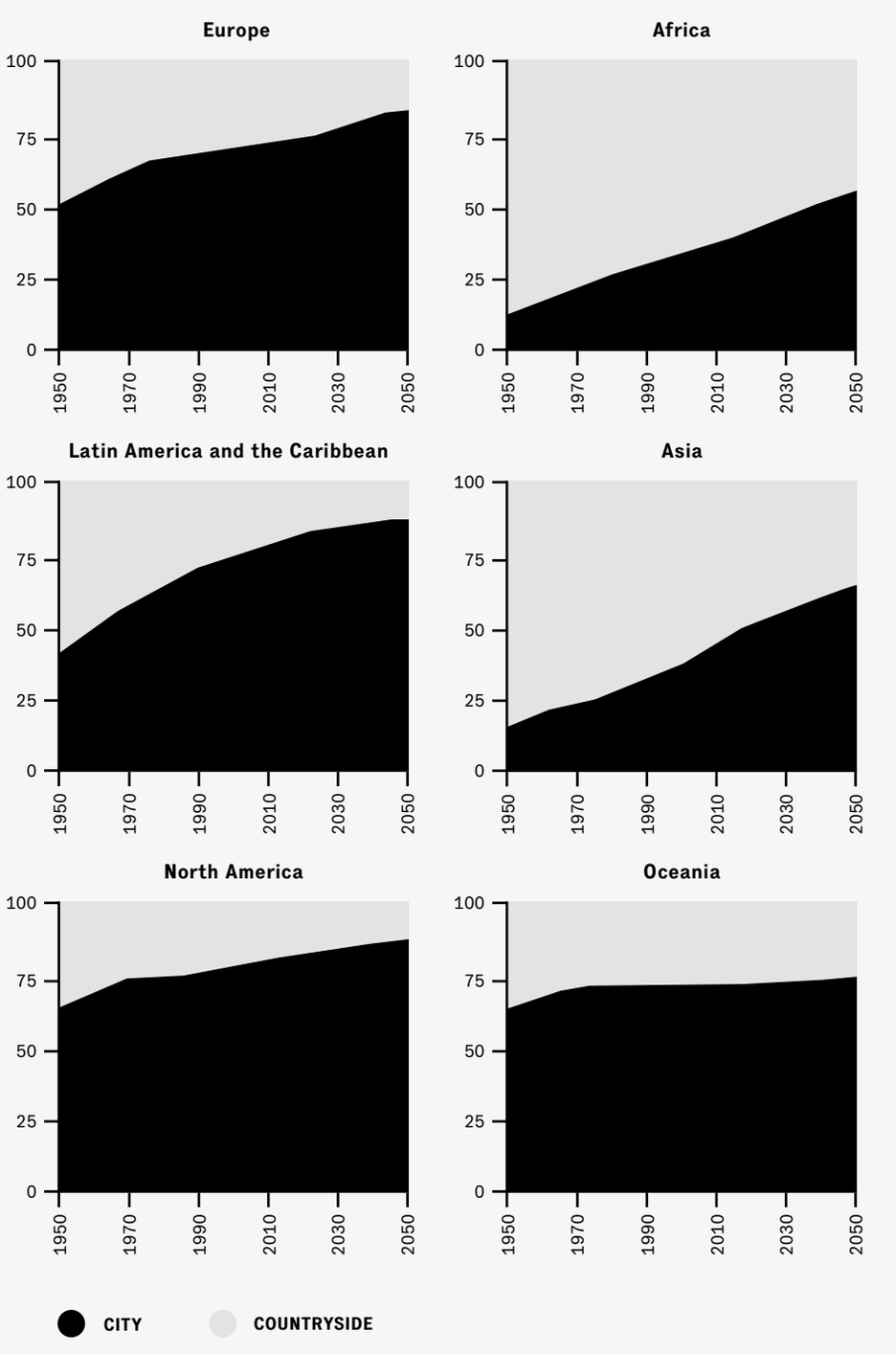



FIG. 4 – Current, historical and future expected rate of urbanization in % by continent, source: Kotzeva (2016), based on Eurostat data



especially with her key work *The Life and Death of American Cities*[74], based on the poor socio-psychological environment of the suburbs of American cities in the 1960s. But even much earlier – at the beginning of the last century – it is possible to follow concepts falling within urban psychology.

Urban psychology does not have an easy task. Cities and their environments are already very close to us, people, and to our free will. Thanks to it, we all are able to modify virtually every created model and regularity by a single decision (although very unlikely). Similarly, at such a low hierarchical level of our socio-economic reality, any scientific endeavor to recognize regularities as well as the numerous and large regional and cultural differences can easily be undermined[75]. For example, in developed countries we usually live longer in cities today, moreover, in relatively decent social security; however, it is not so in the same densely populated Asian or African cities[76]. Moreover, the situation is changing too fast in a rapidly changing society (and as cities and their inhabitants adapt), making it difficult to follow long-term trends.

Nevertheless, these days, a relatively comprehensive theory of differences in the behavior of the population of urban, densely populated areas is already available. Sufficiently proven, for example, is that in large cities we are under the pressure of extreme amounts of information, such as advertising, spoken word, and social contacts, to which we are not biologically geared.

Recently, everything has been accelerated thanks to our so far latest human migration – to our mobile phones (the whole world is in them today, which is why they have such an appealing power) – which perhaps somewhat surprisingly causes an even greater intensity of urban contacts because social networks are mostly used by people who have the opportunity to meet each other "live". Therefore, through the development of technologies, the close becomes even closer.

In a densely populated city we are overwhelmed with an avalanche of social stimuli. We solve multiple things at the same time. Our pace of life is faster. We even walk faster[77]. We stretch our days more and more into the night hours. One of the most important cities in the world – New York – is nicknamed "a city that never sleeps". There is a 24-hour metro service[78].

Biologically, however, we are all about the same. The human brain is capable of accommodating the behavior of a group of 150 members on average. The limitation is given by the fact that with each new member of the group, the number of new relationships increases with Fibonacci's sequence[79]. If

[74] Jacobs (1961)

[75] Richerson, Boyd (2012) discuss this issue in detail and from many perspectives.

[76] Central Intelligence Agency (2018), Chetty, Stepner, Abraham et al. (2016), Dutton (2018)

[77] Bornstein & Bornstein (1976)

[78] Metropolitan Transport Authority (2018)

[79] e.g. Dunlap (1997)

we are three, we must know our relationship to our two colleagues and also the one that is between them. If we are four, the number of relationships has increased by one of ours, but by two more among our colleagues, etc. That is why our primeval communities were about as large as that.

Thus, with our increasing number, population density and the number of everyday contacts, we cannot behave in the same way as in a small group, even with the best intentions. Therefore, we adapt to the extreme amount of everyday contacts. And that is done in such a way that we perceive people moving around us less intensely; we switch off our attention to low priority inputs.

One of the "fathers" of modern sociology, the German philosopher Georg Simmel, thus worked more than a hundred years ago with the concept of a limited amount of daily psychic energy[80]. In a densely populated environment, we protect this energy by changing our behavior. We create a certain social distance between ourselves (so-called polite indifference).

In this connection, the concept of the so-called congestion has been adopted from system science, which refers to the inability of a system to process input from the environment due to either an excessive amount of additional resources or the speed at which they follow – and both these reasons are only different sides of the same coin. Once such a limit is reached, we have to make a decision and either start to ignore, i.e. generalize inputs, or sacrifice some.

Our gradual transition from the so-called fellowship or communality[81], which is characterized by strong and close personal ties, to a so-called society with looser ties and rational organization was described already in 1887 by the German sociologist Ferdinand Tönnies[82]. In a densely populated urban environment or in an intensely interconnected urbanized area, we increasingly delegate responsibility to our surroundings and create specialized institutions replacing former traditional relationships. In other words, and with a bit of cynicism, it can be said that where the community previously served, a psychologist is helping today. Civilization diseases, excessive stress, depression or obesity are mostly associated with modern urban lifestyles these days.

However, it would be a mistake to understand the implications of population density and the shrinking of the world narrowly and simply as a process leading to the overall atomization of society. Inside city centers, the ratio of free and single individuals is truly greater. Partner relationships are under much greater pressure there. However, society-wide, this is

[80] e.g. in the publication Simmel, Levine (ed.) (1972)

[81] from the German original Gemeinschaft vs. Gesselschaft

[82] about his work e.g. Tönnies, Cahnman (1972)



not so unambiguous according to sociological research. We still have our few closest neighbors, a larger circle of friends, and a lot of acquaintances. However, these are no longer our closest neighbors in a large city or generally urbanized and interconnected territory but are much more dispersed in geographical space[83]. With the phenomenon of social networks, this loosening has recently probably increased even more.

[83] Pahl (1970)

Population density affects each of us differently, especially depending on what stage of our life cycle we are in. Therefore, not all of us are in the same situation in the city; or, we are, but each of us in a different moment in time. We are changing also generationally and each new generation is always a little better prepared from youth for the new, greater amount of surrounding information, new levels of stress and new technologies. From the earliest age, the youth has been trained to a plethora of new information, movements or changes in its surroundings a little better than the previous generation. It selects information and chooses from it in a different way. When we are young, we therefore do not even perceive this pressure at first and we adapt better. We are willing to devote more time to our benefit. We have more energy at our disposal. Subsequently, for a family life (if we still want it at all) then for a complex of many reasons – for example, spatial, ecological, social or economic, but sometimes also security and others – we choose a less concentrated environment. We seek out the hinterland of a big city and thus, by our eviction, we contribute to suburbanization.

The closer relationship of an active, hardworking, young and still single person to a densely populated city can be illustrated also by the gravitational modeling that we described in the third chapter. Newton's law of gravity states that the attraction force between two bodies is equal to a multiple of their masses and decreases with a square of their distance. Attracting forces are always mutual, even our little Earth deflects the Sun a little with its matter. Even each of us is a certain matter, and therefore those of us who possess greater social and psychic energy, want to do more and are more confident, are attracted more by a strong, attractive and growing city. And, unfortunately, also from the reverse view of cities deteriorating and declining – those who leave such cities first are the active and independent.

The greater part of our ability to withstand the pressure of a big city, in the economic sense, can be quantified quite well in time. In cities, we appreciate the quality of our stay characterized by more opportunities for earnings, fun and social contacts by the time we have to sacrifice. We have more time

in our youth because we use less time to relax during the day. However, a certain number of factors cannot be quantified as time well – e.g. belonging to a place, habit, good social contacts, quality and affordability of housing, safety and good infrastructure security, etc.

Although the basic variable that determines the style of human life remains its cycle or phase, with ever-increasing mutual proximity of people and technological changes even this is gradually transformed. In the city most of our relationships are shorter in duration. These days, before conceiving the first child, people in the urbanized world have more relationships, they live more frequently in informal unions[84]. After all, the whole popular series *Sex in the City* from the center of New York is not about anything else. Although it is not possible to speak unequivocally about a higher divorce rate depending on the urbanized area[85], it is true that in general with urbanization people start families later and women postpone the age of conception of the first child, often up to the already risky age for pregnancy[86].

These and other demographic changes have been accompanying the urbanization process basically since the Industrial Revolution. Inhabitants moving to cities in developed countries first underwent the first demographic revolution in the 19th century[87], at which the gross birth rate and mortality rate decreased, including in infants. At that time, we started to have fewer children, but they were more likely to live until old age. In the second half of the 20th century, according to some demographers, we began to gradually undergo even the so-called second demographic transition, characterized by a decrease in the gross birth rate below the level of simple reproduction[88]. This is already clearly associated with a change in values and an increase in individualism – spreading, of course, first of all in densely populated cities. However, the concept is still undergoing a deep debate[89], which is largely understandable because, on the one hand, different states react differently to demographic changes and thus somewhat "blur" the research results with their interventions but, on the other hand, also social discourse is getting even more acute – to make people "prefer" not to have any children[90]. In other words, while we mapped the first demographic revolution retrospectively, we follow and actively influence the second demographic transition and even younger transformations of our demographic behavior right in real time.

Thus, the urbanization process, i.e. the developmental trend towards "densifying" people, seems to affect our social behavior and our psyche. However, in densely populated

[84] Manning, Smock (2002)

[85] In the example of Denmark, this is shown by Gautier, Svarer and Teulings (2009).

[86] It is quite possible, though not pleasant, to imagine the future, and world science fiction literature has been working with similar dystopian visions for several decades, in which the centers of densely populated urbanized areas are full of (young) childless singles, while families with children live in the suburban area. It is not possible to say that the situation in the Czech Republic at present, especially in Prague, would deviate too much from this trend.

[87] in detail about this process including regional specifics e.g. Chesnais (1993) and others

[88] i.e. to the level of the so-called total fertility rate in the amount of 2.1 children per woman, more e.g. Kalibová (2002)

[89] in summary, including criticism of theory e.g. Lesthaeghe (2014)

[90] This is extremely problematic not only in terms of reproduction, but also mutual tolerance. On the tram every parent with a screaming child safely recognizes among other passengers those who have children. The protection of the planet and the procreation of children should never stand against each other.



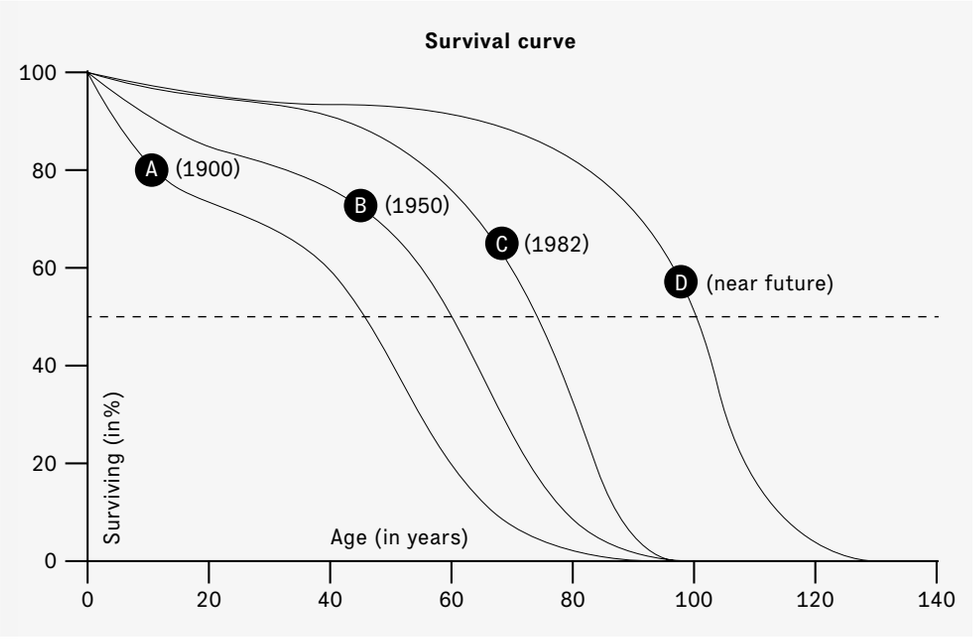



FIG. 5 – Transformation of the human survival curve, source: West (2017)

urban areas, also deeper layers of our humanity are affected. This is partly also because of our physiological changes that occur. G. West, apart from other things, has managed to demonstrate that the size of animals is related to their average life span, heart rate, their susceptibility to tumors, and many other biological characteristics. In other words, in their biological nature, bacteria, insects, birds, mammals as well as man respect the same basic rules of existence. However, today's "urban" man is already starting to deviate slightly from them, mainly due to extremely high-quality housing, improved health care and many other factors appearing almost exclusively in cities[91].

The urban socialization of man did not extend the maximum length of his life, because that remains too strongly anchored in our biological nature, but it significantly changed our survival curve. We are less and less often dying at a younger age and are more likely to live to a higher age (FIG. 5). We manage to "optimize" our lives. However, this deviation of the "urban" man from the "biological" man has been mostly happening only in the last few decades. We have apparently exceeded some critical mass of interconnecting people, cultural memes and innovations only through the global interconnection of cities and people in them.

[91] West (2017), p. 192

However, even deeper in our essence, at the biological level of our genes, the pressure of increasing population density and increasing numbers of contacts and information is not (yet) proven. The answer to why this is most likely so can be found in the work of the leading evolutionary biologist, Charles University professor, Jaroslav Flegr. He describes the necessary conditions for genetic separation of organisms. According to him, there must be a relatively small, long enough separated group of animals that adapts to the new environment through some profound and random transformation. That is, if it survives at all. Evolution in such moments temporarily "thaws", so that consequently, as the population of the given species increases, the reverse mechanisms would already prevent further changes in reproduction[92]. In other words, for a biological change fewer of us human beings are therefore needed, not "more" of us.

Our biological transformation is probably not taking place so far, with continued urbanization and population growth[93], but it may soon change, and it will undoubtedly be so in the more distant future. The human desire to continually improve health and quality of life in general will continue. However, it will face new diseases and allergies, but also, for example, the inevitable changes in the organization of our eating. The future inevitable need for artificially genetically engineered – and therefore extremely identical, and, for our natural biological resistance, less-favored – foods will necessitate first small but increasingly larger modifications to our genes. We must take extreme care that we do not cause disaster by some ill-considered action.

The above, at least roughly described gradual depressing of the individual hierarchical levels constituting our close (especially socio-economic) reality seems to be quite a logical process. Everything new that we create "above" ourselves then influences us and forces us to adapt. And this happens both between people and cities, and between cities and the settlement system. We become human only through integration into society, cities become cities only by their integration into the settlement system. Of course, it would be possible to deal with these different (much more complex) interrelationships of part and whole in more detail, but for us what is particularly important is the fact that for each of us this process is not perceivable in everyday life. And for two reasons. First, we look at our surroundings through the prism of our needs. Rather, we say that we want to move into a big city, not that we are attracted to it. As a result of the development that goes beyond us, we can see negatives rather than positives. We are bothered by

92 Flegr (2016), p. 196

93 Although it is a bit of a question whether, for example, today's "hereditary infertility", i.e. a growing number of previously impossible pregnancies due to advances in medical science, is not the gateway to transformations at the level of our genes. Especially with the growth in the number of children with autism, social inadaptability and other previously less observed syndromes, it seems as if this development directly fits into the ongoing process of transformation of society and man. However, only time will show whether this is just a more improved diagnostics or a development trend.



the many consequences of the existence of the national settlement system and the population density of our cities and the restrictions and rules resulting from all of that, but we no longer perceive the benefits that their existence brings to us, etc. And secondly, each of us changes only minimally. We tend to avoid pressures and, for example, move according to our current needs. The transformation takes place on a collective basis and in the long term and that is why it is hard for us to see.

All these processes and their consequences, however, need to be well known when it is necessary to decide on a higher social unit, such as the city. And all the more, the more we live in cities. We have turned into an urban man and it is all right. With the growth of cities, we turned not only to the growth of (economic, cultural, etc.) product per person, as we have said before, but also to the saving of goods – space, nature, infrastructure[94] – needed for each of us. In other words, an inhabitant of a large city takes less of nature and brings more to society than an inhabitant of a small town. Therefore, from this perspective, our life together is the only way to further develop humanity on our planet. Of course, only if many present and future problems are solved – in particular, better energy distribution, more consistent waste treatment, chemical decomposition of plastics as well as better understanding of our bodies and biological processes to the level of our genes. However, in order for us to continue succeeding in our societal task and not to take some step that will mislead us, we need to thoroughly know the depth and cause of all the processes taking place in our reality, thus also in the settlement system, in cities and in ourselves. We must be absolutely convinced of the correctness of our steps. It is not enough to believe that it is said or written somewhere. It is necessary for each of us to go into the depth of our own behavior, the behavior of nature and the behavior of society derived from it. In the next two chapters, we will therefore focus on the essence of the functioning of our surrounding reality and will use many of the findings that we have just mentioned to illustrate our description.

94 With every doubling of the city's population, within economies of scale, there is growth only by 0.85 times the necessary tangible goods (infrastructure, buildings, etc.). (West 2017, p. 29)

# Part II
# Development of Systems

All systems, and therefore also cities without the supply of any form of information, aim for maximum entropy.

The city possesses only human energy. If we stop wanting to have them, cities will disappear.

The inner urban structure of the city is becoming more and more vague, relaxed, and more indistinct from its center.

In the universe, entropy grows with its expansion. On Earth, this thinning is visible as the passage of time.

The thinning process is a linear equilibrium development from order to chaos.

## 4. Linear development and thinning

In the first part we outlined the development of cities as organisms occurring in our shrinking reality. Cities develop and complete within a settlement system that affects them through certain system processes. In the same way, one level down, man develops and comes to completion within cities that affect him by similar systemic mechanisms. Even our cells develop and complete during the growth of our body, when they are affected by similar systemic mechanisms.

And, on the other hand, it is true that our cells together form our bodies, we associate and form cities, and those together form the settlement system(s). The lower units are responsible for the higher units they create and form them actively. Therefore, there is a logical question: What if this activity of the elements and parts of a larger whole ceased to exist? What if we decided not to create cities anymore and live in them?

The scientific knowledge of the nature of system processes, the development phases of systems and their key drivers in our reality can help us answer these questions.

In the 1970s, the Nobel Prize laureate for chemistry Ilya Prigogine discovered the developmental phases of the systems and described their behavior. The fact that the discoveries were made in the field of chemistry is not so surprising. Chemical systems are simpler than biological or social ones, and experiments can be repeated under more or less the same conditions and then analyzed quite well. In contrast to physical systems, these do not have a problem with the course of time, because the observed particles – molecules – already safely exist in our system of commonly measured time and also their dimensions already allow us to observe them relatively well. However, these days, I. Prigogine's pieces of knowledge are already used also as a basis for behavior of other systems, not only chemical ones.

