Chapter 2
Preface: New Epoch, It's Conceptual Platform and Episteme

2.1 Preface

The main goal of this book is to indicate how much our understanding of contemporary world has changed together with the development of information techniques (see also Lubacz 2008) and related fields, such as mathematical computational techniques. Therefore, I start with general epistemological observations related to this change, and only later I document this change in more detail through the analysis of selected elements of recent history of information technology. Through the latter I understand the history, with the epoch of industrial civilization included, from around 1760, although clearly light signalling was known already in ancient times. As I could not present a comprehensive history (it would require much more space and time), only "elements" are presented, and obviously treated selectively. The method of selection concentrates not on technical or instrumental importance of various inventions that contribute to this history, but on their social or even conceptual importance.

In the above sense this book differs essentially from a number of similar works which are certainly worth reading but pursue different goals (see, e.g., Okin 2005). I understand the concept of information technology or techniques differently; most texts limit this concept to computers and digital techniques or their applications, while personally I believe it is important to stress the role of several other techniques of information processing, especially analog processing, including also the specific analog-digital processing of information in neurons of our brains. Between several contemporary works on the history of information technology, the excellent, deeply technical monograph *From Gutenberg to Internet* (Norman 2005) is so dominated by the horizon or hermeneutic perspective of digital techniques that while Vannevar Bush, the actual inventor of the first electronic (although analog) computer, is mentioned in various contexts in several places, it is not stressed that it was he who constructed the first and rather broadly used type of electronic computer. Sociological approach to this history, e.g. (Mattelart 2001), (Bard and Söderqvist

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2002) is also influenced by the perspective of "digital world", even if it underlines the social importance of information techniques, and sometimes even their impact on the way of perceiving the world, in a stronger and better way. Purely historical approach to the history of technology can be excellent, see, e.g., (Kopczyński 2003), when it comes to the details of development of diverse techniques, but it focuses on other techniques than informational and does not notice the impact of technology on the way the world is perceived.[1] There are also many fundamental works highlighting the impact of changes in contemporary technology on diverse aspects of civilization development, such as the emergence of media society (McLuhan 1964), end of industrial civilization (Bell 1973), wave-like character of civilization development (Toffler and Toffler 1980), the importance of knowledge in information society (Stehr 1994), or finally, the networked character of contemporary society (Castells 2000). The closest to my goals is the collective work (Lucertini et al. 2004), stressing the impact of such changes on the set of concepts that determine our perception of the world and close to the ideas presented by me originally in Wierzbicki (1988).

In these diverse works we can notice a general agreement to the diagnosis that *we live in a period of information revolution*, that this revolution will essentially change not only technology but also socio-economic system, culture and civilization in general, and lead to a new civilization epoch. There are notable exceptions from this general agreement, mostly between humanists working on history or philosophy of technology. E.g., (Dusek 2006, p. 49) maintains that "the theory of post-industrial society was advanced by a number of technocratic thinkers"; in his fight against "technological ", Dusek uses the term "technocratic" as a strongly negative epithet. Similarly, (Kopczyński 2003) does not notice at all the informational revolution and concentrates on the thesis that industrial revolution was the greatest achievement of humanity; Kopczyński also uses the term "technocratic" as an epithet. But the very concept of *technocracy* is used imprecisely by the philosophy and history of technology, because it emerged from transferring Henry Ford's ideas of manufacturing organization to other fields, so it has more to do with management science and *technology brokers* (i.e. entrepreneurs that do not create technology but use it for profit) than with technical creativity. On the other hand, *the evidence of great social and economic changes resulting from applications of computers and network techniques is obvious today,* see, e.g., (Castells 2000), (Bard and Söderqvist 2002). Therefore, the opinions of authors denying these changes can be interpreted as either a *cognitive gap* or a defense of an old paradigm; to repeat: *if the thesis about a beginning of a new epoch is true, then philosophy of technology must take up quite new problems and ask technicians about their opinions.*

[1] For example, the rotary speed controller of James Watt is commented in Kopczyński (2003) with the sentence "The possibility of control of rotary speed provided an ingenious centrifugal controller" without noting its historical conceptual importance and a large number of continuators of this concept that will be discussed in Chap. 8.

2.2 New Epoch with Its Conceptual Platform and Episteme

As already noted, there are many names used to describe the new civilization epoch coming after the informational revolution: *media society, service society, post-industrial, post-Fordist, post-capitalist, information* or *informational society, Third Wave, networked society, knowledge based economy* (each economy was based on knowledge, but it is a matter of degree: after the informational revolution, knowledge becomes the essential productive factor). Personally, I prefer the term *knowledge society* (Stehr 1994) or even *knowledge civilization* (Wierzbicki and Nakamori 2006). This follows from the conviction that one of the main megatrends of the informational revolution, the megatrend (discussed in detail later) of *dematerialization of work*, the usage of informational techniques (computers, robots etc.) to replace people in activities of mechanical, scarcely creative character, leads inevitably to an increased role of knowledge not only in economy, but in social life as a whole. Knowledge is understood here as more than just information, even if information is an essential constituent of knowledge, e.g., one of many possible definitions of knowledge is *information organized for a defined purpose.* Knowledge is also more than just rationally substantiated and organized *explicit knowledge*: the concept of knowledge encompasses also *tacit knowledge* of *preverbal* character, including *tacit knowing* but also *intuition, emotions* and *instincts.*

The critics of the concepts of *knowledge civilization* or *knowledge based economy* maintain that we are yet far away in the global scale from the situation when knowledge will be a decisive production factor. This critique is, however, a-historical: even 60 years after the inventions of J. Watt, who in the years 1760–1781 improved the steam engine (which was known many decades earlier, but was too dangerous to be broadly used before Watt made it more secure), we did not have an industrial society in Poland and only in the years 1820–1830, great efforts of Stanisław Staszic and other adherents to industrial civilization resulted in its beginnings in Poland. Nevertheless, industrial civilization slowly developed world-wide. The great historian Fernand Braudel, who accepted the approximate date 1760 of Watt's inventions as the beginning of the epoch of industrial civilization, knew very well that in the year 1790, 30 years after these inventions, even in England not much was changed.

Following the example of Fernand Braudel, *I accept the date of 1980 as the beginning of informational revolution and thus of the epoch of knowledge civilization:* even if computers were known for circa 50 years earlier (see Chaps. 8 and 9), their broad social application started around 1980 when the competition of Apple and IBM resulted in market supply of personal computers. Just after 1980 the techniques of computer networks were sufficiently developed and declassified for their broader social use (before that date, they were used in military and in some specific applications, such as airplane ticket distribution). Thus, similarly as Braudel, I am aware that today, approximately 30 years after 1980, we cannot expect that the knowledge based economy will be strongly developed. Yet the speed of socio-economic change today is greater than it was 200 years ago and thus informational techniques are much more broadly widespread, their socio-economic penetration is much greater today than that of industrial techniques in 1790; if we assume that the speed of change doubled or even tripled since that time, a reasonable comparison should concern the spread of industrial civilization in 1820 or even 1850.

I am also aware that historical caesuras are stipulated and some philosophers of technology would criticise even Fernand Braudel for his "technocratic determinism", expressed by the fact that he accepted the date of the invention of Johann Gutenberg, circa 1440, as the beginning of the pre-industrial era of banking, geographical discoveries and formation of capitalism, and the date of inventions of James Watt, circa 1760, as the end of that epoch and the beginning of the industrial era. However, some caesuras are necessary and they can be based on the conviction that *it is the nature of broadly socially used tools, characteristic of a given civilization epoch, which co-determines (even if not fully determines) many aspects of social life in that epoch.*[2] This does not mean full technological determinism, since technicians are also people, members of a given society, and they develop tools according to their perception of the needs of that society in a given epoch.

The life in Europe in the years 1000–1440, in the epoch of late middle ages, the civilization of monasteries and gothic cathedrals, was also co-determined by tools typical of this epoch; and the life before the year 1000 was also different, but I know not enough about the tools used then and I think that they were not much different from the tools used in ancient Greece and Rome. If we count in this way, we can distinguish at least four subsequent civilization epochs with their specific *techne* (different variants of the art of constructing tools) that co-determines them. Therefore, I use the term $techne_n$ to describe the art of constructing tools specific for informational revolution and knowledge civilization. The number n is stipulated, and it actually means *subsequent* or *many,* since to account for former civilization epochs we should speak about $techne_5$ or even $techne_9$ (depending on the way in which we treat eras of hunting and gathering with their stone tools, eras of bronze and iron tolls, tools related to the invention of a wheel, etc.) Thus, I believe that the thesis of Tofflers about *the third wave* is oversimplified.