According to I. Prigogine, systems can be in three different development phases – linear equilibrium (LE), linear non-equilibrium (LN) and non-linear non-equilibrium (NN)[95]. Although the size and significance differentiation of cities within the

[95] Prigogine and Stengers (2001), p. 128–140

settlement system, which we described in the previous section, is the second of the aforementioned phases – linear non-equilibrium, it is more suitable to start with a description of the individual phases in order from the procedurally simplest one – linear equilibrium.

The Latin word "linearis" means "straight, linear, composed of straight lines"[96]. The linear dependence of two variables indicates that each of their increases or decreases is even. Each change of one variable causes a proportional change of another variable. The graph of such dependence is a straight line. The linear development is therefore stable, even and easily predictable.

The linear equilibrium phase takes place in any system isolated from the environment that does not draw any form of energy from there. During the linear equilibrium phase of development, each system tends to occupy the most probable states, and in accordance with the 2nd law of thermodynamics[97], entropy, i.e. the degree of uncertainty, increases in it evenly towards its maximum. A system in such a state is said to be in equilibrium. There are countless examples: the water level of the lake gradually calms down in windless conditions, the temperature in the room is equalized, the supply equals the demand.

However, there is one thing to be aware of – the balance of the system and the equalization of the internal environment need not be the same. This can be illustrated by the example of ordinary diffusion, whether in liquid or, for example, the spread of urban life into the surrounding geographical space. Putting a tea bag in the water or increasing the importance of the city center is a relatively short act of concentration, followed by a long period when dilution predominates. However, under normal conditions, this will never occur spontaneously until the values are fully equalized. Tea stains hot water only around the bag. Living in the city center, where, for example, the higher price of housing will always be a little different from their parallels in the suburban area. Both of them have already increased entropy to its maximum, but to fully equalize the values we would have to take a spoon and stir the tea, or in some totalitarian way begin to move the population[98]. It is important to realize that equilibrium and maximum entropy do not necessarily mean the same as formlessness.

Ambiguity and entropy tend to increase always and wherever there are no sources of order. Anything left to its destiny gradually disintegrates[99] toward chaotic disorder: rocks erode, houses and roads disintegrate, stars burn their fuel, the universe expands and gradually cools[100]. Likewise, the exact

[96] according to *Oxford Latin Desk Dictionary*, Morwood (2005)

[97] from many e.g. Covey, Highfield (2003), Atkins (2007)

[98] And if we wanted to talk about balancing ethnic diversity on the planet, it would be necessary to consider some global totalitarianism or war in this respect.

[99] The decay may not be visible immediately. For if the system persists in time and there is no active progression of growth in it, which will be discussed in a while, a certain "internal debt" accumulates inside the system, just like a communication or house dilapidate, even though they are still standing. Due to the complicated linkages between systems, thinning is not happening continuously, but in an abrupt way, which is, among other things, also the nature of the originally biological, nowadays also applied to the sphere of the development of society, the Theory of intermittent equilibrium (more e.g. Bárta, Kovář, Foltýn 2011).

[100] in illustrative form e.g. Hawking (2002)



timetable of buses, which is observed when they are leaving their starting station, becomes more and more only virtual as the stop number increases.

A certain characteristic feature of the systems at this stage of development is the decline in their internal activity, reducing movement and changes in their subsystems. In systems and organisms on Earth in a cyclically changing environment, mainly due to the alternating intensity of solar electromagnetic radiation, i.e. especially in the biosphere and anthroposphere, this phase of development is usually observable in each of these periods. During the day, the overall activity of earthly life generally increases and decreases with dimming and cooling, although it is easy to find countless places or periods when this is not the case. This phase of development is visible also in the city every evening, when the population is more evenly distributed across the city area after a busy working day spent in a crowded center, traffic in the city calms down after the rush hour, and congestion gradually ceases.

In cities, however, it is possible to observe also a long-term linear equilibrium development, cut-off from normal earth cycles. Looking at its internal spatial structure, the gradual increase in entropy happens in the form of mixing individual types of development in the direction from the city center to its outskirts. An organically grown and classic dense urban housing development, originating from the period of its initial historical development, disintegrates away from the city center and becomes less and less concrete, albeit with many irregularities due to regional specifics and discontinuities of development. FIG. 6 shows this on the example of ground plans of localities in Prague.

Looking at whole cities, the increase in entropy is also observable, always after their golden era of development[101]. Such a long-term decline is documented and illustrative enough even in the first city on Earth with a million inhabitants, in the Italian Rome. At the turn of AD, Imperial Rome had more than a million inhabitants on an area of 1,386 hectares[102]. However, in the following 1,000 years, Rome gradually diminished to a few tens of thousands of inhabitants and was literally dismantled. Its monumental buildings, including the Colosseum, served throughout this period as a source of material for other construction activity.

In today's urban-economic-geographical terminology, cities are referred to as shrinking cities[103] at this stage of development. In an increasingly interconnected contemporary world, their shrinkage is usually due to their former narrowly focused orientation to the old industries. In Europe, in the past, this has

[101] Golden epochs of selected cities are described by e.g. Hall (1998).

[102] Hrůza (2014), p. 143

[103] e.g. Rumpel, Slach, Koutský (2013)

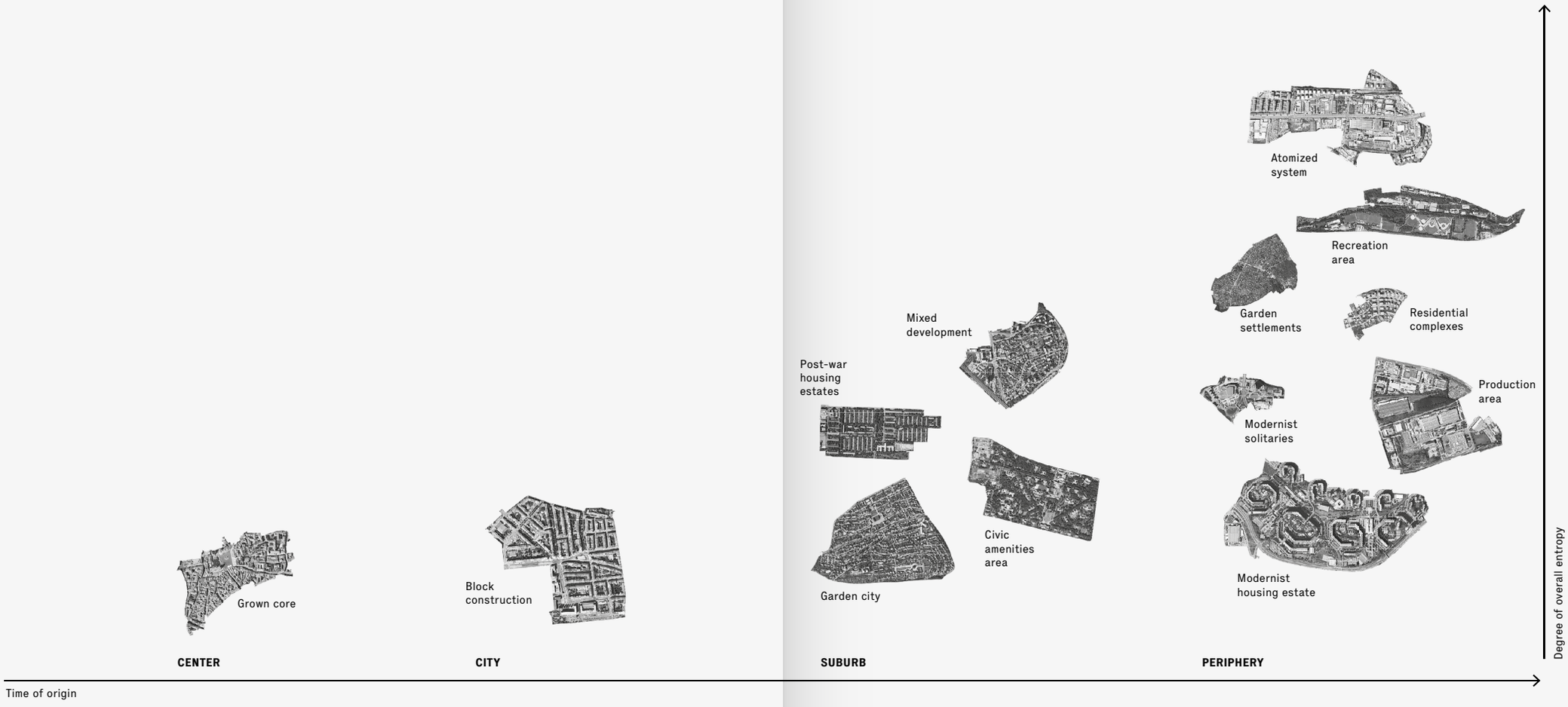



FIG. 6 – Gradual growth of entropy in buildings on the example of localities in Prague, source: Koucký et al. (2014)

not escaped cities and areas such as Manchester in the UK, the Ruhr area in Germany or Silesia on the Czech-Polish border. Thus, also in the Czech towns, Ostrava and its surroundings, which have been experiencing a decline in population and economic activities since the 1980s (some a little later). These include also overseas cities, such as the long-declining American Detroit, with its former major industry focus as a city of engineering and automotive industry.

And finally, it is possible to talk about the phase of attenuation also at the level of entire settlement systems, in which population growth has ceased, which virtually almost all European, as well as other, developed world nations have reached. In most of them, however, this is currently complemented by increasing migration and, if not quantitative, at least qualitative growth in economic activities. This process is not much observable in the largest cities in these settlement systems. Even though the population is no longer increasing in the whole settlement system, important cities (or their agglomerations), due to their great attractiveness, are still growing more than small towns. This often leads to the vacuuming of rural areas, where there is subsequently a risk that the population will gradually decrease to a level where, for example, the funding of a school or other basic necessary civic amenity do not pay off[104]. The disintegration of the community in these villages is then a genuine, even though in those places not very welcome, example of a long-term increase in entropy.

If population growth in the settlement system ever stops and, hand in hand with it, our day-to-day striving for urban management and mutual closeness fades away, everything created by man will disappear with time and all will be absorbed by nature. All epochs of the decline of cities or larger territorial social units have always been associated with a certain disillusionment from development, a decline in interest in public affairs, and that is why there is no reason to believe that it will be different in the future. Economic goods as well as technological level are always connected with people, their activities and to a large extent also with their quantity and their internal settings. People must constantly strive to create and take responsibility for themselves as well as for the higher units[105]. We do not have and we have never had any other choice.

If we go even further to the necessary generalization, then at the level of our largest observed system – the visible universe – the linear equilibrium phase is characterized and observable as its expansion. The universe, according to the theory of relativity, a four-dimensional space-time continuum,

[104] in the conditions of the Czech Republic e.g. Ouředníček, Špačková, Feřtrová (2011)

[105] Responsibility and the need for its extent in state bodies is discussed by e.g. Snyder (2017).



is cooling and thinning. Deconcentration of matter and energy, thinning, take place in it. In places affected by sufficiently strong gravity and other basic physical forces, thinning does not occur, so we do not observe anything like that in our bodies or houses. However, the equivalent of thinning is still "happening" over time in these places. The passage of time means that the area of what has already taken place is increasing. In time, everything falls apart, disintegrates and tends to uncertainty. Even our own efforts and the power of opinions are diminishing over time.

Therefore, the very course of time at the most general level corresponds to the increase in entropy, and thus the increase in entropy = the course of time = thinning = the linear equilibrium phase of system development.

During the linear equilibrium phase in the system, all processes and mutual ties cease, which leads to maximum entropy. Thinning outweighs the supply of energy or information. Growing uncertainty is faster. The system indulges in relaxation and dissolves its structure in the form of developmental asymmetry into an indeterminate shape and forgets the previous states. This type of development can therefore be described by the simple schema shown in FIG. 7.The term chaos used in the schema comes from the Greek *khaos* and is the naming of the original emptiness[106]. The English term *order* comes from the Latin ōrdior and denotes the beginning[107].

Total chaos and total order in our surrounding reality are not very common. And if they really occur, then, the concepts of chaos and order get interconnected. Because they are complementary concepts in these exceptional situations and their

[106] Harper (2018a)

[107] Morwood (2005)

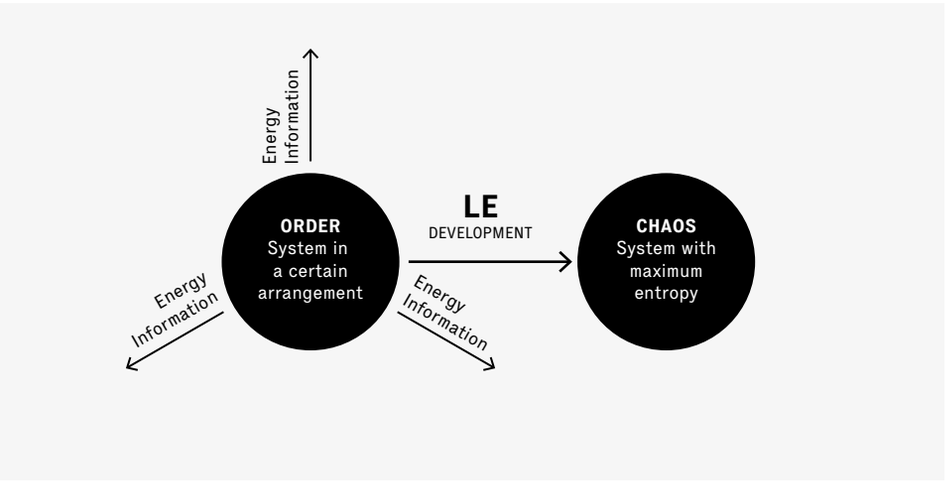



FIG. 7 – Scheme of linear equilibrium phase of systems development, source: elaborated by the author

relationship lies in the scale of observation. For example, when looking at water through a microscope, we observe extreme chaos in the form of a huge number of randomly moving water molecules, but when we withdraw, this chaos disappears and we can see the order of the calm water level. The same is true when looking at the lawn below us. From a distance we can see the order, but from a close up view it is clear that each blade of grass is different and there are different small beetles sitting on each of them. Similarly, when we look at the city from an airplane, we can see, for example, tall and short houses. As we get closer, we can see that each of them is differently tall, differently voluminous, differently colored, etc. If we go even closer, we would see that they are all built of similar bricks, etc. As the scale changes, the order turns into chaos and vice versa.

Thus, although we work with these two terms in our schemas – in this one and also the following ones – for the sake of better illustration, we treat them as certain "finite" or "specific" states of system development, but in fact they are rather directions of development; it is as if we were moving around the circle in one direction or another.

The linear equilibrium phase which we have described in this chapter shows what happens to a system when no sources of order act on it. However, it is also interesting that it does not describe one single way how order can turn into chaos. Both other two phases of the development of systems can also be a way, albeit somewhat different. We will describe it in the following chapters.

The opposite of the thinning process means concentration, when the amount of information grows.

Concentration has both content and form. It is both quantity and unevenness.

During concentration, systems are hierarchized and their elements specialize and cooperate, just like cities in a settlement system.

Hierarchy means differentiation into few “bigs” and many “smalls”: New York, London, Tokyo vs. hundreds of thousands of small villages.

The mathematical essence of every hierarchy is a fractal.

The process of concentration is a linear nonequilibrium development from chaos to order.

## 5. Non-equilibrium development and concentration

The thinning that occurs during the linear equilibrium phase of system development is ubiquitous and always present. It happens “in the background” of all phenomena in our reality. It’s global. In contrast to this, however, in our reality it is possible to observe locally and temporarily a decrease in entropy, i.e. its opposite, concentration.

Concentration primarily means an amount which, however, creates (time) spatial inequality at different scales of observation. These two sides of the same coin can be easily understood in the example of human existence on Earth. The number of people on planet Earth is growing. Here concentration means amount. Quantity. However, looking at Earth from a distance, we can see that outside the Earth, in outer space, their numbers are not increasing. Here, concentration means uneven distribution in space. Similarly, people on the Earth itself are unevenly distributed, especially at lower altitudes and near the coasts, where both the daytime and year-round climate are more balanced. Unevenness is therefore a direct measure of concentration[108].

Concentration can be monitored also over time; here we talk about intensity or frequency. This partly includes also the ability of man to make human efforts. Above we mentioned that it is needed to create our cities. It also means concentration. In our thinking we even use this term directly – we concentrate on some activity or idea. There are indeed many aspects of concentration.

The second law of thermodynamics implies that any local and temporary entropy reduction due to concentration is always redeemed by an increase in entropy in the wider surroundings of the system. In other words, nothing is free. Thus, for example, the Sun supplies the Earth with electromagnetic radiation, while consuming its cosmic fuel. The cheetah can make an extreme effort and start running quickly in a snap to catch an antelope or gazelle, but before and after it must eat and rest. Also, a simple repair of some building by human labor means for engineers and workers to eat first, create

[108] The degree of concentration, i.e. the unevenness, can be measured using various indices – e.g. the H concentration index used by geographer M. Hampl (e.g. Hampl 1998, 2005 and others), the value of which indicates the proportion of the territory in which the less concentrated half of the phenomenon is distributed.

a project, get material and previously made machines. In the case of using the work of machines, this in turn means converting some previously created energy source into energy of a simpler structure, usually heat. Thus, the very existence of human civilization is not free, and is therefore based on the decline and growth of entropy in systems around us. We consume in order to exist on our planet, and this principle cannot be reversed.

The significant difference between concentration and thinning is, among other things, that while thinning is a dimensionless and universal process in which there are, apart from the running time or expanding space-time, no units, concentration always has a certain content. It can be a concentration of matter, energy, atoms, cells, people, houses, cars, standards, data and much more. We can see people moving together to one place, shortening distances and an increase in connection intensity. There are many kinds of "energy" and forms of concentration.

Therefore, cybernetics and later computer science began to work with the appropriate metaconcept – "information". And it will come in handy also for us because it allows us to put under the same roof natural, social, economic or even abstract legislative systems. Information is a fundamental unit of order and stands in opposition to entropy. In the Information Theory formula, these two basic entities have a reverse sign[109]. Every energy transfer, every energy quantum is, according to information theory, coded information in some way. And, conversely, any information – be it binary digital code consisting of zeros and ones, human language, genetic DNA, chemical transfer in the chemical system or physical energy, wind, nuclear, thermal, and other energies – is actually the energy itself[110]. From this perspective, even social means of exchange, i.e. money and capital in general, are information.

In cities, the basic "information" that is directed to them, shapes them and transforms them is people. We are the basic elements of a system known as urban organism. Derived kinds of information are our knowledge[111], but also money, capital, cars, houses, but also patents and many other tangible as well as intangible goods. In addition to the growing population, the concentration process in the settlement system is also being filled with a reduction in geographical space. That is, by shrinking the map of the world as a result of the development of increasingly modern means of transport and the resulting increase in the intensity of interconnection of places or cities.

The remaining two developmental phases described by I. Prigogine describe the developmental process in which

[109] e.g. Covey, Highfield (2011) or Barrow (2008)

[110] Wiener (1963), in more detail about the information e.g. Gleick (2013)

[111] Leading Czech expert in the issue of smart cities, professor and former Dean of the Faculty of Transportation Sciences of the Czech Technical University in Prague Prof. Miroslav Svítek thus distinguishes information from data and from knowledge. Data composed of information can already generate a report and their higher level is knowledge (Svítek 2013).



concentration predominates over thinning forces. Both are non-equilibrium phases, namely linear non-equilibrium and non-linear non-equilibrium. In this chapter we will focus on the "still" linear one.

The linear non-equilibrium phase of development is usually long. It is a period of existence of systems or life of organisms. It is a period when systems evolve and, above all, grow. In cosmic phenomena, this is the period when matter, dust, and gaseous particles are clustering in interstellar space (and the thermonuclear reaction has not yet been ignited). In natural phenomena, it is the period when, for example, colonies of animals or plants grow due to sufficient resources. In social phenomena, it is the period when, for example, companies gain a larger market share with a new product. In the case of a city it is the period when people move into it and their activities multiply. And at the level of the settlement system in this period cities grow or get closer to each other as a result of shortening distances. This also shows that the intensity of the concentration process in the history of the human race accelerates, inter alia, also with the proliferation of new forms of concentration.

During the linear non-equilibrium phase, the systems move away from equilibrium due to the prevailing concentration of information, but still in a substantially even manner. No information added to the system can be lost, just as energy cannot be lost in accordance with the law of conservation of energy. The evolving system therefore tries to keep it in itself in some form. It can no longer move towards maximum entropy, and therefore at least adopts a state of its minimal decrease. In practice, this manifests itself in the diversification of the internal environment of the system and thus through the hierarchization of its elements.

Diversification can be observed in all systems, whether natural or social. Air driven in the tube or water in the trough flow the fastest in the center and slowest at the edges. The heated water in the pot is thermally stratified up to the cold surface. The growing pack of animals is hierarchized in power and meaning. Words vary according to the frequency of use in the living language. Companies differentiate according to their turnover or size. Likewise, state legislation and the public administration system are growing and hierarchizing. A very illustrative and typical example of the hierarchical differentiation of system elements is the development of the settlement system described in the previous section, during which cities are divided into large and small, respectively significant and less significant ones.

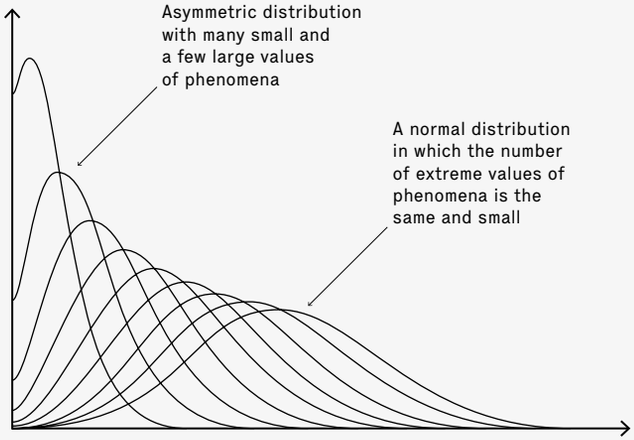



FIG. 8 – Comparison of normal and asymmetric frequency distribution in a set of elements, source: elaborated by the author

All these variations, whether we observe physical, chemical, biological, but also economic or social systems in general, are characterized by a small number of large and significant and many small and less significant ones. Or, if we want to use the language of advanced complex layered systems, a lot of controlled and a small number of controlling. A representation of such a distribution is a pyramid with one peak and a large base[112].

Different systems have different sized bases. Therefore, the key characteristic of any system is the steepness of its hierarchical structure, i.e. how many elements of the lower level equal to one element of the higher level. This can be described by so-called size order rules, which are not a new discovery at all. For example, the well-known Zipf rule, described already at the beginning of the 20th century by German physicist Felix Auerbach[113] in the context of cities and settlement systems says that the order of the first element in the hierarchy is inversely proportional to its size or frequency. When applied to a settlement system[114], this would mean that the largest city in a given settlement system should be twice the size of the second in the order etc.

The hierarchically diverse set of elements in the system, represented in the graph, forms a curve of the so-called asymmetric frequency distribution with a pronounced right-hand skew. Thus, the power function, in the case of its limit variant, is the curve of inverse proportion (FIG. 8).

[112] These regularities in irregularities are the basis of many theories describing the socio-economic space – from probably the best-known Central Place Theory by German geographer Walter Christaller (Christaller 1933) to localization theories (e.g. by Weber, Weber 2012).

[113] Auerbach (2013)

[114] However, it works also for e.g. the frequency of use of words in a language, Q-year flows in rivers and many others.



Among others, a significant Czech demographer and social geographer Professor Jaromír Korčák[115] dealt with the essence of the emergence of these uneven arrangements even before World War II. In his opinion, in nature it is possible to observe essentially two basic types of statistical distribution of phenomenon frequencies. One of them is a well-known, normal or Gaussian distribution of frequencies with the highest number of phenomena at average values and the second is just the above-mentioned asymmetric distribution with a pronounced right side skew characterized by small numbers for large and significant elements of the set and high frequencies in small elements. Normal Gaussian frequency distribution arises as a result of repetition of the same, the so-called intra-species pattern of conditions (e.g. population height, IQ), asymmetric differentiation arises as a result of a combination of internal and external development factors[116]. The more the formation and growth of the elements of the set are interdependent, the more the concave shape of the Gaussian curve deviates from the central value towards the left part of the graph up to the curve of the power function, in extreme cases the inverse proportion. From the point of view of their mathematical nature, both of these "extreme" and all of their transitional variants of distribution are transforming each other.

Since all phenomena in our immediate vicinity have arisen as a result of the prevailing concentration process over thinning, asymmetry in the distribution of elements in sets of phenomena are all around us. For example, our universe is in 68% made up of a so far very mysterious "dark energy" responsible for its expansion, a minor part of it – 27% – is formed by gravitational and space-curving "dark matter", while visible matter makes up less than 5% of all matter and the energy of the universe, and is concentrated into galaxies[117]. Or, in our solar system, the vast majority of matter and energy in the Sun is at its center, and then there are 4 large planets, two dozen bodies over 1 km in diameter, thousands of hundred-meter bodies, millions of small bodies, and billions of dust particles. There are many small hills on the dry land of planet Earth, a few large mountains, and only a couple of the highest peaks. There are also a lot of small islands and few big ones. Even large animals are few, small animals a lot, there are many more bacteria, which also corresponds to the food chain. Also, in every city or, even generally, in cities there are few tall buildings and, by contrast, a large number of small buildings. There are few large states and cities and many small ones. Even the economic Pareto rule 80/20[118] is of the same nature, and also many others.

[115] However, thanks to Korčák's scientific reputation, another significant name dealing with a similar topic is not very much mentioned in the Czech Republic, namely Lewis Fry Richardson, a British mathematician and meteorologist, whose research was focused on weather and war conflicts, more e.g. in Richardson (2007, 2012).

[116] Korčák 1941

[117] e.g. NASA Science (2018)

[118] e.g. Koch (1999)

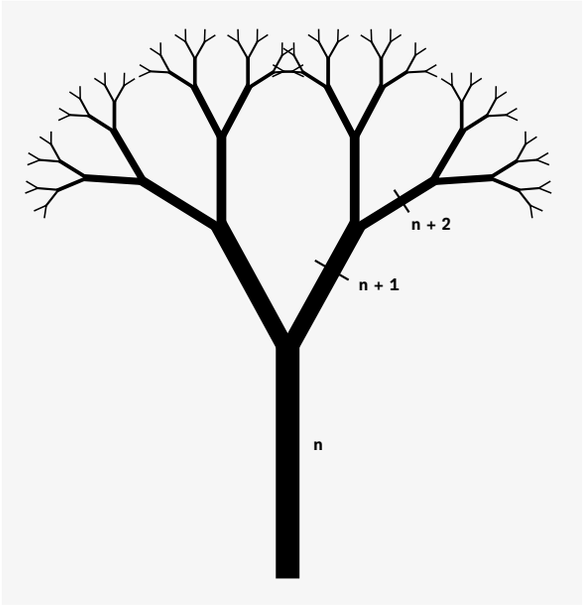



FIG. 9 – Simple fractal – idealized tree with iteration marking, source: Lopez, Langre, Michelin (2011), adapted

Asymmetry "a few maxima – many minima" is most visible in space, but it can also be observed in time (or in space-time). Large earthquakes, fires, floods, but also terrorist attacks[119] rarely happen, while the frequency of the small ones is much higher. And what is also essential is to increase this asymmetry over time. Thus, for example, agriculture covers large areas of the Earth's surface, the later established industry is already concentrated in cities, progressive tertiary (consultancy) and banking only in large cities, quaternary and quinary – control centers, research centers – only in the most important centers of the settlement system.

Since in the reality around us the external conditionality and interdependence of phenomena are present virtually always and everywhere, the distribution of the set represented by a mathematically pure Gaussian curve can never really occur[120]. So that the Gaussian curve does not feel so far-removed, it is good to remember that there is virtually no counterpart to it in our reality – pure inverse proportion. On the left side of the graph forms always at least a hint of concave shape, because each phenomenon must have a certain minimum space to be created. All houses and buildings sorted by height will begin with the highest frequency in two-story houses, because smaller houses make no sense. The same holds true, for example, for rivers, because to a certain length and width

[119] e.g. Clauset, Young, Gleditsch (2007)

[120] Even IQ in humans is not distributed quite symmetrically. On the left side of the curve, mental disorders due to biological causes slightly prevail.



we call them streams, etc. Both extreme distributions behave more like certain attractors of system development, but nature avoids them.

The mathematical basis for these "regularities in irregularities" was created by the French-American mathematician of Polish origin, Benoit Mandelbrot, in the second half of the 20th century[121]. He unified until then rather occasional and fragmentary findings on asymmetries in various scientific disciplines with knowledge in the field of the non-integer dimensions of the important German mathematician F. Hausdorff[122] and thus proved that even such different phenomena as the distribution of islands, the shape of their boundaries, Brown's motion of the dust particles on the surface of the water, the distribution of matter in the universe, the shape of the lungs and many others have the same mathematical basis. He named it a fractal.

Fractals are extraordinary mathematical objects on the border between order and chaos. They are models of the world, because even the world itself is theoretically definable by a fractal, but a very complex one. However, in this chapter we will suffice with a description of simple fractals, which are very illustrative (FIG. 9). Their basic feature is that they always have the same shape, viewed from any distance. Each

[121] To learn more about his life, see Mandelbrot (2014), about the origin and principle of fractals e.g. Mandelbrot (2003). For Czech readers, it is also important to mention that B. Mandelbrot – according to Geofrey West – was much more based on L.F. Richardson than on the extensive, but unfortunately published during World War II, work by J. Korčák. As my colleague from the Faculty of Science of Charles University, geographer Josef Novotný (Novotný 2010) found out based on direct email correspondence, Mandelbrot apparently did not read Korčák's work on natural duality.

[122] Hausdorff, Plotkin (2005)

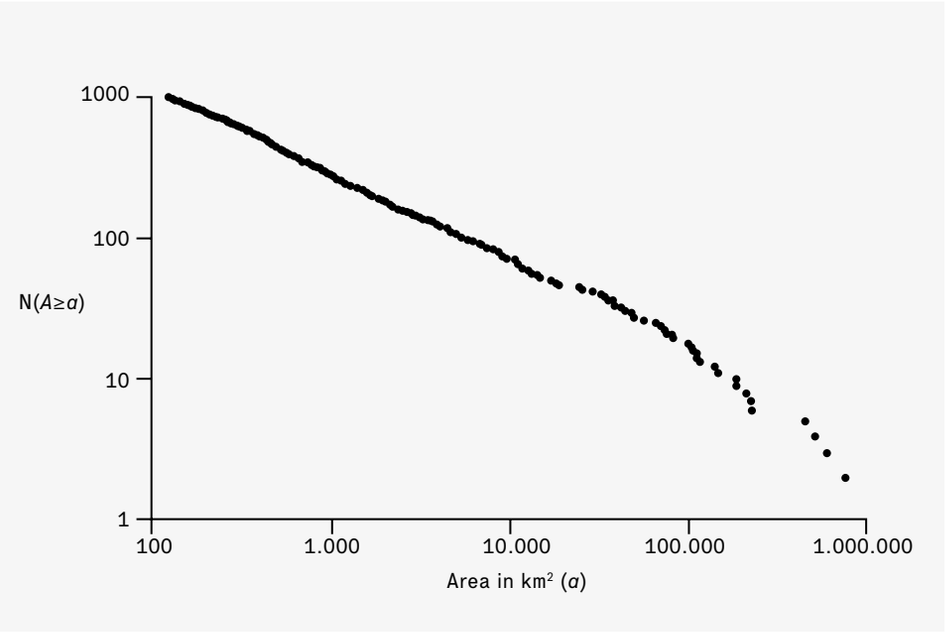



FIG. 10 – LLog-log graph of the size differentiation of the world's islands (islands larger than 100 km²); note: this is a set of 1,073 islands, where the y-axis shows the number of islands (N) with an area that is greater than or equal to a certain area, source: Novotný (2010)

detail of the whole reproduces the part and each part reproduces the whole. From whatever distance you look, you still have a feeling that you are following the same shape curves. An example of such a simple fractal can be a tree. Its each twig is similar to a large branch. Part of the urban infrastructure network or the human bloodstream looks like the entire network. Or also: if we keep magnifying (the map of) the coast of some island, the shore curve becomes more and more zigzagging, thus lengthening indefinitely. This phenomenon was called self-similarity, homothetics, and in a general sense it does not have to mean merely shape nesting but can also relate to function, dynamics and basically anything.

Fractal objects are formations with a non-integer, so-called fractal dimension (from the Latin "fractus" meaning "worn-out" or "broken"). While a straight line, plane, or body are representative of exactly one-, two-, or three-dimensional objects, fractals lie somewhere in between. The fractal dimension can be fractional – for example ½ – or it can also consist of an irrational number. Mandelbrot cleverly created the fractal dimension in such a way as to give an integer result for already used geometric objects, such as a line, plane, or cube, while not conflicting with geometric axioms. With such an adjustment, the dust on the line has a dimension between 0–1, the island's shoreline between 1–2 and the surface of our lungs between 2–3.

A higher fractal dimension within the above-mentioned intervals is a sign of greater complexity of the system. For example, the lungs are very complex in shape. They have been designed so that they could release as much air as possible in the shortest possible time, for which they need as large a surface as possible with the small volume required[123].

The fractal dimension of the settlement system describing its complexity denotes the penetrability of its hierarchical arrangement. The fractal dimension is an advanced size order rule in this regard. For its calculation it is suitable to use graph with both axes logarithmized – the so-called log-log graph. We already know that the asymmetric distribution of frequencies in the graph is represented by the power function curve, so if we plot it in a graph with logarithmic axes and appropriately select relativized indicators in individual axes (FIG. 10), in an idealized case, the result will be a line. Its direction is then the sought-after fractal dimension. Unfortunately, in real phenomena we can never accurately calculate the exact values of fractal dimensions (in the next chapters and parts it will be shown why) and in fact we

[123] The area of the lungs in an average person is equal to the tennis court area (Lamrini, Atounti 2017).



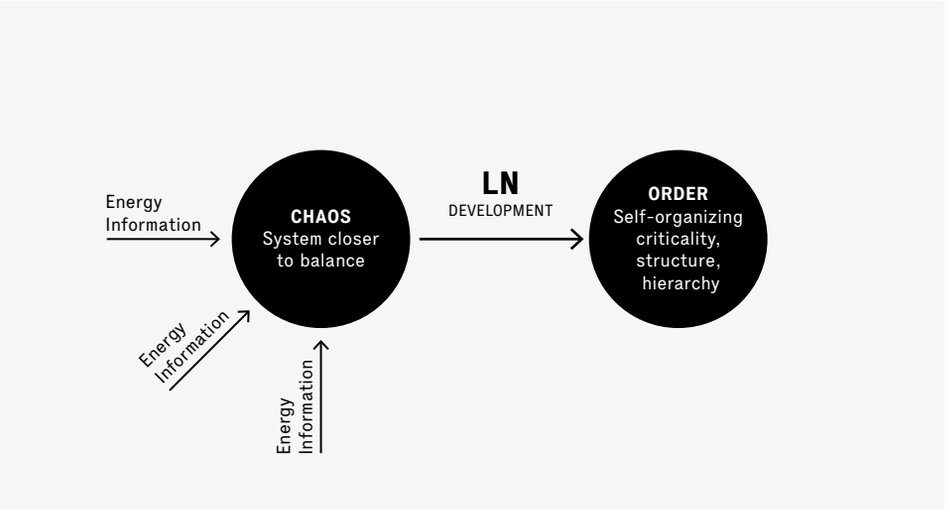



FIG. 11 – Scheme of linear nonequilibrium phase of systems development, source: elaborated by the author

are only estimating them. Mandelbrot's mathematical apparatus and the fractal nature of most phenomena in our reality brought a new impulse into the knowledge of the world at the end of the 20th century. In almost every field of science, observing phenomena with fractal asymmetric frequency distribution has become a trend. And thus also in the sciences of the city, where especially the infrastructure shows not only fractal diversification, but also the fractal shapes of its line networks, from large and high-capacity parts of e.g. the water main, usually in the city center to small individual connections at houses on its outskirts. However, the differentiation of elements takes place in all subsystems of the city – for example, traffic flow rises in some streets more than in others, some parks are used more by residents than others, etc.

The already mentioned Santa Fe Institute and the team of G. West have recently brought the fresh wind into the study of these regularities in irregularities, as they managed to clarify and quantify the links between similar irregularities in animals, cities and firms[124]. This showed that cities are basically all the same. A large city is an enlargement of a small city in terms of the amount of infrastructure or e.g. transport, but also in terms of the number of cultural institutions. The number of socio-economic quantitative indicators with the size of the city is increasing super-linearly with a coefficient of 1. 15. In other words, in an interconnected settlement system (such as a national one), with every doubling of the size of a city, the wage level of its inhabitants, the number of companies,

[124] According to West (2017), living organisms, from bacteria to mammals, show the same or common values of fractal dimensions (multiples of 0.25) when scaled by size due to the common nature of the functioning of metabolic networks. In other words, a large animal is in terms of, for example, its metabolic rate an enlargement of a smalll one. During its life, the heart of an elephant strikes as many times as the heart of a field mouse whose heart beats many times faster, but – or because of that – it lives for a shorter time. In the case of cities, doubling their size will increase the need for e.g. infrastructure, for example, by 0.85 times, while in animals, this savings is greater, 0.75 times. Living organisms and man are formed

better than the units we build and it will certainly be interesting to see how these economies of scale will be the future e.g. in computer programs and artificial intelligence (West (2017), pp. 93–94).

patents, but also cultural goods, etc. will increase by an average of 1.15 times.

The linear non-equilibrium phase takes place as opposed to the linear equilibrium phase at the reversed ratio of the supply of information and thinning. Due to the prevalence of concentration during the linear non-equilibrium phase of development, the system differentiates in size or significance of its parts or elements. We have already shown in the previous section a model with marbles, which illustrates that during the creation of these hierarchies, the originally competitive relationships between the elements are always transformed into cooperative ones. So it can be said that the following applies: concentration = growth of information = hierarchization = transformation of competition into cooperation = linear non-equilibrium phase of system development.

The second phase of system development – linear non-equilibrium – can be described by the reverse schema than in the equilibrium phase (FIG. 11).

And, of course, the same thing as we have stated in the linear equilibrium phase applies here: neither chaos nor order mean the final states of development, but rather its directions. In advanced development systems in our world, this scheme already begins in a position of great imbalance. However, the continued concentration of information increases this imbalance even more.

In the next chapter we will look at what may follow in the further development of systems “beyond” the order created by the internal fractal differentiation of their parts and elements. We will describe in it, after some necessary clarification of terms and phenomena, the last, third – non-linear non-equilibrium – phase of system development.

Excessive concentration of information leads to nonlinear, chaotic and unpredictable development.

Exceeding a certain degree leads to the breakthrough of old structures and the creation of a new order.

The decline of trust and the sense of belonging among people below a critical level leads to social unrest.

High population density leads to a decline in automobile ownership.

Surface nonlinearity does not have to turn into a deep nonlinearity, but each deep one started as a surface nonlinearity.

The basic triad of the process of concentration is chaos – order – choice.

# 6. Nonlinear development and choice

In the last chapter, we described how the real phenomena around us, when the concentration process predominates in them, internally hierarchically differentiate in accordance with the size order rules, whose form is constantly refined into the form of fractal dimensions, based on the mathematical apparatus developed in the 2nd half of the 20th century by French-American mathematician Mandelbrot. In this chapter, we will focus on one of the possible options for further development of systems. Ilya Prigogine called it a non-linear non-equilibrium phase.

The word non-linear refers to the kind of dependency of two variables, where the dependent variable exhibits non-uniform growth, such as exponential, with the growth independently of the variable. An example of the real output of such a nonlinearity is e.g. the whistling microphone feedback, which usually greatly frightens everyone in the hall, or also the fission reaction when a nuclear charge explodes. In the city, such an example can be the escalation of street violence and social unrest.

Nonlinear dependence of phenomena denotes any other than linear dependence and therefore can be of two kinds. We have already mentioned that with every doubling of the size of the city, there will be more than a doubling of the socio-economic goods produced by the city per capita. This is so-called superlinear non-linearity. Apart from that, however, there is also its counterpart – sublinear nonlinearity. Its consequences are, for example, economies of scale, e.g. with every doubling of the size of a city, less than twice the amount of urban infrastructure per person is needed. The development of the system during the non-linear phase described by I. Prigogine corresponds to the superlinear dependence. Only a small change at the beginning leads, after some time, to big changes in the whole system. During this process, the system activates positive feedbacks among elements. Sometimes this effect is described as a rolling snowball.

Partially and perhaps even a little surprisingly, the second phase of system development described in the previous

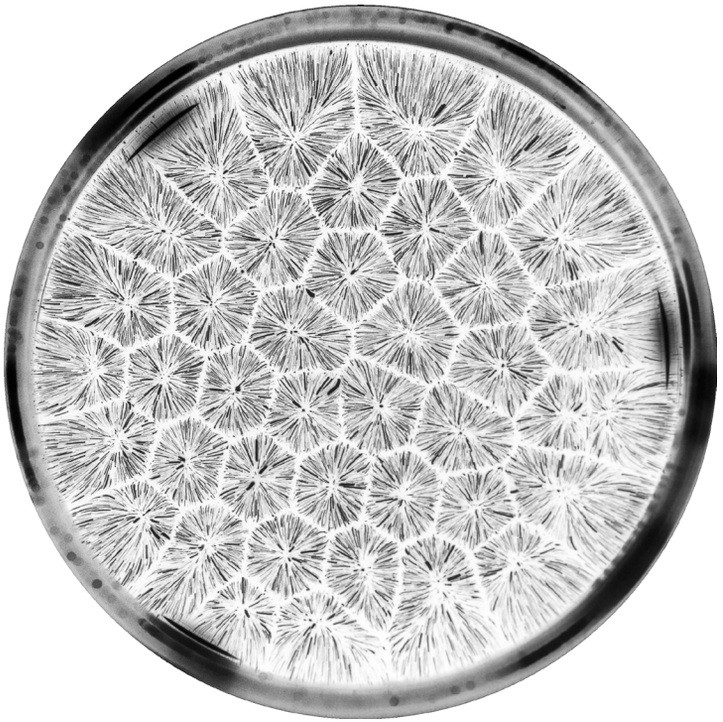


FIG. 12 – Bénard cells, source: Jäger (1996)

chapter was also non-linear. However, Ilya Prigogine considered the possibility of a relatively easy approximation of the "small" increase in systemic imbalance so different from the "wild" and rapid non-linear development that he kept the word in the title. And both phases are different, indeed. While in a linear non-equilibrium phase of development, a system exposed to an ever-increasing supply of information tries to set its internal evolution as best as it can – it therefore occupies a position of at least a minimal decrease in entropy – in the non-linear phase it already needs to "relieve" somehow differently and must make its inner transformation. Such non-linear development-altered systems with a new internal order were given the name of a dissipative structure, from the Latin *dis-supare*[125] signifying distracting, scattering, escaping. Today it is already clear that all systems around us, including ourselves, were originally created by a similar process.