Irrespectively of the numbering of civilization epochs, we are perhaps correct in the judgment that the inventions of Gutenberg and Watt enabled (not caused,

[2] The concept of *historical materialism* of Karl Marx, according to which socio-economic changes are determined by the development of *productive forces*, must be modified after the informational revolution: equally or more important are *tools* commonly used by people in a given civilization epoch, and *techne*, the art of constructing such tools. For example, it is computers together with robots and automatic washing machines that enable nowadays the realization of the goal of full equality of women (socio-cultural changes are also needed to reach this goal, but it would be not attainable without these tools). Therefore, we should rather interpret it as a *techno-cultural co-evolution.* See also Sadowski (2009).

because there were many other causes) the development of socio-economic processes that resulted in the civilization of print and industrial civilization.

Significantly, both these inventions were not entirely new, they were considerable improvements of older inventions, crucial for a broad social application and penetration. Print was known earlier in China, but did not lead to an era of print for many reasons, technically because Chinese printing matrix was very difficult and laborious to engrave. The invention of Johann Gutenberg was to use separate type letters to set up a printing matrix: this enabled broad social penetration of typed books, at first naturally expensive and accessible only for rich families, but later gradually less and less expensive. Similarly, steam engine was known before James Watt (since around 1698; Thomas Newcomen improved it around 1710, 50 years before Watt inventions) but was inefficient in terms of energy use and dangerous, and it had a tendency to explode because of instability of its rotary speed. James Watt constructed an efficient and safe steam engine by adding some important elements: additional steam chamber improving efficiency, etc., but the most essential element was a centrifugal rotary speed controller, in a sense a prototype of the concept of feedback, discussed in detail in further chapters. Similarly, computers were known before 1980, but before personal computers they were reserved for a small group of "computer priests", and computer networks were reserved for military use.

As already mentioned, instead of more precise accounting of historical periods, some authors (Toffler and Toffler 1980) discuss three civilization waves: *agricultural, industrial and information civilization.* A book by Tofflers, entitled *The Third Wave,* had a very important impact, also in preparing the democratization of Poland[3]; however, their approach is too simplified, because agricultural civilization had many phases. Therefore, I prefer to discuss *three recent periods of long-duration or civilization epochs*:

- *pre-industrial or print civilization (formation of capitalism)* 1440–1760;
- *industrial civilization* 1760–1980;
- *knowledge civilization* 1980–2100(?).

The date 2100(?) is not only a simple prediction based on the shortening time spans of these periods (320, 220, at least 120?) but also can be substantiated differently, see (Kameoka and Wierzbicki 2005) and Chap. 8. We observe, as will

[3] In fact, Tofflers predicted the fall of the so-called communist system: in *The Third Wave* they state that robotization and automation will lead to the destruction of the class of manufacturing proletariat and that information society will develop, but it can develop only in democratic and market economy states (thus, Nasim Taleb in his book *The Black Swan,* 2007, is incorrect when saying that nobody predicted this fall). Ronald Reagan knew these opinions and acted by promoting high tech space weapons, thus putting a pressure on the communist system. On the other hand, from personal experience (I have promoted the idea of information society in Poland since around 1985 and obtained even the T. Hoffmokl Award for these efforts) I know that the leaders of Polish government at that time, Wojciech Jaruzelski and Mieczysław Rakowski, read the book of Tofflers, which might have helped to convince them about the need of democratization of Poland and negotiation with Solidarity movement.

be discussed later in detail, a shortening of civilization delays or delay times, defined as the time elapsed between an essentially new idea and its broad socio-economic application. If such delays would result in a wave-like civilization development (which is a fully justified conclusion in the theory of feedback systems), then it can be shown that the period of such a wave or cycle corresponds to approximately four times the delay. If we estimate civilization delay times today as 30–40 years, then the corresponding period of a civilization wave, the time of knowledge civilization epoch, can be estimated as 120–160 years.

Perhaps more interesting are answers not to the question how long the new civilization epoch will last, but to the question what changes it will bring. These changes will be discussed in detail in the last chapters of this book; but generally they are related to three main megatrends[4] of the informational revolution, discussed in Wierzbicki (2000, 2008). Below I recall them shortly, together with short discussion:

I. Technical megatrend of *digital integration*;
II. Socio-economic megatrend of *dematerialization of work and change of professions;*
III. Intellectual megatrend of *change of the way of perceiving the world.*

The technical megatrend of *digital integration* is sometimes also called *convergence megatrend*. All signals, results of measurements, data etc. could be transformed and transmitted in an uniform digital standard form, but this requires time and adaptation. From a technical perspective, *digital integration could be much more advanced,* if its speed were not limited by economic, social and political aspects.