Non-linear development can start running in the system in the case of two fulfilled conditions. With sufficient resources (information) entering it during the concentration process, and at the same time with limited space that will prevent its further growth and thus thinning. This process can be illustrated by the now classic example of self-organization[126] – during the formation of so-called Bénard cells on the surface of a thin heated layer of liquid[127] (FIG. 12).

The essence of the formation of these cell resembling regions is based on changing the heat transfer in the liquid from the bottom of the vessel. By heating the bottom of the vessel, the water molecules transmit their increasing kinetic energy (due to the increasing temperature) through mutual collisions – transmission by conduction. In this process, the liquid tends to thermally stratify. At some point, however, the transfer of heat to the surface is not enough in this way, and one of the molecules breaks through to the cold surface and entrains the other molecules with it – the heat transfer begins by convection, streaming. Circulating convection cylinders are formed inside the liquid and cells are formed on the surface. This new feature of the system is called emerging, surfacing.

During the non-linear phase of system development, in which its internal settings, structure and behavior are changed and the information received has to start storing and transforming in it in another way, some of the old structures that in the past conditions held the system together and in some arrangement are always broken. In the above-described example with Bénard cells, such a disrupted support structure is the "intermolecular" cooperative way of heat conduction. In the case of social unrest it is a violation of trust and belonging among people. And, for example, in the transformation of a city with increasing population density into a so-called city of short distances, it is a change in the movement of people – from passenger cars to public transport and pedestrian traffic.

In general, it is true that as the entire system falls into chaos as a result of breaking the support structure, its parts break free from their ties to the whole, gain freedom and harmonize their supply and dispensing of information and energy. They start to behave in accordance with their own patterns. During the transition between the linear and non-linear phases of development, thus, figuratively speaking, leaders[128] are sought among the parts who will go their way first. It is no coincidence that this reminds us of civil revolutions, the fight against oppression, the conquest of Bastille and other exceptional events in social history, including the emergence of settlement systems and states. As a rule, we know those leaders from them who made fundamental decisions on the further direction of development. However, these would not be given the chance to make a historical choice without the development and pressure of the outside.

125 Morwood (2005)

126 Self-organization is a term used for development happening spontaneously without external intervention (e.g. human). Therefore, it is not widely used in the context of social systems, however, at the same time, it is also clear that in the case of a common (unconscious) activity of many people it is basically an analogy of self-organization.

127 Prigogine, Stengers (2001), in the Czech Republic Duršpek (2012) or Prokšová, Duršpek (2007)

128 People act each a little differently in society. As a result of their internal set-up, some play a role of a rather positive "igniting" feedback, while others a rather negative "inhibitory" feedback. In relation to the surroundings in a given place and time, sometimes one or the other is needed.

It is never possible to predict precisely – only with a certain probability – which part of a system, which precisely an element, a firm, or which precisely a human will start the non-linear development. However, already existing inequalities and inhomogeneities in the system will always serve to develop non-linearity. Most likely, it will always be an element in a certain proximity to the location (and also the moment) of the highest density of information in the given system. That is, in the place of the greatest concentration of matter, energy or even knowledge and money, but also pathological phenomena. In social systems, these places are therefore usually cities or their surroundings, where there is the highest concentration of people and goods created by them. Innovation in general – both technological, economic and social – usually occurs in the largest cities. Cities are therefore rightly called engines of innovation.

The moment of initiation of non-linear development, i.e. the limit point of transition between linear non-equilibrium and non-linear development, was named as the so-called bifurcation, i.e. branching point. The bifurcation point in physical systems is, for example, the moment when the first air molecule begins to change the laminar airflow to turbulent, or when the mass and energy concentration in the cosmic bodies is so great that nuclear fusion is ignited in the first atomic nucleus. In the biological system, in the organism, it is, for example, the moment when the first cell leaves its natural cellular altruism and its uncontrollable cancer-causing multiplication begins. In our head it is a moment of new thought or decision and a change of our behavior. In a city, these may be moments of some decisive social event – e.g. some extreme traffic accident, in which young cyclists die, may trigger an enforcement of a change in the preference and precedence of traffic modes. In a settlement system, this may be the start of a suburbanization process after the center of the largest city becomes unsuitable for the life of, for example, families with children. And in large, man- transcending systems, these are generally moments of the beginnings of crises or disasters – for example, critical temperature inequality causes the creation of a tornado, exceeding a certain level of CO2 concentration in Earth's atmosphere launches a process of rapid global warming[129], the collapse of a large bank will also launch a run on other banking houses, an unfortunate or otherwise induced incident with already no mutual trust between states will cause a war conflict, etc.A consecution of bifurcations, the effect of a rolling snowball, is called a bifurcation cascade. For us observers, this is a major problem, since only a slight change in the initial conditions leads to huge differences in the later behavior of the whole system. This development, extremely sensitive to initial conditions, came to be known as Butterfly Effect[130]. Even though we are able to construct a deterministic model of behavior of such a system that does not contain coincidence, i.e. even though we are able to create a complex three-dimensional attractor of their development, we are not able to predict their future development due to ignorance of the exact initial conditions.

This is due to the fact that the bifurcation cascade, and therefore any non-linearity, is fractal in nature, which in other words means that in every system, each bifurcation point is the result of bifurcations in increasingly smaller subsystems. For example, in a crack of material on the surface of a ceramic mug that ultimately causes its overall deconstruction, it can always be traced deeper and deeper to its origin, up to the level of chance placed beyond our ability to observe[131]. And, moreover, all this is possible only retroactively. The exact direction of nonlinear development can never be estimated in advance.

Therefore, non-linearities cannot be "bound" into causalities and "figured out". Causalities as guidelines to estimate the future can serve only for linear development. During non-linear development we can identify correlations, but it is not possible to tell what existed earlier, if the chicken or the egg. Nonlinearities are strange and intertwined in this, they behave similarly to quantum mechanics, as if only their consequence determined the cause. It is as if through the deep non-linearities the

[129] Changes in global climate including consequences are shown, using maps, for example, by Beckel et al. (1997).

[130] The name was used by the aforementioned American mathematician and meteorologist Edward Norton Lorenz. More e.g. in Coveney and Highfield (2003) or Lorenz (1995).

[131] Werner K. Heisenberg, a German physicist and Nobel Prize laureate in physics, published the so-called uncertainty principle in 1932, according to which we can never objectively know the surrounding reality completely, also because we ourselves are influencing it just by our observation. Heisenberg's principle of uncertainty in a simplified form says that one of the two basic characteristics of elementary particles – position or momentum – cannot always be determined with accuracy. When observing an elementary particle, we have to send a photon to it, a minimum amount of energy, but by this we influence the observed

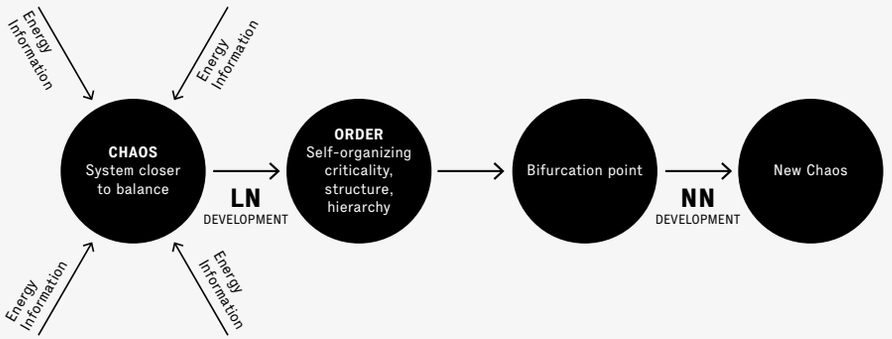



FIG. 13 – Scheme of system development in the concentration process, source: elaborated by the author

particle itself, deflect it and change the reality by observation itself (e.g. Hawking 1991). This does not mean, however, that the surrounding reality is not objective, but that the origin of everything is unknowable to us. The beginning of chance is beyond our world. Later this inner uncertainty within each system was proven by an Austrian mathematician with Czech roots Kurt Gödel, after whom these relevant mathematical theorems are named (e.g. Smullyan 2003). Both the principle of uncertainty in physics and Gödel's theorem in the queen of all sciences – mathematics – have shifted the causes of all causalities in our reality beyond the horizon of the existence and functioning of our four-dimensional space-time, thus „beyond the sight" of our physical observing abilities.

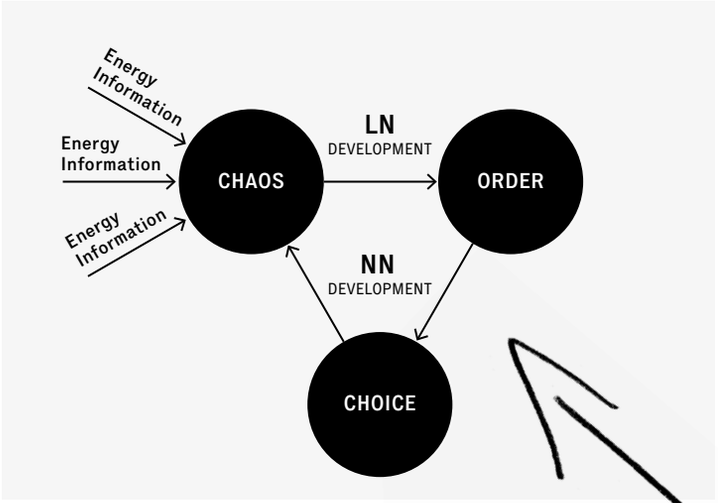



FIG. 14 – Triad of concentration, source: elaborated by the author

quantum nature of our world and the chance incarnate within each bifurcation reach the scale of our human world. It is as if the past meets the present in non-linearity and the consequences determine the causes.

Concentration process, i.e. both linear and non-linear non-equilibrium phase, can be plotted in a common flowchart as shown in FIG. 13. In the linear non-equilibrium phase the qualitative development of the system is terminated and bifurcation occurs at the edge of the quantitative limit in places of the greatest concentration of information. The system then immerses itself in a formless chaos for a moment in the non-linear non-equilibrium phase, which will form the basis for a later new order in which causes and effects will again be distinguished.

The scheme of the system development during concentration can be further modified. It can be rewritten into a "pseudo" cyclic algorithm, in which chaos becomes an order that, when a certain limit is exceeded, disappears and another order, a new order, begins to form again. System development through a linear non-equilibrium and non-linear non-equilibrium phase is shown in FIG. 14. This flowchart is the basic triad of concentration. It is the basic flowchart of each system that takes place during the concentration process, i.e. as the flow of information increases. However, it is not a closed circle, but rather a spiral.

In the scheme above, besides the previously used terms – order and chaos – we also changed bifurcation for choice. Bifurcation points for different types of systems are named



[132] American journalist Malcolm Gladwell thus names the key moments of history in the book of the same name – Gladwell (2008).

differently, sometimes even poetically, such as the breakpoint[132]. For us, however, it is advantageous to use more general terminology that would allow us to put under one roof systems both simple and complex, natural, technical and especially social, such as the city. Bifurcation means a decision on the future direction of the system development, so we will continue to use the overarching word "choice".

This generalization will be very important to us later. Because our human decision and bifurcation in natural, i.e. physical, chemical and biological systems has this very basis. Both are non-linearities, coming in their deepest essence from chance, the cause of which lies on the basis of the uncertainty principle beyond our reach. At the same time, both have also similar consequences. These are moments at which the surrounding order is demolished. Similarly, like bifurcation and bifurcation cascade transform the existing order in the natural system, so our human decisions destroy the previously created social surrounding rules. Each of our activities and initiatives changes the structures around us.

However, people and society are more complex and more stratified systems, and therefore also the course of their non-linearities is more variable and interesting for us. That is why in the next section – before we get, in the next book, to our human decisions and generally to decision-making – we will try to put the existing knowledge of the individual development phases of the systems into the context of the development of our entire surrounding world, with a gradually increasing focus on the development of human society and ultimately also of our cities.

BASIS OF THE WORLD

# Part III
# Development from the Perspective of Systems Theory

Development is a tug of war between thinning and concentration. Concentration predominates on Earth.

Reality arose from information, thinning and initial inequality. All forces have shared this same essence.

Complex multilayer systems are seldom subject to deep all-encompassing nonlinearities.

Change occurs in big cities. In the countryside, development is almost non-existent.

Long-term development takes place on the edge between order and chaos.

Society that hits a reasonable amount of change with respect to the surrounding conditions is successful.

# 7. Development and its basic characteristics

In this chapter, we will describe the essence and basic characteristics of the development of our surrounding reality by summarizing the knowledge from the previous part. There are two basic system processes – concentration and thinning. Despite their apparent contradiction, supported by their naming, both processes are not antagonistic. On the contrary, they are complementary when looking at the whole reality which, however, is not new information for humanity. Already Aristotle in one of his most important works – *Metaphysics* – stated that beingness at each moment and all its states have their origins in the difference between dense and thin[133]. And he had far from today's knowledge from countless disciplines of natural, technical and social sciences.

The relationship between thinning and concentration can be demonstrated using a certain modified form of our model with marbles. Each marble in our model is assigned a certain pressure towards our, this time already soft pad. Let, for example, their weight be the cause of pressure for the time being (in reality, however, it is complexity). As the pad begins to weaken and thus thin, each marble will further increase the inequality of its surroundings. We can imagine the thinning of the pad by expanding it to the sides, by means of which it loses its thickness. However, beware, it is not elastic and therefore our stretching does not stretch and reinforce it but makes it thinner. Gradually, in this way, with continuing thinning of the base, the originally separated surroundings of nearby marbles merge into one increasingly larger one. Thus, within the thinning process, in each original inequality the concentration process begins, thereby creating a growing inequality (FIG. 15).

This is exactly how also our universe behaves[134]. Its expansion in places where there is not enough mass and energy, takes place in accordance with the theory of relativity[135], in four-dimensional space-time. Expansion takes place at exactly above-the-limit speed in such a way that due to the amount of mass it will not experience its gravitational collapse[136]. The so-called dark energy, which has not been much explored so far, which makes up more than 2/3 of all the "matter" of the

133 Aristoteles (2015), p. 26

134 in a well arranged way e.g. Barrow (2013)

135 The theory of relativity, its bases, basic concepts, results as well as criticism is described also for non-physicists e.g. by Ferreira (2015).

136 e.g. Hawking (1991) or a broader view in Penrose (2013)

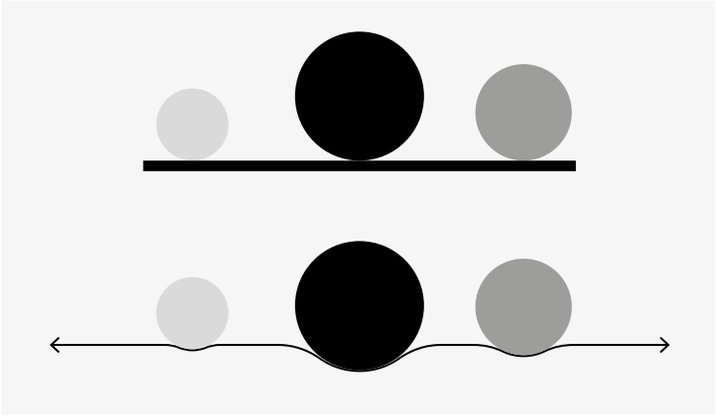


FIG. 15 – Interconnectedness of thinning and concentration processes, source: elaborated by the author

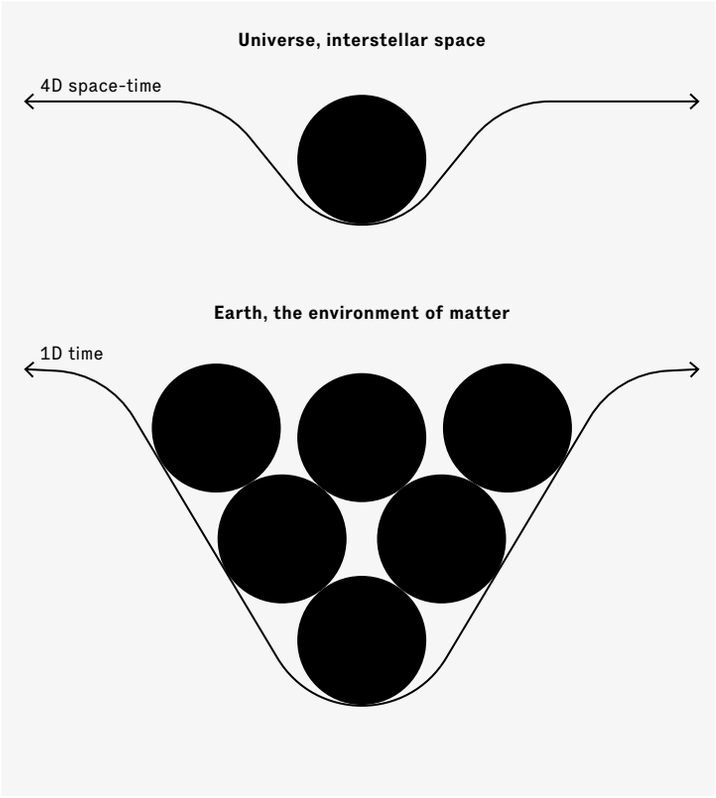



FIG. 16 – Development as thinning of space-time vs. development over time, source: elaborated by the author



universe, behaves just as strangely "inelastically" as our pad in the model with the marbles.

On Earth and generally in a gravitational field full of matter and energy, space expansion does not take place, only one of the four dimensions "continues" to thin, and that is time (FIG. 16). The passage of time literally means that the area of what has already taken place is expanding. However, because we ourselves exist "in time" on Earth, we do not perceive its course. It is very difficult for us to "look over" our time[137]. But we can imagine it, for example, as if we were sinking ever deeper due to thinning, trying to get by our own effort from this movement upward, just as a drowning person tries to get above the surface to take a breath.

Because thinning and from it in places of inequality derived and inverse process – concentration – cannot exist one without the other, neither our triad of concentration derived in the previous part is a complete basis of the evolution of beingness. This is the basic triad[138] of development. However, there is no more need to create any schema. It is a trinity made up of some existence (information) and a process of thinning and initial inequality in reality.

With this gradual generalization and the growth of abstraction, also the language and the terms used were unified. Thus, at this extreme level of abstraction, information is representative of energy or matter, but also of order, structure, shape, or system. Thinning is a process indicating growth of entropy and uncertainty, disappearance of order, cooling, chaos. And, finally, the first inequality is the influence of external coincidence, the cause of the first choice, the decision, the innovation, the manifestation of will. In particular systems, i.e. at a slightly lower level of abstraction and closer looking, these terms are already separated from each other. We distinguish, for example, a system (settlement), which is made up of subsystems = cities, and its structure (shape, hierarchy), into which cities are differentiated in it according to the rule of size order. Likewise, pure coincidence transforms into e.g. the expression of our free will at a lower level of generalization.

However, this is very important: It is only from such a distant and abstract view of our surrounding reality that the same basis of all the attractive forces and their manifestations is evident. These are all the consequences of inequalities in reality, enabling local and temporary conversion of thinning to concentration. Gravity alone is a side effect of the curvature of space-time[139]. But also the appealing power of cities, the appealing power of every information, and other powers, these all are manifestations of a "given" curved space. And thus also

[137] Moreover, in the last few decades it has been showing that time (or its non-existence) will probably be the key to many problems in physics that are difficult to solve, possibly also to the creation of the Quantum Theory of Gravity, as exemplified by e.g. Smolin (2009, 2013) or especially Barbour (2001). And to a certain extent it is also logical, given that our time emerged only with a certain dilution of the first dense cosmic "matter" (more e.g. Weinberg 1982). We measure and derive its course from the movement (change) of the smallest particles.

[138] The fact that the triad is the basic figure, which nature counts with, is discussed by e.g. Veverka (2013), p. 253.

[139] e.g. Clegg (2012), p. 103

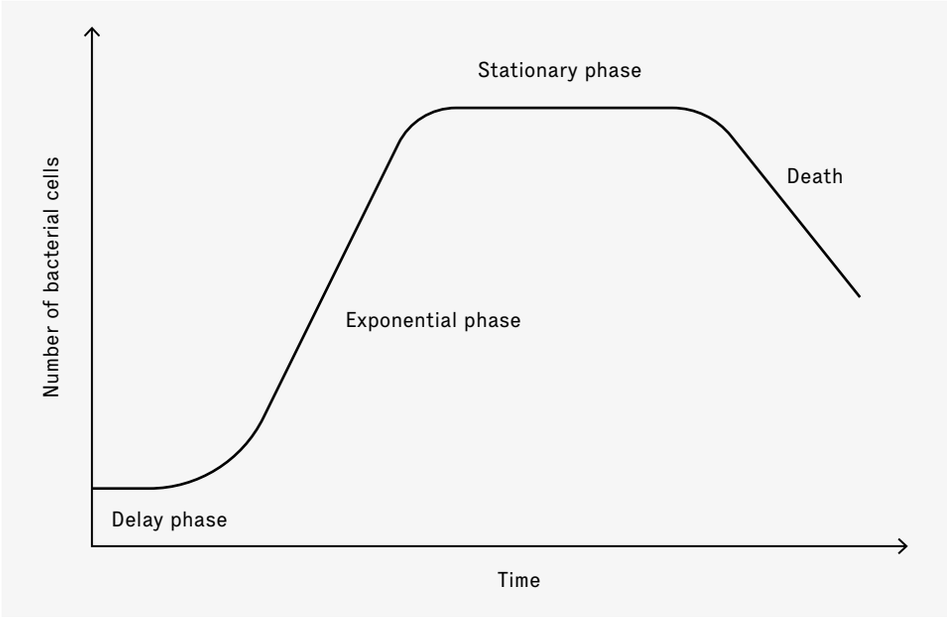



FIG. 17 – Bacterial colony development curve in a closed system with limited resources, source: Wang, Fan, Chen, Terentjev (2015)
Note: Bacterial colony development is characterized by four phases:
Phase 1 (delay): bacteria adapt to the new environment, they do not pay much attention to replication, but cells can grow in their volume;
Phase 2 (exponential): the binary division process is in progress;
Phase 3 (stationary): the number of new cells equals the number of dead cells due to resource depletion; Phase 4 (death): bacteria lose the ability to divide and the number of dead cells increasingly exceeds the number of living cells.

the crystallization of the substance, the solidification of water into ice, the formation of stars, our moving into cities, all these are again results of the same mechanism. Thinning results in an ever more intense but locally defined concentration. Even on our planet, nature has already begun and will increasingly force us to live close together in cities in the future.

The curvature of the space is the result of the prevalence of the locally acting concentration over the global thinning, and four types of development can be distinguished according to the extent of this curvature. They are very in tune with the development classes described by the American physicist and computer scientist Steven Wolfram, after whom they were also named as the so-called Wolfram's classes[140].

[140] Wolfram (2002), p. 231–242

The first class of development is one where the resources (energy, effort, information) are not enough to thin out, and the system returns to its initial form upon their acceptance. In other words, it means that either there is not enough energy and power to make any internal alteration to the system, or it means unlimited space and time for their growth in systems



capable of self-organization or in directly living systems. Such a development can be observed, for example, in the under-limit stress of some material that does not lead to its transformation or destruction, but also, for example, in the first growing and subsequently dying colony of bacteria with limited resources. Here it is often characterized first by a logistic (so-called "S") growth curve and a subsequent phase of deterioration (FIG. 17).

This type of development has been predicted to the human population as a whole many times already[141]. The best-known is probably the dark prediction by the English economist Thomas Robert Malthus, which predicted a geometric increase in number to mankind and only a linear increase in resources due to the limited space of our planet. Thus, sooner or later an inevitable collapse, as in bacteria. But, so far, mankind has always managed to innovate industrial, energy and production processes so that catastrophic visions of exponential population growth on the one hand and only a linear increase in disposable resources on the other have not yet come true. There has always been enough of a very different material on Earth for us, from a large amount of substance "caught" from outer space, where it has previously formed through the action of the same evolutionary mechanisms in several generations of stars preceding our solar system. So far, we have always had something to build on and discover deeper and deeper hidden sources of energy, to interconnect and combine in every possible way a huge number of cornerstones of matter or life.

[141] In its most famous form it is so-called Malthusianism according to the English political economist and demographer Thomas Malthus (1766–1834), e.g. Loužek (2014).

The second class of development occurs if there are sufficient resources to thin out for the "permanent" existence of the system. Thus, in other words, so many that it would theoretically be possible to continue to grow. However, through this endless continuation of growth into unlimited space (and time) such systems will always, sooner or later, disintegrate (and re-emerge) due to some general structural constraint.

As far as the inanimate nature is concerned, it is possible to use, as an example, the already well-known thought experiment, which also explains its limited nature. The table top is being covered with sand from bottomless hand[142]. Gradually a pyramid is formed, first small and later increasingly larger. Due to their own friction grains of sand do not spill evenly over the table, but always in certain avalanches. The pile always reaches a certain threshold, but it will level up again when the sand comes in again as soon as the accumulated surface avalanche slips (and this is the so-called self-organizing criticality[143]). With an unlimited size of the table, however, due to the increasing weight of the pile, it will inevitably sooner or later

[142] This was described more than 30 years ago by Bak, Tang and Wiesenfeld (1987).

[143] The model of a table with a growing pile of sand also shows that already a relatively small pile of sand is beginning to show self-organizing criticality – the maximum slope possible, depending on the coarseness and complexity of the grain shape. In its structure, a small tree basically immediately looks like a big tree. Except for minor variations, a child physically looks like an adult from the earliest age. The small two-storey house is in the main parameters the same as a multi-storey house. Even relatively small towns have a central urban infrastructure (e.g. sewerage). The polarity of the core city and the periphery is evident from relatively small and underpopulated regions, etc.

break through the table top, somewhere below the site of the most accumulated matter.

In the field of living nature, we can find an illustrative example of the second class of development of trees that have been encoded by the unrestricted growth of genes. Yet, no tree will grow into heaven, as the saying goes. Trees grow on their surface in the growth part. On their trunk there is an increase in wood mass in annual rings and each increase in the diameter of their trunk corresponds to the same increase in the diameter of branches and roots. Branches of trees thus form a simple self-similar fractal already from a small tree. However, while the cross-section of their trunk increases with the square, the volume and thus the weight of their crown increases with the power of the third, which inevitably leads to collapse at some point. Usually this is accelerated by mushrooms, unfavorable weather conditions or in fruit trees occasional overproduction of heavy fruits.

In the area of social systems, a typical example is the gradually growing and increasingly larger portion of the monopoly market, eventually causing its degeneration and disintegration. Or, typical examples of this class of development are the great ancient empires (in European space especially the Roman Empire), which gradually expanded to a size when – due to the limited speed of transport and in general the transmission of information as well as technological and organizational constraints – they were unable to maintain their integrity, especially after the exchange of their rulers.

Whether it is the growth of trees or the growth of large empires into the surrounding unlimited space (and time), the cause of their disintegration, and thus a new, recurring beginning, is not a lack of resources, but rather their constant abundance.

We do not have to describe the third class of development too much now, as we have explained it sufficiently in the previous section – it is a non-linear development. It needs sufficient resources and limited space (and time) and internally changes the functioning of the system due to the fall of one of the support structures. It is ruled by chance, absolute irregularity and chaos.

The most interesting for us is Wolfram's fourth class of development, which is located between the second and the third class. Exactly on the edge of too much order and too much chaos. On the edge of transformation and growth. Partially nonlinear and partially linear. Wolfram's class IV of development is specific in that it creates ever more complex



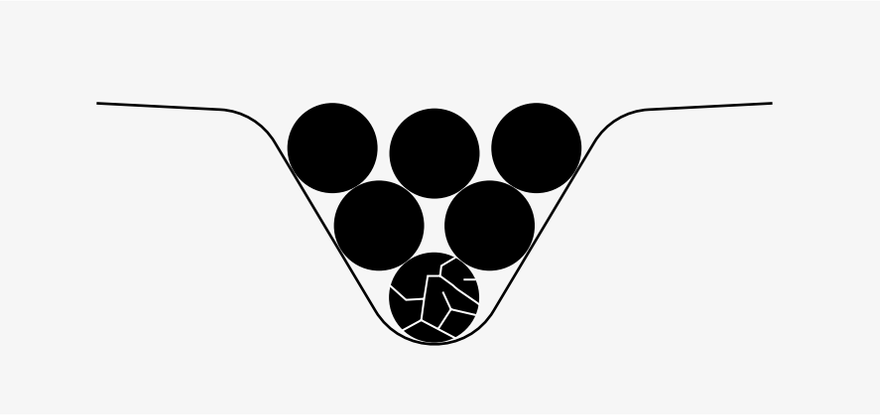


FIG. 18 – Growing pressure in places of greatest inequalities, source: elaborated by the author

structures. Its "fractals" are complex, partly similar to each other, but never exactly repeating patterns[144].

[144] Of which the "fractal of fractals", the Mandelbrott set, seems to be the pattern of development. More about the experiment performed by scientists H.O. Peitgen and P.H. Richter, e.g. Gleick (1996), p. 240.

To understand its essence, we will use our earlier knowledge and the model with the marbles, representing the evolution of cities within a shrinking settlement system. We already know that we originally showed it upside down for simplicity. The largest cities, or generally the most energetic elements of the system, the highest control layers in a complex system are, when interpreting our reality correctly, not the highest, in the limelight, but on the contrary, the lowest, buried by the greatest pressure deep within the settlement system.

If somewhere in this hierarchically most exposed area of the system, the ambient pressure reaches a certain limit value, i.e. when the thinning is locally slower than the concentration, melting occurs and nonlinear development starts (FIG. 18). That, in the form of the fall of the supporting structures of the system, i.e. as a certain chaos, subsequently spreads further to the other levels of the hierarchical structure. We know this very well from our world: it is precisely the inhabitants of big cities who feel the need to transform their own behavior first. It is in the most advanced parts of the world that social innovations are happening – and with them also partly related technological innovations, as we will see in the next chapter.

However, due to the large straddling of the complex multilayered system, the nonlinear development that has begun is somewhat limited. What is manifested in the core element by a rapid chaotic evolution is increasingly less evident in the other levels of the hierarchy, in the lower control layers due to their action as feedback inhibiting bonds. There is the effect of thinning – both spatial and temporal (this development

happens over time). As a result, nonlinearities can be observed substantially permanently in complex multilayer systems. However, these are of different sizes, preferably superficial and deep.

Surface non-linearity changes the future behavior of the system, for example, determines the direction of further movement. Such a non-linearity is, for example, our decision. Also the position of the bridge in the city or innovation of the industrial product in the company. Or also an avalanche of snow, but also e.g. a big tornado – if we look at them from the perspective of the whole mountains, or atmosphere. Conversely, deep non-linearity breaks the support structures of the system in the form of links among its elements. It completely transforms it.

Possible examples of deep non-linearities in the field of inanimate matter are phase transitions between states or initiation of thermonuclear reactions. We do not use the phrase "phase transition" in living organisms much, but of course the same phenomena, and therefore non-linearities of different depths, also occur. Perhaps the most illustrative example of profound nonlinearity within an individual's life is the conversion of insect larvae into an adult individual. In humans and mammals, such a profound non-linearity is, for example, cancerous growth, ultimately leading to the disruption of homeostasis and the death of the individual, i.e., transformation at the physiological level, to a halt of metabolism.

It is always true that any profound nonlinearity is the result of superficial nonlinearity, but the opposite is not true. Not every crazy cell has to grow into a large and whole system engulfing non-linearity. Not every human experience starts a personal transformation, not every car in the city starts a traffic jam, not every displaced family from the city center starts a massive exodus to the periphery, not every bank crash causes a global economic crisis and not every CO2 molecule initiates global warming.

Wolfram's class IV – between order and chaos – so typical of the long-term development of complex multilayer systems, is a description of the development itself. That can be thus defined – at least on our planet Earth – concentration arising from thinning. As a drag and drop of two basic system processes. We will now describe three characteristics of development, which are resistance to complexity, discretion in the form of developmental steps, and also the relativity of its speed.

Generally, complexity decreases by thinning and increases by the process of concentration[145]. And thus also the development, even if we do not observe it in our immediate vicinity

[145] This does not mean that everything more concentrated is more complex than anything less concentrated. This means that every single system subject to the concentration process becomes more complex during this process.



on Earth, is trying to avoid complexity as much as possible. It accepts complexity with reluctance and always only temporarily until it finds another way. It avoids complexity like electricity, which goes the path of least resistance, or a river that flows in the direction of the greatest gradient. Therefore, capital moves to places of highest profit, animals travel to places with abundant food, and man settles in places most suitable (easiest) for his life. It is a direct consequence of the thinning process, against which concentration means the need for energy and effort.

Sooner or later, any obstacle that stands in the way of development is either overcome or circumvented. While development tends to bring every system always to the limits of its capabilities, it can, due to many circumstances, begin to bypass it and work with it as a building unit of a larger whole. Thanks to this, it is possible to imagine the development as a river flowing through uneven terrain formed by previously created inequalities. As soon as it fills all surrounding places with the same complexity, i.e. it reaches a truly insurmountable obstacle, it will start to grow upwards. Towards greater complexity. The level of this river of development begins to rise "very reluctantly", begins to fill every inequality in the surrounding terrain, creating new bays and looking for ways to flow further. In doing so, it will begin to connect the previously separated elements and different spaces. The rise in the level of this now already a lake of development, and hence the temporary increase in complexity, will end when a new flow point is found or created or, if we want, punctured in the surrounding environment.

The dams that prevent development from continuing along the path of lowest complexity are all around us. At the most general level, these are time and space. But each system, by its very existence, constitutes some barrier, some structure, some regulation of the development of another system. Thus, anything can be mentioned, be it the already mentioned rising water barrier, the planet's climatic zoning to expand the species or the genetic nature of the animals, and the shape of the DNA from which all other forms of earthly life arise. Also the shape of the body of each organism, which delimits its possible spheres of activities and abilities. The limited physical space of our planet, as well as the nature of our universe and all its events, are delimited by the values of gravity and a few other physical constants[146].

In social systems it is us who create these limits of development. Partially consciously, partially involuntarily, we are gradually defining them in more and more detail after previous

[146] E.g. gravitational constant, Boltzmann constant, speed of light in vacuum, charge and resting weight of electron, Planck time and others (Urbanová, Hofmann, Alexa 2006).

bad experiences with ourselves. By means of laws we define the space of our actions, by natural human rights we define society, by the institute of the family then the basic building unit of society, by the state borders or walls of the city we define space. We also forbid many things – with alternating successes – for example, the usage of nuclear weapons after realizing the threat of mutual self-destruction. Or we try to agree on a ban on the release of greenhouse gases, poisonous substances and nowadays even plastics accumulating in the oceans. In the economic field, for example, we set the rules of exchange, the value of money or (formerly) its coverage, and many other financial market regulations which, however, the continuing concentration always once in a while sweeps and forces us to rework them[147].

[147] From one point of view, financial crises are always the result of inadequate regulation, while from another it is clear that these crises must sooner or later come anyway. However, by regulating markets or stock exchange transactions, we can accelerate or delay the changes.

Everything new that arises as a result of the closure of development into limits always has, at the same time, a certain potential to destroy these old structures, just as rising water has a tendency to break its way somewhere in the rock or dam as its water level, its volume, and thus pressure and power increase. Like the last grain of sand can be the cause of an avalanche, but also of the breaking of the table top. How far below the current level of the river/lake of development something similar will occur corresponds to the sharpness and dramatic character of the course of non-linear development.

However, breaking very deep structures does not necessarily have to do with development at its surface. For example, mankind surely has the power to avert or, on the contrary, initiate a nuclear war, but equally devastating for us will be e.g. an explosion of Yellowstone volcano or some major earthquake, that is, events totally unrelated to us or very much beyond us. The deepest and most surprising beginnings of large non-linearities are usually caused by some external event. In the case of the planet Earth, it would be the impact of some cosmic body, in the case of the Inca empire, it was, for example, the arrival of the Spaniards. Lebanese-American mathematician Nicolas Taleb calls these unexpected events the so-called black swans[148]. However, it is probably we who are really responsible for today's global climate changes, that is, the beginning of planet-wide non-linearity.

[148] Taleb (2011)

The depth of structures in development is related to their stability. Far below the level of development, are by interconnected feedback already established massive, strong and stabilized currents, while chaotic swarming of many new things take place on the surface. New structures are always unstable. Living systems and cells are somewhat younger and less stable than inanimate molecules and atoms. In man, biological



structures are older and more stable than social structures. Structure stability can be distinguished also in our daily activities – for example, walking is a structure older and more stable than driving. Body language and spoken word are structures older and more stable than communication via the Internet etc.

The process of stabilizing structures takes place as an exchange of something for something else. Series of newly emerging structures are always thinning, as only some of them stabilize through mutual competition. During the process of stabilizing structures, they also undergo partial transformation. The new structures take roots in the old structures, disrupt them, connect with them and as a whole they consolidate and stabilize. Like grass grows into the soil, and both layers together strengthen themselves against erosion and whims of the weather. And like us, people, are getting deeper and deeper into the mysteries of nature, matter, and development itself, and thanks to that we are still here and survive as an animal species.

At the same time, the sharp edges of mutually stabilizing structures are abraded during this process. Cities thus create a settlement system, but at the same time, through its impact, they differentiate in accordance with the size order rule. In the same way, urban blocks of houses were created inside the city by their gradual multiplication, but at the same time by the influence of the city, its needs of passability and functionality embodied, for example, in building regulations. Man, in turn, is the result of a clash of biological determinism "from the bottom" and socialization "from the top". The highest control layer of the human organism (i.e. our consciousness) is, at the same time, part of the lowest social layer. We create society, but it in turn forms us.

The stability of structures is directly related to the speed of their modification and hence the speed of development. Many small, rapid and chaotic changes, surface nonlinearities, are happening on the surface of the river of development. At great depths, where it has already been reduced due to interconnected feedback and regulation, its pace is slower from the surface point of view and at the very deep level utterly stopped. This means, among other things, that between the change of something deep and great, a great deal of superficial and small development takes place. Thus, for example, the formation of the universe from energy and later matter has allowed the emergence of several generations of stars, including our Sun. The establishment of our solar system and the ignition of the thermonuclear reaction in the Sun have created

enough time for the creation of the Earth and life on it. And, similarly, during a small change in the functioning of the state or a small change in the structure of the city, people manage to get married, start a family and often also divorce, change jobs several times, etc.

This developmental process has implications for its observation and description. Firstly, it seems that development as a result of alternating periods of major or minor changes does not run smoothly and continuously, but in steps, by fits and starts[149]. The development always alternates periods of stasis and periods of non-linearity, just as there are periods of accumulation of inequalities on the pile of sand and then moments of slides and spreading of the pile. Even the evolution of living organisms consists of epochs of calm and revolutions. From the perspective of long-term development, evolution is thus basically exclusively made up of revolutions.

Secondly, the rate of development is very relative, tied to the scale of observation. From the perspective of a particular system, it always seems that it continues in time and space ever further. However, when viewed from outside and far, it always seems as if the development created its own niches. Like the edge of the fractal endlessly diminishes. In other words, our current human world is heading somewhere thanks to gradual progress, but from the perspective of, let's say, our solar system, it is not very important whether the Earth is dominated by dinosaurs, people with mobile phones or monkeys with sticks. And it is similar with the inner world of each of us.

However, in the hierarchical proximity of us humans, the stability of the surrounding structures and the associated speed of development are questionable. It is very difficult for us to distinguish what – from what we have done in history – is stable, supportive, durable and therefore necessary for our further development. The debatable stability that has been the subject of increasingly heated debates over recent years is about the planet, the environment, the food chain, the organization of states, the appearance and form of our cities, but also e.g. the genetic nature of living organisms and us, people. Thus, we are asking ourselves the right questions, such as: How many of us can survive on planet Earth? What should our planetwide social organization look like? Can we allow the extensive development of our cities into the landscape? Is the food chain a necessity for us, or are we already able to produce suitable foods? Is changing genes in living organisms harmless and beneficial to us? And what about changing our own human genes? Is it a devastating step or, on the contrary, a necessity to overcome new diseases and the fading effects

149 After all, even the course of the time itself we cannot measure in our world as continuous, but after minimal indivisible jumps, units of the so-called Planck time (e.g. Weinberg 1998).



of today's medicines? For example, is gene manipulation using the CRISPR/Cas9 method[150] which, in contrast to previous methods of gene therapy, persists in the next generation, good or evil for mankind?

This uncertainty of ours also implies uncertainty in the correctness of selected solutions. It is an extreme evil to reject and ignore problems. But it is also impossible to completely prevent the transformation of our planet (and hence also the climate change) unless, here on Earth, we all give up our own lives and those of our children. We realized the problem precisely because there are so many of us here and that we are all extremely interconnected with one another, both of which stem directly from the essence of the fundamental systemic process – concentration. Therefore, the root cause is difficult to change, so it is important to focus on treating the consequences. For example, we can try to slow down changes as much as possible, and thus gain time to adapt for ourselves and nature. Certainly, today's challenge is better and more consistent waste disposal and other similar measures.

Until now, Earth's evolution has been due to the constant supply of vast amounts of solar electromagnetic radiation[151] and, at the same time, due to virtually infinite geographic space for most systems. However, exactly this has begun to change with the human occupation of the entire surface of the planet several hundred years ago. Therefore, to keep society on Earth on the thin line delimited by Wolfram's class IV, our efforts and strain must be intense enough, but at the same time we must avoid our – equally dangerous – extreme human transformations. Our ancestors – though it was at a different time – had prudently built some cultural-socio-religious walls behind which horrors and dreads could await[152].

In other words, if we want to succeed as today's connected global society, we need to learn to better recognize the threats that come from the confined space of our planet, as well as the stability and necessity of some of our social structures. The former cannot be without natural sciences, the latter without a thorough knowledge of the historical development of man, of man within society and of the development of society as a whole.

Unfortunately, it is not possible on several pages of the text to cover the whole of human history from the origin of man via the emergence of cities to today's global societies. Moreover, as extremely regionally diverse as we can imagine. This is perhaps not even necessary because, especially in the last few years, countless books were published, describing the history of man and society in their complexity and, in particular,

150 CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) / CAS9 (CRISPR-associated genes) is a modern method and technique of gene manipulation known as "gene editing" that, unlike previous techniques, allows the change to be maintained in subsequent generations of individuals (more e.g. Petr 2015).

151 So-called solar constant, whose value fluctuates and is somewhere between 1,360–1,365 W/m2, more e.g. Kopp, Lean (2011).

152 Moreover, it is now becoming apparent that our interconnection can be a problem. Obviously, the fact that we get information about phenomena and situations to which we are not prepared and we are not able to solve them in any way (not even symbolically in elections), is quite frustrating for part of the population. The slowing down of further interconnections and a certain return to closed state borders is therefore to some extent understandable, although not very welcome and perhaps only temporary. In other words, the Internet has temporarily outstripped our current abilities to manage and regulate. It is therefore necessary to take into account that it will take some time for humanity to be ready for this new state.

in terms of directional development, describing it sufficiently widely and deeply[153]. Therefore, in the following chapters we will focus only on selected historical moments – in the following chapter those related to the development of society and in the last chapter then those directly related to the development of cities.

[153] from many, in a modern way e.g. Harari (2013)

The unceasing concentration process can be found in the historical development of society as a whole in the form of concentration and growth of power.

The tools of power are: the speed of information dissemination and our relocation, the ability to organize society and manage the territory, the technological level and the economic tools of exchange.

The deep nonlinearities in human development were the cognitive, agricultural, and industrial revolutions.

State formations were created to increase the power of cities. The cities thus got inside a society-wide organization.

The settlement of the whole planet started the society-wide process of modernization and emancipation.

If states want to survive, they must connect more intensively and at the same time hand over power to regions and large cities.

## 8. Development of society on the edge of order and chaos

Let us recall first that our surrounding reality is formed by the mutual tug of war between two basic system processes – thinning and concentration. Thinning is dimensionless and happens on Earth over time. However, concentration already takes shape of some form of information.

In social systems, the concentration process must be understood as the population growth on the basic level, but in a broader sense also as their concentration in cities, their size differentiation according to the rules of size order, origin and size or power differentiation of states but also as economic or technological growth as well as the development of many other tools of our social organization.

The unifying name of these social processes, which allows the description of complex social development while ensuring sufficient clarity, is the concentration of power and its continuous growth. And both in the sense of the power of the individual, but also of the power of the social whole of which the individual is a part (i.e. an element).

The power of anything, of any system, and hence also of its elements, i.e. atoms, cells, people, cities, states, or generally the power of any information, can be defined as the ability of these elements to shape development: to participate in it, to respond to thinning by means of their own concentration, to increase inequalities in reality. The Scottish philosopher David Hume linked the term power directly to terms of activity, work, power or energy[154]. Thus, for example, also our movement is an activity, and thus a process in which power spreads. So is our speech. When someone speaks, he spreads his power to the surroundings. If someone speaks to us, they try to control us.

Power is itself a representative of order and information. To have power means to have a better position in the hierarchy of some system. The opposite of power is then “a lack of” power, or loss of information and order growing in the process of thinning.

In the social sciences, the issue of power was elaborated by one of the most remarkable modern thinkers, living in

[154] Hume (2015), p. 171

the 19th century, by German philosopher Friedrich Wilhelm Nietzsche[155], who in turn derived his knowledge from other important but lesser-known philosophers, especially the German thinker Arthur Schopenhauer[156] and American essayist Ralph Waldo Emerson[157]. In particular, the essence of life described by them – the will to power – is a concept that is entirely consistent with the system theory described in the preceding chapters. In those, however, we dealt with the functioning of all systems under development. Thus, even the inanimate systems, for which we do not use the notion of will, even though a similar form of choice, based in its deep essence on coincidence, takes place in them in the non-linear phase of their development[158].

On Earth, as a result of the temporary dominance of the process of concentration over thinning, all emerging systems are being pushed towards the growth of hierarchy and power. And even the fact that, for example, of course it is in human capabilities to refuse this power struggle[159], this does not change anything in that. On the contrary, it is precisely because each of us perceives the struggle for power with a different intensity and differently that we, within society, also diversify and create hierarchical arrangements thanks to which we can cooperate and work together. The historical and long-term development of man within society, and hence also the development of cities and states, including industry, technology and economy, is therefore directly linked to the increasing concentration of power.

Man evolved on Earth some 260 to 350,000 years ago[160], and some probably more than 70,000 years ago[161] in some of our direct ancestors occurred, on the edge between the pressure of external circumstances and within all organisms on Earth through an ongoing concentration process, triggering of a profound nonlinearity in the genetic information copying system. In layman's terms, there has been a mistake in the many times tested cell division process.

In this human first non-linearity, which is called the cognitive revolution, the present day was connected with the deep past in which the organisms preceding the prehistoric man evolved. The skills needed to live until then had become, starting from that moment, obsolete in the ensuing competitive struggle. Today we are able to determine that humans differ by two percent from chimpanzees in their genetic makeup, but this first moment of non-linearity was perhaps much smaller[162]. The first and slight genetic mutation hit just the demanded advantage in the competitive struggle inside and outside the social group. This event probably occurred in one of the more

155 e.g. Nietzsche (2002), about his work in summary e.g. Kouba (2006)

156 summary work of Schopenhauer (1998)

157 Nietzsche, however, never boasted of the origins of his ideas, especially when it comes to R.W. Emerson (Hummel 1946).

158 Similarly, for example, Teilhard de Chardin thinks that consciousness is present at all levels, but only in man becomes more important (Teilhard de Chardin 1990, p. 200).

159 The process of creating a hierarchy in a group (organisms as well as humans) is interesting in that it is formed from both sides – the weaker will eventually find several stronger ones among themselves, but on the other side the strongest ones stultify the other strong ones.

160 Schlebusch, Malström, Günther et al. (2017)

161 Harari (2013), p. 13

162 Marks (2003)



162 Marks (2003)

163 according to biologist J. Flegr evolution thaws in small numbers of individuals (Flegr 2016, p. 196)

164 Geographist M. Hampl thus directly divides the development phases of systems into: 1) determination, 2) exploitation and 3) cooperative (e.g. Hampl 1998), which are based on Stage Theory (Rostow 1965).

165 Or, increasing the probability of survival of our genes, as described by a British biologist and professor at Oxford University C.R. Dawkins (2003).

166 Harari (2013), p. 108. From our earlier theoretical potential of "being everywhere" (analogous to the physical particle superposition), we have, through our primary choices, established our own future being only "somewhere" on Earth.

167 Harari (2013), p. 112

severed packs of anthropoid apes[163]. And maybe even in more places roughly simultaneously.

Man began his pilgrimage on Earth many tens of thousands of years ago, just like any other organism strongly determined by the environment[164]. Over time, our survival was a question of who would win. Every day in nature we fought for safety and food. Our ability to reproduce and survive at that time was a hard-to-reach balance with the environment. Therefore, we were pushed together by dangerous and unfavorable natural conditions and by the concentration of power at that time we tried to increase especially our probability of survival in each moment[165].

Our primordial abandonment of the daily need for harvesting and dangerous hunting more than 10,000 years ago, which we first replaced with the occasional and later annual crop management in fertile areas[166], was therefore inevitable in terms of increasing our (group) power over nature.Managing fields in fertile areas rightfully seemed easier for the people of that time, and perhaps even more necessary in the period in question, but certainly safer than uncertain and frequent hunting. With the crop we saved on activity and gained more time for thinking and other activities.

At the same time, however, many other problems have emerged. For example, we began to multiply more quickly and therefore we could not go back – we would not be able to maintain ourselves with the earlier lifestyle[167]. The thinning process can thus be observed at the human level, among other things, as our unwillingness or even laziness to perform earlier activities that from a certain point of view seem to us to be more demanding or dangerous.

Development is a constant tug of war between thinning and concentration, and therefore our every single step has evoked a second step on the development side, and it has forced us again to look for the way forward. The development has always been catching us, again and again, and established a new balance. With each of our "facilitation" in the form of greater power, that is, better and more efficient concentration and mutual organization, we have adapted collectively to this new level and have begun to devote our saved time to new activities.Thus, in the period of the Neolithic Revolution, we underwent another deeper non-linear development – not as deep as hundreds of thousands of years ago at the level of our genes, but at the level of our ability to organize ourselves. And this non-linearity is now called the agricultural revolution.

We had to go into every struggle – more and more directed against one's own species as opposed to the previous struggle

for survival in nature – with a greater concentration of power than the opponent. For example, those human communities that were able to take advantage of the experience of their elders, less fit for fighting, have gained some competitive advantage.

As hunters and gatherers, we (and our genes with us) were not able to concentrate our power too much, because our brain allows us to form functional social groups of not more than 150 members[168]. This number before the Neolithic Revolution formed a certain framework for the extended family. However, once we had settled down, it was necessary to cross this border. In the end, we succeeded in doing so, but at the cost of changing our mutual organization. Our initial community began to transform into society. Community into society. We have developed ideas, rules of behavior, customs, traditions and religions, and our human interdependence from the family community has turned into a rational arrangement in some way.Development never offered too many choices to people. In times of hostile natural environment, it was not possible to behave like today. Man's power against the forces of nature operating in his immediate vicinity – but this also applied to other groups of people – has always been extremely small. Therefore, the only way to wage at least a little balanced struggle was to interconnect, to unite. From time immemorial, it has always been true for us people that we are less afraid if we are together – both in the case of our ancient struggle against nature, and our later struggle against foreign groups of people, or even later the struggle against oppression and repression in totalitarian states.

Many thousands of years ago, therefore, we began to concentrate more and more territorially. We created seats and settlements that were usually far less secure outside than inside. This necessitated also our vertical hierarchy, creating ruling, subject, and other classes.

Groups better linked with better tools, working practices and combat strategies were able to better overcome both natural conditions and their own competitors. Gradually, a wide range of power tools emerged. The human ability to concentrate power gradually began to gain increasing variability due to further development. From today's perspective, power tools can be divided into several groups, for example:

- the speed of human movement (changing very slowly up to the industrial revolution, was given by the speed of walking, running, or the speed of riding animals),

[168] according to Harari (2013), p. 39



- speed of information dissemination, i.e. availability of especially written word and its distribution,
- economic (monetary) exchange tools allowing an increasing number of people to participate in the progress of the whole group,
- organizational tools of territorial and social governance, both in peacetime and especially in times of war (including religion),
- technologies, both those enabling our proximity in cities (infrastructure), as well as weapons and military equipment.

By improving and combining them, different communities or individuals were able to concentrate their power increasingly, which in turn manifested itself essentially in three different ways – in the size of the dominated territory, in social status, and also in – arising from these two – the availability of tools and assets. Simply, though to put it mildly inaccurately, people and human groups can increase their power over the territory, over other people and over the means of production, that is, over wealth and property.

A certain, and not entirely insignificant, inaccuracy of this expression is that, for example, spatial growth of power is already a dilution of the previous type of concentration of power, which has, however, made room for a new type of concentration. Such as, for example, grass to grow on the soil, first it upsets the soil so that it can penetrate through it. It is an analogy of an avalanche of sand on a pile that falls at a time when its height would continue to increase due to further falling grains during linear development. However, for good illustration and easy understanding of the causal context, we will use such simplification in the following text, and thus, for example, the growth of the controlled territory will be described directly as a manifestation of the concentration of power and not as a consequence.

The river of evolution always flows through the path of least resistance, therefore, with every difficulty in gaining power in one direction, we (rarely) individually or (rather) collectively took a different path. On that path we then refined our instruments of power so that further gain of power became again easier in one of the other or even previously abandoned directions of development. For example, a good internal organization of a certain community, i.e. especially its good command, has made it possible to enlarge territory. However, the need for greater efforts to defend and manage it has again increased the demands for a quality internal organization.

But it was a long journey full of mistakes and missteps. Many groups, and later also nations, often relied on only one or only some of the instruments of power and "forgot" the need for the others as well. Therefore, often, by using brute force, "barbarian" nations have plundered more advanced and better socially organized cultures in certain areas[169].

The power of elites in groups has always been based on some legitimacy before their other members or allies. They have always tolerated them in exchange for growth (or at least not too great a decrease) in their own power. It is a universal principle of interpersonal cooperation called non-zero sum strategy[170]. This briefly says, among other things, that most of the work is usually done by each of us alone but, in the long run, it is more sustainable (eventually actually for everyone) to devote part of one's own activities to family, friends, community and higher units.

The elites, in order to sustain their power in the long term, therefore had to continually care for further and further growth of their power[171], especially in the form of territorial and economic gains. With territorial growth, the original farm settlements and places of commerce became, in the course of time, increasingly intertwined settlement systems with their own hierarchy. The settlements have evolved into cities, city states, settlement systems, empires and kingdoms.

The development typical of the differentiation of systems to a few large and many small systems has gradually taken place on more and more levels. Larger units (some forms of state formations) have always been created on the shoulders of the smaller ones, but after their formation they further formed them by their internal environment and organically interconnected with them. Within these units were formed culture, language, economic rules of exchange and taxes, customs and religion, but also, for example, education and health.

Cities – once, according to Plato, municipalities in the sense of Greek *polis*, from today's perspective city states[172] – gradually got "inside" the society-wide organization formed first by regional groupings, later by nations (and today also by multinational groupings). However, it remained fortified, enclosed within its walls, because the surrounding environment was still not very friendly for people's lives at that time.

At the end of the Middle Ages, in Western Europe, the then-elites and the state units controlled by them reached, due to a huge number of clashes especially because of the increasingly limited potential for territorial continental gains, to the size, wealth and technological and organizational level enabling successful ocean voyages. The essentially halted

169 The collapses of complex societies are discussed in detail by Tainter (2009).

170 This issue is elaborated extensively and in detail by Wright (2011).

171 Often, however, these merely consolidated their power within their groups through repression and regulation in general, and this was usually the beginning of their end or at least the long-term subsequent decline of the whole community.

172 Both in *The Republic* (Plato 1993) and *The Laws* (Plato 2003) and in other works, Plato always used the term *polis* for the community of people we understand today in relation to the city or state.



territorial growth of power had thus become relatively easy again, and a few European coastal state formations covered essentially the entire planet with their overseas territories over the next two centuries. By the end of the 18th century at the latest, gaining more land on Earth and with it also the growth of power over the territory had become much more difficult than before. In economic terms, the cost of further growth of this kind of power increased too much.

Of course, the concentration process at that time took place also differently, for example in the form of information (writing and media) and economic interconnection (trade and market), but the epoch of large territorial gains ended when its continuation encountered excessive risks and associated costs. And much later in the 20th century, the mutual human belonging, whose violations after two world wars and the threat of mutual destruction by nuclear weapons proved to be a much worse variant of development in the form of continuation of the outdated territorial power struggle. In other words, the spatially extensive evolution of human society at the turn of the 17th and 18th centuries encountered old, deep and stable structures – the limited space of the planet on the one hand and on the other hand and later on the very existence and preservation of the human race.

Originally territorial units spatially not strictly defined in the shape of various forms of state formations[173] at the edge of this clash began to slowly stabilize in space in the 17th century and become relatively stabilized structures for further social development. Therefore, since the beginning of the 18th century, human society, as a result of the ongoing process of concentration (power) on the one hand, and on the other hand the territorial constraints in its then core – Western Europe – has been able to enter the historically next, very deep non-linear phase of development, full of feedback and the whole complex of changes without the possibility of unambiguous identification of their mutual causality.

With the end of the possibility of territorial growth, especially of the naval powers, the then level of concentration of power of the elites ruling over them began to gradually decrease. Since the beginning of the 18th century, absolutist and oppressive types of governance have gradually begun to change in Europe towards more democratic forms. The previously described concepts of the constitutional state, the three basic pillars of state power, natural human rights[174], met the demand. Together with this development, changes also in legal and administrative systems took place. The gradual abolition of serfdom or, in general, the institute of servitude[175]

173 Island states were previously established exceptions.

174 In particular, Thomas Hobbes (e.g. Hobbes, Chotaš, Masopust, Barabáš (ed. 2009), John Locke (e.g. Locke 1992), Charles Louis Montesquieu (Montesquieu 2003), Jean-Jacques Rousseau (Rousseau, Šálená 2002)) and others, whose works were reflected e.g. in the French "Declaration of the Rights of Man and Citizen" or in the American "Declaration of Independence" or "Constitution" – here, e.g. The Federalist Papers – Hamilton, Madison, Jay (2010).

175 e.g. Frais (2005)

intertwined with the introduction of subsidiarity elements (and much later, the methods of participation[176]) into public administration.

The rules that had kept the social hierarchy formed until then, began to break gradually. The units had nowhere else to grow in power, but through the people the concentration process continued. Social strata, groups, and people have become more and more free and less self-restrained[177]. Gradually, it began and accelerated the process of human emancipation, that is, the transformation of efforts to support the growth of the power of the whole to the efforts of increasing their own power. Indeed, the original meaning of the word freedom – in the Greek language *eleuthería*, in Old English *freodom*[178], in Czech from the Indo-European root *suobh-oda*[179] – meaning liberation from slavery, tyranny, generally oppressive power, manifested by the possibility to choose. And the origin of the word emancipation, from the Latin *emancipare*, means to dismiss from the thrall, loosing from paternal power[180].

The process of emancipation is a universal phenomenon deeply conditioned by our psychology and observable across nations and communities. It can be seen in the context of development on the collectivism-individualism[181] axis where the direction towards individualism indicates an increase in the level of emancipation, i.e. an emphasis on personal autonomy that leads to self-fulfillment and self-expression and where, in the direction of collectivism, human "self-fulfillment" occurs through externally defined duties[182]. However, the process of emancipation can also be seen as the return of man to his nature, which was suppressed during the historical social development full of competition among people and groups. This view based on humanism is closer to today's Western society. But universally, emancipation is not very successful in situations where one's own survival is at risk.

In general, we can say that in the context of many interrelated cultural transformations, including religious ones[183], the importance of human life began to grow in Western European civilization and, at the same time, the power first of non-elected, i.e. chosen, later already elected individuals began to weaken. It took mankind some time – precisely speaking, up to the limit of linear non-equilibrium development at the turn of the 17th and 18th centuries – to begin to move permanently in a new direction on the collectivism-individualism axis. Thus, this is seen to continue all the way to the so-far latest state of the social system, which is democracy[184], as an institutionalized environment for free human decisions and choices. The fact that this long-term and society-wide process was not easy

176 Participation is understood as an activity that is closely linked to the promotion of democracy and openness of society (Prudký et al. 2009).

177 The combination of freedom in a general sense and economic freedom is very strong – among others e.g. Friedman (1993).

178 Harper (2018b)

179 Loucká (2003)

180 Harper (2018c)

181 The issue is summarized and demonstrated by means of many correlations by Inglehard, Welzer (2010) and they identify traces of this knowledge in the works of sociologists from the turn of the 19th and 20th centuries: E. Durkheim, the already mentioned F. Tönnies and also particularly Max Weber linking the progression of Western European civilization with culture and Protestant religion.

182 more in the extensive work of Geert Hofstede, best e.g. in Hofstede (1980)

183 including the religious, more in e.g. the extensive work of M. Weber – *Protestant Ethics and the Spirit of Capitalism*, described e.g. in Weber, Havelka (ed.) (1998)

184 more e.g. Fukuyama (2002), but also Inglehart, Welzer (2010) and others



and far from straightforward is evidenced also by the fact that each state initially followed this development in a different way. While, for example, the United Kingdom continued to progressively weaken the power of the monarch through further democratization of institutions begun much earlier[185], France embarked in the 18th century on several revolutions and wars, and also Germany, in the 19th century, consolidated first independent state formations on its territory, later also outside it[186]. However, the winding of this path is evidenced in particular by the late 20th century, two world wars, the collapse of the colonial world and the waves of state independence[187]. However, also the turn of many countries, including the Czech Republic, in the second half of the 20th century back to collectivist state systems, in which the spirit of freedom and personal autonomy was mistaken for liberation from the necessity of choice[188].

Reflections of the described emancipation process can be observed in many aspects of long-term modern social development. We will now focus mainly on the technological and economic aspects.

In Western Europe in the 18th century, the gradually increasing elements of freedom and the individual increase in power in the form of leisure time and resources allowed individuals to better and to a greater degree offset inequalities (in economic terms, the differences between demand and supply) in their immediate surroundings. One of these inequities was the great inequality between the need to further concentrate the workforce and the limited number of people, while the demand for labor productivity continued to increase. In this respect, it is more than symptomatic that an improved steam engine was created (albeit only after 50 years of the existence of this know-how) and commercially used by Scottish mechanic James Watt in the 1770s[189], i.e. roughly at the same time as the last up until that time "unoccupied" habitable continent – Australia – was declared the territory of Great Britain[190].

As the machine emerged and the concentration of power became increasingly less and less dependent on the amount of pure human labor, the ability to accumulate power gradually shifted to the sphere of property and wealth of important industrialists and entrepreneurs living in the cities, further accelerating the crumbling of the power of the elites and social transformation of states. Therefore, the loss of power of elites cannot be by any chance considered a loss of power of these social units (unless it was a nationwide collapse). On the contrary, it was in fact an increase in their strength, as many

185 More about the constant search for the right level of freedom in historic England and the modern-day United Kingdom well-described in e.g. Maurois (1993). Great Britain must always be considered a relatively exceptional (developed) island state.

186 e.g. Budaj (2016)

187 also with relation to the present condition e.g. Taoua (2018)

188 Hayek (1990)

189 the phenomenon of industrialization summarized as well as with other references described by e.g. Savický (ed.) (2016)

190 Hayek (1990)

more people began to participate in their performance with their own liberated energy.

Subsequently, from the turn of the 18th and 19th centuries, one industrial and generally technological innovation began to follow another. Under the legal and security framework of the states providing the market (gradually increasingly free and unrestricted and, at the same time, increasingly territorially larger until finally global today), new hierarchies began to be formed, based on the technological and company-organizational level of knowledge in the given era. With continued population growth and technical progress, this gradually led to a more complex or, better to say, "organic" behavior of the whole-society system. Like other complex systems (or organisms), the increasingly intertwined world economy had begun to exhibit certain analogies of rhythms.These economical-technological cycles were described already in the early 20th century by the Russian economist Nikolai Kondratiev[191] and have since been elaborated in countless works[192]. To date, these five cycles are distinguished and are linked in particular to technological innovations – steam utilization, rail development, electricity, oil and automotive, and finally computer and the Internet. Even their origin must be sought in the general concentration process, but this requires some explanation.

All industrial innovations should be seen as non-linearities in social development. Compared to the overall transformation of society we are talking about, however, these non-linearities are less profound. They happen within an already established and ever so steady socio-economic framework.

Every technological innovation has always meant the materialization of the desire to accumulate more power. New and economically used and developed innovation therefore does not usually reduce inequality; on the contrary, it increases it. "Deeper" innovations, be it the invention of lettering or later letterpress, the "invention" of insurance and its use in overseas discoveries[193], the steam engine, electricity, and others, always had a centralizing effect first and strengthened only a certain group of people. Only later, after reaching the profit limits of these groups, did some element of these innovations always spread by diffusion, i.e. thinning. Thus, knowledge began to spread through books, the ability to calculate and share economic risk created banks and subsequently international trade. Therefore, any such comparison of social inequality has always had to do with speeding up or improving the transmission of information (money is also information), shortening distances, speeding up transport, increasing contact, or generally improving (mutual or information) accessibility[194].

191 Kondratiev (1935)

192 Blažek, Uhlíř (2002), p. 97

193 Taylor (1996)

194 The same can be observed in the digital or e.g. telephone network. In the future, there will be no reason for a call between two neighboring places, several dozen meters away from each other (mobile phones) to be mediated with the involvement of a remote center.



The discovery of a steam engine in the second half of the 18th century and the need to concentrate production lines to its vicinity (we were unable to conduct energy too far) attracted people to the cities. In London, this occurred first, during the 18th century. In the middle of the 19th century, geographic space began to shrink rapidly. The development of rail transport began, we gained the ability to spread (electric) energy, the automobile industry took the field. This again spread the cities into space. At the end of the 20th century, our "relocation" took place again – this time into the virtual world and into our mobile phones. Space (at least the virtual one) has shrunk to singularity.

The economic cycles described by Kondratiev and others should therefore generally be understood as societal spatial concentration waves, a sharp improvement in the availability of labor, mutual accessibility of people, energy and information[195]. In other words, these are great and step-by-step advancements of certain non-availabilities of different types of information or its media in the history of social development.

In today's next economic cycle, unavailability can mean also, for example, overly complex machine control or computing in general. In this respect, it is also likely that the next concentration wave will go beyond the power of computer technology that enables people, on the one hand, through an advanced interface made up of sufficiently advanced artificial intelligence to access a wider range of information, manufacturing processes, supply networks, research and innovation and more for many present day people on the planet heretofore forbidden knowledge. As a result – and the future seems optimistic in this respect – among other things, the creative work of an increasing number of people will also better manifest and to a larger extent, and thus technological innovations will continue to increase. Enhanced computing power[196] will also allow people across nations through advanced digital interpreters to communicate with one another in one language.

However, as in the past, also this future technological development will put increasing pressure on more and more societal changes. In the urbanized parts of developed nations already in the second half of the 20th century the emancipation of the population reached its peak and to some extent lost its attractiveness when even the sexual minorities got what they wanted. It is therefore appropriate not to call the following development emancipation anymore, but individualization. Today, this seems to go beyond a reasonable framework for a well-functioning society[197]. And maybe we really need

195 In this respect, however, due to the complexity of the issue, there is to a certain extent a lack of research into the gradual or step development of the proximity and connectivity (= number of connections) of people depending on the key innovations described in connection with Kondratiev's cycles. Deeper research is needed in this historic-economic-technological-geographical area.

196 i.e. the overall level of hardware, software, advanced miniaturization, new types of batteries, etc.

197 Reflections on this development e.g. Lipovetsky (2008). However, even according to our first president T.G. Masaryk, extreme individualism was at least doubtful. According to him, no self is and cannot be alone. Each individual develops in society and is, in a better case, brought up in a family (Masaryk 1946, p. 34).

198 However, it can be assumed that there are limits as well. In order for society to function, at least the so-called creative minorities, an important engine of further civilization movement, must be created. These were described by the important British historian Arnold J. Toynbee, more e.g. Sokol (2016) or Krejčí (2002).

199 from many e.g. Keeley (1997) or Roser (2013)

to worry about further changes. The complete "equality" of all interconnected people, the absence of social or scientific elites, the formless mass of billions of cosmopolitan world citizens[198], such a thing can only be one step to some collective outburst of hate and destruction. On the other hand, it is proven, however, that modern complex societies are less violent than primitive societies[199].

It is also clear that there will be further pressure to weaken national borders, driven on the one hand by the ever-growing economic-technological hierarchy of globally operating firms. And to a certain extent, in contrast to this, the ongoing emancipation of people demanding an increasing share of power and greater responsibility for at least their immediate surroundings. So, as the 19th century is called the period of empires, the 20th century is a period of states, it would probably be right to call the 21st century a period of cities, or rather metropolitan areas and regions. And it is likely with further technology growth that even further in the future, this development will continue through some form of advanced virtual reality to the human communities to which we are naturally biologically set. It would therefore be a mistake to consider the development to date to be complete, as we will continue to seek and refine our own measure of nature in our actions and behavior also in the future[200].

So, if the states want to continue at least in some form, they will ultimately have no choice but to face, on the one hand, through ever closer mutual economic interconnections, the power of multinational corporations, and in the environmental field global environmental problems. On the other hand – especially in the social sphere, in the areas of construction, housing and environment but also, for example, education or culture – they will have to release the reins to regions and big cities. In other words, states are too small and weak to global problems, but at the same time they are too large and cumbersome to address the rapidly growing diversity of human needs. States are now choosing, and in the future it will be more and more topical, between two directions of further development. Either they can gradually reduce their own power in certain directions, or increasingly risk that their power will later be diminished uncontrollably, in all directions at once.

This whole process, which we have outlined in broad terms and which is described by various authors from different sides and by different names – modernization, individualization, industrialization, urbanization, etc. – is a story of many chapters. Only the theme of the relationship and tensions between structures in the form of state formations and their borders pervading the more or less free market would make for many separate books[201]. And similarly, the issue of boundaries, limits and limitations of the emancipation process cannot be described in just a few lines – after all, we will return to this issue later, from a different side, in the section devoted to planning. For us, however, it is important that part of this gradually deeper and deeper transformation of society has been and continues to be a change in the spatial and population size of cities and the change in people's behavior associated with it. Therefore, in the next chapter we will focus directly on the manifestations of basic system processes in cities.

200 From the position of the richer part of the world it should also be added that existential uncertainty is still a dominant reality in a relatively large part of the planet, characterized by low socio-economic level, lack of quality education and information, material deprivation and from all of this resulting limited choice of the population concerned.

201 Every cycle always entails also some deeper transformation in the functioning of a larger system. It is therefore impossible not to see, for example, the connection between Kondratiev's cycles and gradual corrections of the world economic system (e.g. Narkus 2012). This was the withdrawal from the gold standard in the 1920s, between the 3rd and 4th Kondratiev cycles, and in the 1970s the Brettonwood system was abolished and the role of the International Monetary Fund and the independence of central banks was subsequently strengthened.

The golden age of the world's most important cities is connected with how their respective states formed and developed.

The development of industrial conurbations was not the core of socio-economic-technological nonlinearity, but one of their consequences.

The growth of metropolitan areas in the 20th century is a remnant of earlier growth of states.

The internal structuring of the city, both functional and urban, is part of society-wide nonlinearities.

Cities were detached from their hinterland due to the interconnection of the world.

Today, the life of a resident in Prague is closer to the resident of Buenos Aires than to people living in the countryside.

# 9. Development and future of cities

Unlike simple systems, the development taking place in a complex system, i.e. also in the social one, is extremely diverse. Somewhere and sometimes thinning predominates in it, somewhere and sometimes growth linear phases occur in it, and somewhere and sometimes non-linearities of different depth occur in it. And, moreover, all these already differentiated processes happen differently at scale levels. And it is true that the lower the level, the more detailed, in the case of the social system, therefore closer to us people, the greater the variability of processes, but also, for example, the greater their speed of rotation.

Therefore, at city scale levels, or even closer to us, it is very difficult to find some unifying lines across the evolution – as was the case with concentration and thinning of power (chosen individuals) in all-society development, which we described in the previous chapter. This of course does not mean that the basic system processes – thinning and concentration – are not the main drivers of development. However, this means that these basic rules are hidden under the influence of many other factors, conditioned, for example, by time (epoch), regional context, past elections, cultural specifics, technical maturity of the given community and many other factors. It is very similar to the situation when we repeatedly drop a plain sheet of paper from a table, and it always hits the ground differently and at other times, despite the effects of Newton's universal laws of gravity.

In this chapter, we will focus only on certain selected moments and processes in the history of cities, where both the influence of the basic system processes and the transformation of the development phases of the systems are evident and especially the development itself as Wolfram's class IV on the edge between order and chaos. And, of course, even in these examples considerable simplification and generalization will need to be utilized.

The growth, i.e. linear non-equilibrium phase of system development can be well identified during historical periods, when extensive harmonious development took place at

several hierarchical levels of the given social system. It was, for example, the period of growth of ancient Rome within the Roman Empire until and around the turn of the era, but also the period of growth of other major cities and state formations controlled by them (and at the same time controlling them). Such periods were usually the golden eras of their development (See TAB. 2). Most cities in history had only one such era[202].

However, the period after this golden era of theirs developed differently for each of these high achievers of the individual epochs. As always, ancient Rome is a good example to study.

The expansion of the Roman Empire at the turn of the era was so rapid[203] as a result of the relatively easily accessible surrounding area that the necessary progress in social organization and in particular the speed of transport, or transmission of information and with it also power was not achieved. In the final analysis, the Roman Empire, just as it was composed of many diverse territorial units, collapsed after some time without any visible transformation. That is, almost.

Inside at that time an incredibly large, powerful, and populous Rome, probably the first and for a long time the last city with a million inhabitants on Earth, a seemingly minor but extremely important innovation, i.e. non-linearity, occurred from the perspective of the organization of society. After several centuries, despite the general decline of the city, the Holy See was established there, and the central part of Rome became the basis of a new kind of concentration of power.

The example of the Roman Empire shows the importance of a combination of somewhat limited space and sufficient resources for complex development, and that this is true not only in natural systems but also in social ones. If it had not been for the creation of the Vatican State, the emergence and decline of the Roman Empire, and Rome itself with it, would have been an example of other than Wolfram's class IV of development on the border between order and chaos. It would be class 3, thus repetition. And for a long period of the Middle Ages, it looked like it. In fact, state formations in this period were not in any way socially or technically more advanced than the former Roman Empire. However, it was precisely because of the transformation of Rome into the center of Christianity[204] as a result of the unifying influences of the Christian religion, there was no repetition of the same fate, i.e. disintegration, in these later state formations. In other words, thanks to at least some similarity in the core of the then state formations on the

202 In fact, the vast majority (not only of large European) cities had only one golden era, but there are exceptions – e.g. New York or Vienna, as described e.g. by Hall (1998). In the Czech towns, their golden era dates back to the 14th and 15th centuries (e.g. Winter, Royt, Havel 1991). This historicizing view speaks more of the settlement system as a whole. Industry (in the case of e.g. the Ostrava region) and especially the recently globalizing economy (affecting mostly large centers – Prague and Brno) cannot be neglected.

203 And this was mainly due to the technological and scientific superiority taken over from ancient Greece.

204 And essentially in a similar way, for the later rise of Western Europe, the separation of Protestants from the Catholic Church, i.e. Protestant ethics (e.g. Ferguson 2014), is often appreciated. Christianity (especially Prostestantism) at the heart of capitalism is at the heart of Max Weber's theories (e.g. Giddens 2013, p. 88).



| City | The golden age |
|---|---|
| Athens | 500 BC |
| Rome | turn of the century |
| Florence | 14th century |
| London | 16th century or other centuries |

TAB. 2 – The golden age of major European cities before the Industrial Revolution, source: Hall (1998), adapted

continent, the states began to limit one another territorially before they hit the limit of the then underdeveloped instruments of concentration of power.

What is particularly important to us, however, has been a huge technological advance in the art of urban construction in Rome itself[205]. We owe much to the golden epoch of Rome to this day. Judge for yourself: in Rome at the turn of the era 18 aqueducts with a total length of over 500 km provided water, there were 11 forums and the same number of public spas, 10 basilicas and 9 circuses and theaters, 28 libraries, 36 triumphal arches, 22 equestrian statues, more than 150 monuments, 8 bridges and 6 obelisks[206]. The human skills that created all of this have never since disappeared in further social development. On the contrary, it is thanks to it that today it is possible to see retrospectively in many places of Europe in the Middle Ages how cities under the roofs of existing state bodies literally grew like mushrooms after rain. In the Czech Republic, such a period of "reproduction" of cities dates back to the 12th and 13th centuries, especially during the reign of Ottokar II of Bohemia. However, each area in Western Europe was subject to different pressures from its surroundings at different times, and therefore it is no longer possible to draw unifying conclusions beyond the aforementioned nature of the art of building cities.

In the long period of the Middle Ages, not only the social organization but also the inner environment of cities were not much affected by significant non-linearities of development. Those can be better observed again only since the end of the 16th and especially through the 17th century and later, when the territory of the then state formations covered the whole Earth, making further territorial gain possible only due to greater technological superiority[207]. Approximately since then, it is possible to observe the disharmonies of development on the individual hierarchical levels of an increasingly interconnected social system – at least in the basic division at the levels of people, cities and state formations. The states had nowhere else to grow territorially (although the great and powerful even then countless times occupied and some still

205 Among other things, Rome was a high achiever also in e.g. dealing with fires. Although due to the primitive (or no) building codes and materials used its buildings were very vulnerable to large-scale fires and public fire services were virtually non-existent, wealthy citizens often had such fire brigades at their disposal and cheaply purchased burning flats before the fire was located (Norwich (ed.) 2016). Among many others exploring this issue e.g. Diamond (2008).

206 Hrůza (2014), p. 143

207 Completed in the 20th century with the capacity of total self-destruction during the nuclear war between the USA and USSR.

occupy other territories), and their former extensive development consequently had to turn inwards with varying intensity, to hierarchically lower levels. In particular, in terms of the development of prepared inequalities for further concentration, they had to turn to large and important cities.

In cities, the pressure on their borders gradually began to increase. In the 18th century, in important cities in Western Europe, these were usually made up of walls, which, at the same time, were not much needed from the security point of view at that time. Moreover, in the second half of the 18th century, these became annoying because of the need for urban spatial development – at that time industry could not carry energy over long distances and, therefore, workforce had to concentrate near a central steam engine. When cities began to outstrip job opportunities in rural areas, causing a large relocation of population, there was nothing left for the cities but to open up to the surrounding area. And that precisely at the cost of some dilution of power over its own territory, which will flow through our next text like a silver thread. By the end of the 19th century, more or less all the important cities in Western and Central Europe had destroyed their development-preventing walls[208].

It is also worth noting that in the case of the 18th and 19th centuries this is another era of founding new cities, in places of mineral deposits, again under the ceiling of state formations, but also under the ceiling of the already functioning continental market. And since the costs of transporting these primary industrial products at that time were not nearly as minimal as they are today, then, as a rule, not cities alone but large industrial urban conurbations were founded[209]; a conurbation without a clear hierarchy, as we know it from functional regions, where the core city is usually surrounded by agricultural surroundings.

For this extensive urban development in the "early industrial" centuries it is true that, the same as the general development, it was not continuous, but rather abrupt. Many times, urban growth has come across territorial limits in the form of limited transport speeds, and therefore it has not only been a driving force for other technological innovations that first enabled faster urban mass transport and later also individual transport but, at the same time, it was also a fundamental cause of differentiation of inner urban environment. This non-linearity, i.e. the gradual transformation of city centers from the former majority housing function to industry and commerce, is well described by the economic Bid Rent Theory[210], whose essence can be expressed in a concise way

[208] Perhaps with the exception of Prague, where the demolition did not begin until 1894 (Hrůza 2014, p. 473). Often, the walls were removed only at the time when they themselves had grown into the urban organism. In the case of Prague, Bečková (1998) states that more than 100 houses were built only in the area of Prague's Vinohrady in just 30 years (1881–1910).

[208] And based on many types of localization factors (from countless publications, see e.g. Venables 1996).

[210] from the Bid Rent Theory, e.g. Fujita (1991)



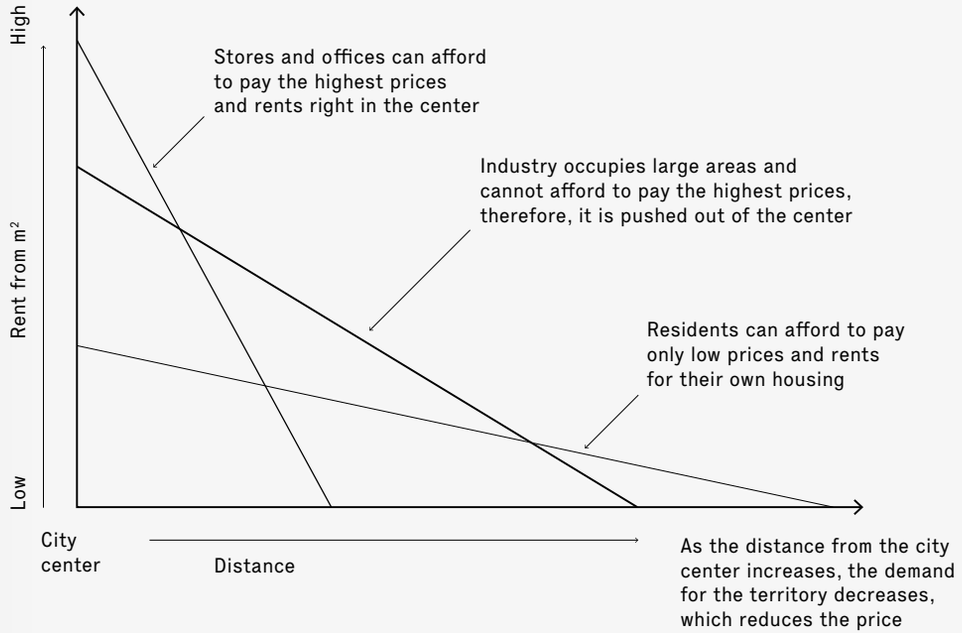
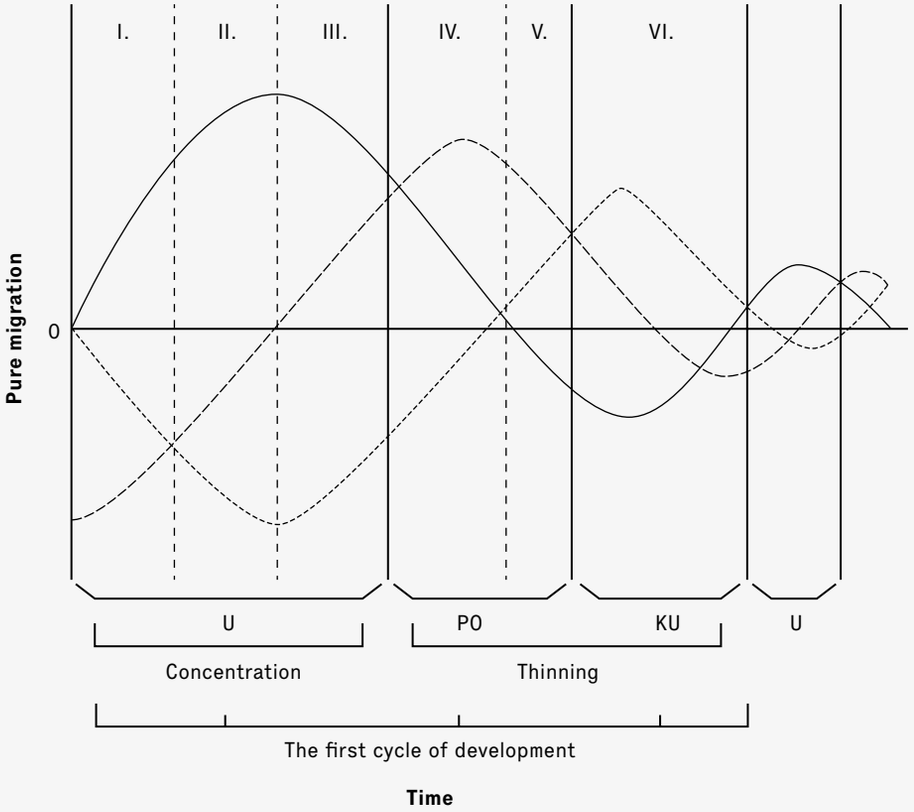



FIG. 19 – Land rent theory, source: Harvey, Jowsey (2004), adapted

that higher value added functions gradually push lower value added functions from the city center (FIG. 19).

In the aftermath of the industrial revolution, the development in the individual cities began to diverge extremely due to an increasing number of factors and influences. Even minor differences in the regional and cultural context, in the era of development or in the technological level of maturity of the given community have become the basis for the total otherness of the then rapidly growing or directly emerging cities. American cities, for example, were caught by the era of their development already at the time when public transport and increasingly individual car traffic were developed, which allowed their extreme spatial expansion. Some of these cities, however, were territorially limited, but since at that time there was already an elevator, it could and, at the same time, it had to grow in height instead of in width. For example, islands[211] (New York) or harbors surrounded by mountains (Chicago, Hong Kong) can be a good example from the late 19th and

[211] Czech geologist and climatologist Václav Cílek, CSc. explicitly states that in New York City the walls – so typical of urban development in Europe – have been replaced by the coast of the island since time immemorial (Cílek 2010).

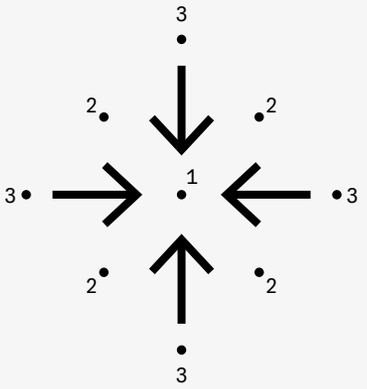



I. Early phase of primary city development
II. Interphase of primary city development
III. Late phase of primary city development
IV. Early phase of medium-sized cities development
V. Late phase of medium-sized cities development
VI. Phase of small towns development

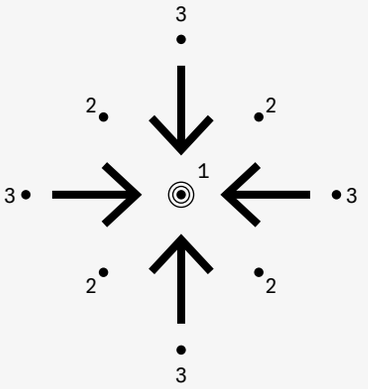
U Urbanization
PT Polarization turn
CU Counterurbanization
— Primary cities
-- Medium-sized cities
--- Small towns

FIG. 20 – Scheme of system development according to the theory of differential urbanization, source: Geyer, Kontuly (eds.) 1993

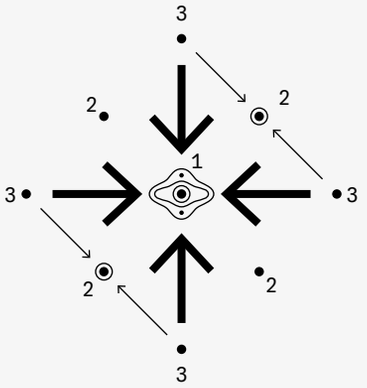




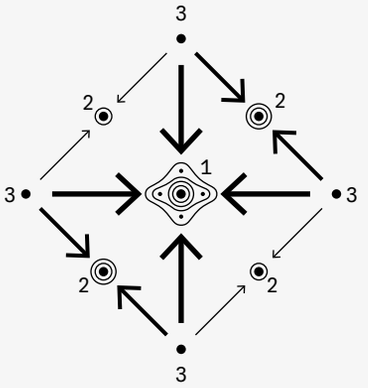

Early phase of primary city development



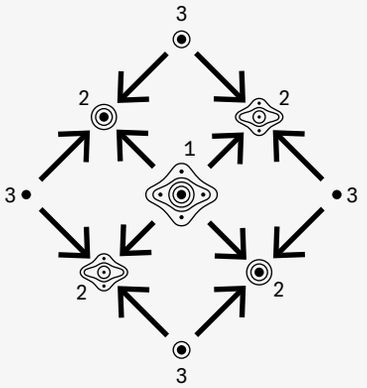

Interphase of primary city development



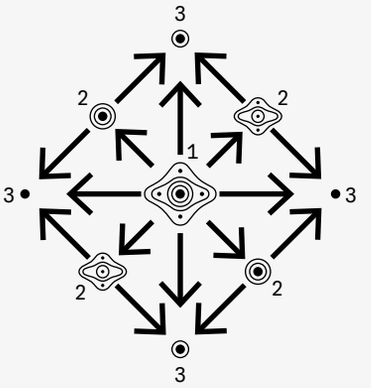

Late phase of primary city development




Early phase of medium-sized cities development




Late phase of medium-sized cities development




Phase of small towns development

early 20th centuries. Asian and Middle Eastern cities emerged even later.

The diversity of urban development trends can also be demonstrated by the consequences of the different size or importance of cities within the settlement system. Non-linear development usually begins in the largest city and only then spreads to the settlement system. One of the most recent urbanization theories, the so-called Theory of Differential Urbanization, attempts to describe this. It says that manifestations of growth occur in the following order: the largest cities, then centers in their hinterland, and only then the development of medium-sized centers (FIG. 20).

Over the last few centuries, the transformation of the more and more society-wide system has become ever deeper. An increasing number of different processes are intertwined and merged into one, originally not quite appropriately named globalization, but now clearly evidently named as complexation. Causalities, causes and consequences can be less and less identified in it. The only thing that remains clear is that while borders of states do not change much, with some exceptions, and usually as a result of serious conflicts rejected by the general public, cities and the people living in them are subject to ongoing development.

Thus, in particular, large cities have been expanding a lot for more than a century and connecting in densely populated urban metropolitan areas[212]. A physicist would see certain analogies of cosmic clusters in this, and a chemist would compare the process in question to the crystallization of a substance such as ice in water. The most important and continental ones have names – such as BosWash in the east of the US or Blue Banana in Europe[213]. These are areas of continental character with tens or hundreds of millions of inhabitants. In densely populated areas, especially of southeast Asia, but also of Latin America and Africa, new and more urban metropolitan areas are emerging.

While within big cities there is a non-linear development and our behavior is changing, as we have already described in Chapter 3, the evolution on the edge between order and chaos is largely related especially to the closer territories outside these core areas, outside the territory of previously clearly defined city boundaries. The suburban zone is thus the epitome of development. And this is largely a problem, both in terms of the environment and the management of this area, which, however, are connected vessels today.

Compact cities are able to respond more quickly to emerging problems, while urban areas, "scattered" in space, with

[212] the topic of metropolitan areas in the Czech Republic, for example the study by Dostál, Hampl (2002) or Hampl, Marada (2016)

[213] more on the issue e.g. Toušek, Kunc and Vystoupil (2008)



decentralized governance are unable to make decisions and respond to changes. Especially problematic in this respect is the uncoordinated suburbanization called urban sprawl[214]. In the past, cities were usually established as centers of agriculture, or trade in agricultural products (and later industry) and, therefore, they are usually surrounded by the most fertile land. It is somewhat paradoxical that in this respect, cities constrained by physical-geographical barriers, i.e. islands or e.g. ports from the other side reaching to the foot of the mountains, are doing best today.

Although there is, against previous assumptions, still not one large so-called ecumenopolis[215], i.e. an area-wide built-up territory without any borders, forming on the surface of the Earth, we are rightly concerned about the occupation of land by built-up areas. In the future, it may become apparent that the environment is as hard a barrier to the further development of our society as the territorial constraints of our planet, reached by state formations at the turn of the 17th and 18th centuries. Thus, the environment and its transformation will push us even more together towards an internal transformation of our entire society – into increasing polarization on the axis between (large) urban territory versus other territories. It is a manifestation of an increasingly intense, deep non-linear development, transferred as a residue of the earlier expansion of states to the hierarchically lower level of our largest cities.

The global nature of this trend is made possible by a simple fact. Today, not only food, but virtually any commodity can be transported at minimal cost and very quickly from virtually anywhere on Earth. In particular, large cities have broken away from their surroundings, even competing with them instead of collaborating (competing for residents and their activities), but they gradually began to share these former facilities of theirs (such as agricultural, but also industrial). This reduced the number of "degrees of freedom" of development, since while before each urban organism responded to the situation in its region, and that in turn responded to the situation in even greater surroundings, with shared facilities in the course of particularly the last century, especially large cities began to develop in one and the same surrounding environment[216].

As a result, today's globally interconnected cities (and their inhabitants) are more similar to one another in all new things than before. Urban life is almost no longer different across continents. The lifestyle of a resident of Prague is closer to the lifestyle of a resident of, for example, Buenos Aires, than to life in a village.

[214] In Czech conditions e.g. Hnilička (2012).

[215] More about it, preferably, the author of the term himself: Doxiadis (1974). In fact, something else is happening on Earth. In accordance with our findings from the previous chapters, it seems that once inequalities have arisen, they usually remain throughout the development. This is evidenced, among other things, by the calculation of commuting in the Czech settlement system between 1991 and 2001. To important cities – the core areas of regions – commuting from the neighboring, already previously hierarchically subordinate municipalities increases proportionally to the size difference of the centers (Hudeček 2010). In other words, from villages around a large center, during the process of commuting into it, an increasing proportion of people living and working there is sucked into it over time, and this trend is most evident at the largest centers in the settlement system. Therefore, not an ecumenopolis, but several dominant, but large-scale urbanized areas can be expected in the future on the surface of the Earth. Also the famous Jane Jacobs has thought about this phenomenon but she calls the principle of this development a „certain/some force" that pushes the settlement system towards one dominant

metropolitan area over time (Jacobs 2012).

[216] And the same applies to people connected through the Internet.

As before man overcame physical-geographical differences, today's urban man overcomes cultural differences. But not a person living outside these cities, thus fulfilling the diversification of a complex system that makes it possible to keep the development of our society in a narrow space of Wolfram's class IV.

Thus, these days, on the one hand, there is a community of people inside large, densely populated cities, where, thanks to close contact of people, progressive opinions are formed, people are not afraid to experiment in them, and where, therefore, rapid development is taking place. And, on the other hand, there is a person less connected to the global world, usually living in a less densely populated environment, which is determined by surrounding cycles. In other words, on the one hand there is a generally melted or even liquid social environment spreading newer and newer views of the surrounding reality through the information media, and on the other hand a traditional environment, only partially eager to exploit the products, innovations and ideas emerging within cities[217].

[217] Good urbanism is therefore about the economics of time. In the city, we can deal with other things than securing our biological needs. A resident of an apartment building takes care of just a few walls and the rest of his time devotes to cultural activities, and therefore large cities spread culture, language and even, for example, fashion.

And at the intersection, but also the edge of both, is the close background of (large) cities, where the way of society-wide development leads. But this is also nothing new in human history.

It was in cities where our efforts to recognize different human rights has always begun. First, for example, in the abolition of slavery, later in the equality of women, in universal suffrage and many others. The essence of such a society is, due to the continued emancipation, strong individualization within the global interconnection. Indeed, these are liquid-like properties – as this phenomenon was described and named by the Polish-British sociologist Zygmunt Bauman[218].

[218] Bauman (2002)

At the same time, living in cities (especially the big ones) has never brought only benefits. Apart from the "air that liberates", cities have also always unwillingly supported e.g. the creation of social inequalities; decimation by poor hygiene and the resulting epidemics therefrom were common. Even the inhabitants of modern cities, who benefited from their rapid economic development, always subsequently felt also the negative side of their own proximity as well as the proximity of the first machines and people.

Therefore, many times in history it was necessary to look for a way forward. The richest and most important cities could afford to use the strength and power of even a higher entity – a state formation – to carry out its internal reconstruction. In the 19th century, especially Paris excelled among them[219]. However, the urban environment was poor even in less



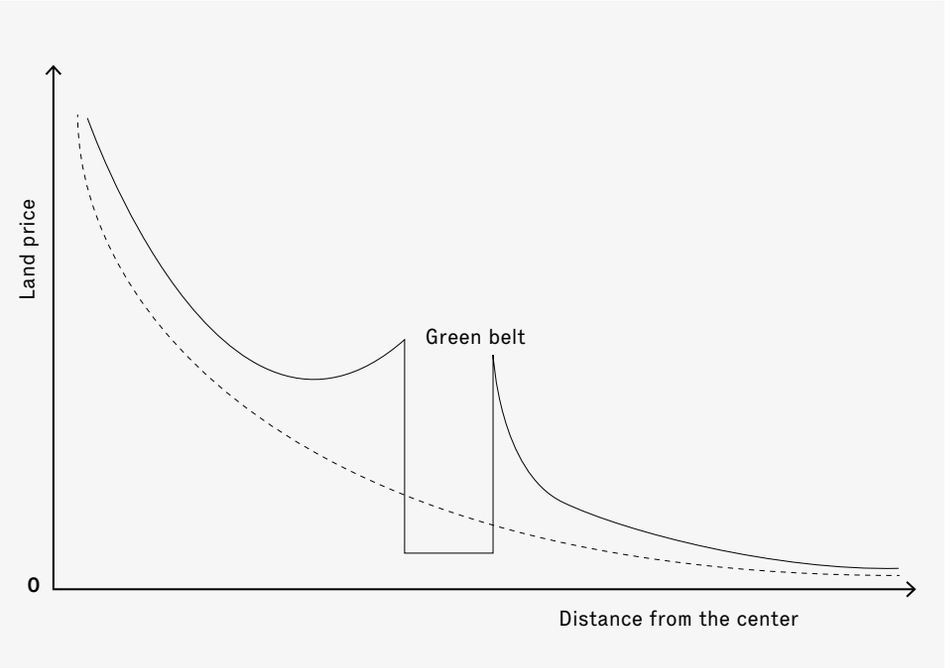



FIG. 21 – Influence of the green belt on the value of the territory, source: Harwey, Jowsey (2004)

[219] E.g. Hausmann's reconstruction of Paris in the 19th century during the reign of Napoleon III. The transformation is described in detail by Jordan (1996). However, also the interventions of totalitarian states in the form of their most important cities, such as Nazi Germany or the Soviet Union and others, must be similarly assessed. For this step, there must always be a certain degree of despotism in the state.

[220] A name of a somewhat utopian concept of a city solving the problems of big cities polluted by industry. The author of the term is Ebenezer Howard. More e.g. Hall, Ward (2014) and many others.

important cities. Attention, and hence the development itself, turned for the first time and not for the last time to the areas around cities. The concept of remote housing, named as the Garden City[220], was conceived as a green belt of populated area around the city center, combining the benefits of a beautiful landscape and proximity to a city full of life. However, its importance later proved to be economical as well, as shown in FIG. 21.

Le Corbussier introduced the concept of a modernist settlement, which was later formulated under the Athens Charter in 1933[221]. In the communist world, it was eventually linked to a modified concept of garden towns – Prague (and many other cities) thus acquired the outer ring of housing estates, in the second half of the 20th century.

Gradually, however, it turned out that rather than the benefits of a certain proximity to both the production line and the landscape, this concept combines rather clear disadvantages from both. There was a rediscovery of street qualities and a continuous and frontal development, and at the same time the new generation grew with the drive to change and correct things. People began to return to the city again, in which the citizens' elected city administration also played a major role,

which remedied the quality of life in certain areas. But also the ability of people to innovate their practices and cultivate the industry.

This is a direct demonstration of the evolution as being dragged between thinning and concentration. While space is being released as a result of non-linear development, new consequences of continued concentration are being pushed into this space at the same time, and vice versa. Similar to a growing pile of sand, where the avalanche of sand slides down in order to – but at the same time also because – put more matter in its place.

In the history of a successful city, every general deterioration in living conditions that exceeded a certain limit, i.e. was perceived by the inhabitants, has always been resolved. And again, every further increase in proximity, availability and density brought countless new challenges that then urban society had to deal with.

Was better fire protection needed? Building regulations were modified, less flammable building materials were developed or used and streets were widened. Was it necessary to travel further and in large groups of people? The bus was used and tram tracks were built. But was there already stabilized development in the area? Subway tunnels were dug up. Do today's cities have the problem that families with children in them are not faring well? Therefore, they strive to be as friendly as possible for moms with prams, offering free and mainly barrier-free transport as well as non-smoking pubs. Do people fill the streets with their cars and pollute the air? Cities therefore turn their roads into cycle paths and pedestrian zones and favor electric cars. Is there unmanageable crime in the city and people worry about their lives and their property? Cities are strengthening repressive forces and developing new methods for detecting crimes[222].

A good example of overcoming the biggest problems are usually high achievers in size and importance. For example, the first modern city with a million inhabitants – London – faced heaps of horse droppings at the turn of the 19th and 20th centuries[223]. The ubiquitous smell, rot and contagions emerging from it brought a near end to the enormous and apparently unsustainable concentration of population, capital and industry at that time. London was saved by the internal combustion engine and the automobile. In the last 50 years, however, voices have been growing in it demanding the decrease of the number of cars. People feel they are choking on their fumes. Waste, noise, light smog and, recently, also too much heat are still ahead of us to solve. And over time, contamination with

[221] An extensive description of the development of world urbanism is provided e.g. by Hrůza (2014).

[222] These and other possibilities of using big data for administration (not only of cities) are mentioned by although popular-educational, yet a publication based on real cases by Mayer-Schönberger, Cukier (2014).

[223] Tarr, Shane (1997)

[224] As a rule, only some shock, some unexpected catastrophe – a fire that engulfs wooden houses separated by narrow streets (as in London in 1666 (Hanson 2002)), or a blackout in a cascading failure of an overloaded distribution network (as in Auckland in 2006 (Electricity Authority of New Zealand 2010)) will reveal some decreasing rate of such urban resilience. Or also the emergence and rapid exponential spread of a dangerous virus against which it is not possible to build barriers in a fluid urban environment, which until recently was a threat especially in densely populated African or Asian cities (e.g. SARS in 2003), which, however, easily grows into a global pandemic in today's world (as in the case of COVID-19).

[225] Such cities are referred to "walkable cities" (Speck 2012).

[226] What can be shared in densely populated urban areas is a major research and political theme these days. Starting with common commodities such as territories, housing, means of transport through energy, water, waste treatment, use of various technologies up to administration (Gorenflo et al. (Eds.) 2018). And, on the other hand, it is quite likely, although research in this area is not very widespread yet, that we also share our "in-organic" microflora in large cities. That also our human bodies with all the bacteria adapt to one another.

[227] Hudeček, Dlouhý, Hnilička et al. (2018)



certain frequencies of electromagnetic radiation from a plethora of wireless digital and mobile devices may also matter[224].

For the long-term sustainable development of human society, it is therefore necessary – as it was many times in the past – to continue to seek ways to bring the inhabitants closer together and connect them more intensively in harmony with the natural environment.

On the one hand, this is easy. In densely populated areas, it is enough to get out of the cars and return to the older types of human movement – walking. To create a so-called compact city of short distances, where it is enough to move on foot, or use public transport[225], and where more and more things can be shared and thus strengthen agglomeration savings[226]. People want to live close to one another and at the same time have plenty of privacy and such a demand today, when it is no longer possible to build an organically grown city without a plan due to especially safety, fire, hygiene and other standards, populated urban block structures, blocks of houses with offices as well as apartments lined with streets with living parterre and cafes but, of course, with sufficiently large and spacious apartments with sufficient floor space per capita, are the most relevant[227]. Today, it is possible, because the modern IT industry is so close to office work that e.g. a family with children creates more noise and other externalities today than an ordinary office. Today's common trend (not only) in European cities is the mixing of different functions.

At the same time, however, this is not an easy task, as this direction of development needs to be enforced in our contemporary society. And here, on the contrary, the situation has become much more complex compared to a similar situation in the past due to the growing emancipation and individualization. Therefore, in the future, it will be necessary either to strengthen, above all, large cities in their decision-making – in particular to subordinate their surroundings to them in terms of power – or to move decision-making from cities to a higher, at least regional level, i.e. the level of agglomerations and metropolitan areas. But this is already part of the theme of the second book, the decision-making.

City Management and Administration
Tomáš Hudeček

Prague Institute of Planing
and Development, 2020

Graphic design: Martin Odehnal
Translation: Didacticus, s.r.o., Marcela Uhrová

Financial support:
Project n. TL01000423 “Improvement of systems
and processes of permitting new construction
in Prague: affordable housing”, Technology Agency
of the Czech Republic 2018–2020.

Reviewers:
Miroslav Svítek, prof., Czech Technical University
Jan Jehlík, prof., Czech Technical University

City Management and Administration: ISBN 978-80-88377-15-3
The First Book: ISBN 978-80-88377-16-0
The Second Book: ISBN 978-80-88377-17-7
The Third Book: ISBN 978-80-88377-18-4

Originally published as *Řízení a správa města*

**The study is devoted to the complex issue of knowledge and management of complex systems, illustrated in more detail on the example of Prague. The scope of the author's interests is extraordinary, and therefore in the factual elaboration of the topics he consciously does not strive to solve the problems, but to diagnose them and arrange them in a certain way. I see the main benefit of the book in the creation of a wide range of stimuli for further research at the theoretical and practical level.**

Martin Hampl, prof., Charles University

ISBN 978-80-88377-16-0