Telecommunication networks, including computer networks, are being integrated, but this process is slow because *a full integration of standards would allow new and small enterprises to offer various services* on this profitable and fast growing market. If standards are not integrated, it is easy to defend monopolistic or oligopolistic positions on this market, e.g. by formulating sufficiently complex requirements concerning connection of networks, so-called *interconnect* conditions.[5]

Diverse aspects of the intelligence of networks, computers, decision support, even generally of our ambient habitat, are subject of integration. The miniaturization of microprocessors and diverse sensors enables the development of *ambient intelligence*, sometimes called also *Internet of things,* in the form of an intelligent office, room, shop, car, highway etc.

Diverse media of communication, newspapers, books, radio, television, are subject to integration. A slow transition from paper to electronic form of recording

[4] I understand the concept of *megatrends* slightly differently than their original definition by John Naisbit (1982) who required that megatrends should be new directions, while for me megatrends must be important social phenomena of long duration, lasting at least several decades.

[5] I once checked personally how voluminous are interconnect conditions of NTT (the former telecommunications monopolist in Japan): about two thousand pages.

takes place, although a change of human customs requires long time. Economic and political consequences of media integration are well understood and we already observe fierce *struggles to control the integrated media.* A related issue is the struggle to control knowledge by its privatization; but academic environments respond to that: universities and research institutes postulate today an open publication of all research results financed from public funds, using Internet portals and the principles of *Open Access*.

The socio-economic megatrend of dematerialization of work and change of professions is even stronger than the megatrend of digital integration. The ideal of technology resulting in less heavy and monotone work drove the technical advancement of the epoch of industrial civilization, at least it was so perceived by technicians, but not necessarily entrepreneurs or philosophers of technology. The industrial civilization epoch ended when this ideal started to materialize, when robots and computers started to replace heavy work of people. In fact, we can concur with the diagnosis of (Toffler and Toffler 1980) that robotization and automation lead to the destruction of the classical proletariat class and that the informational revolution will cause (has now already caused) also the fall of the so-called communist system. However, related fast changes of technology have caused also fast changes in professions and a resulting phenomenon of the so-called *structural unemployment.* This term is actually erroneous, as it stems from a static way of thinking: it indicates that the structure of economy has changed and the resulting unemployment will be observed as long as the structure of labour will adapt to the structure of economy. But after the informational revolution, we actually observe a continuous change of the structure of economy and the speed of this change is limited precisely by the speed of adaptation of the labour force. *Already today we can build fully automated and robotized factories, but what to do with people working in existing ones? The Economist* (issue April 21–27, 2012) promoted the construction of such factories under the name of *third industrial revolution,* but completely disregarded its socio-political aspects. A sudden third industrial revolution would mean sudden 50 % of unemployment, which is politically unacceptable. If old professions disappear, we must *devise new professions* that will replace the old ones. We must also *provide relatively permanent working places* for young people starting their professional life. The neoliberal slogan (popular, e.g., in Poland) that we must not interfere with labour market because it will result in difficulties for entrepreneurs and will drive them away, is not acceptable. Intervention on the labour market should take the form of a *new industrial policy* that would promote the formation of new, relatively permanent working places, naturally adapted to the conditions after the informational revolution. It will be discussed in more detail in Chap. 14.

Dematerialization of work has certain undoubted advantages. It *enables actual satisfaction of the women's rights slogan.* Women liberation movements remained utopian in the era of industrial civilization. It was only the computer and the robot (considering contemporary washing machine as a kind of robot) that actually enabled equal rights of women, even if for the full realization of those rights a corresponding change of social customs and mores is also necessary. Paradoxically, *feminist activists* often do not notice these elementary conditions.

Dematerialization of work results in further great dangers beside unemployment and precariat formation. Not all people are sufficiently elastic and capable of changing profession several times in life. This results in generational divide, between young people, more easily learning how to use new tools, and older people. Generational divide is a part of digital exclusion or digital divide[6]—between those who gain by using digital techniques and those who cannot use them, whatever the reasons. The digital divide is a phenomenon of long social duration; exposed to market forces, it would finally disappear, but not earlier than after many decades. An obvious method of counteracting it is a reform and intensification of education, but such a reform must address the needs of the new epoch and include life-long education.

A fundamental reform of education is also necessary because of the third *megatrend of intellectual challenges including the change of the way of perceiving the world and a conceptual revolution*, the most difficult one to cope with. This megatrend brings the greatest challenges and we shall concentrate on it, starting with the concept of *episteme.*

Episteme, in its postmodern meaning as the way of creating and justifying knowledge characteristic of a given epoch, develops, according to Foucault (1972), in the beginning period of that epoch. Michel Foucaultdescribes the formation of *modern episteme* (characteristic of the period of industrial civilization) at the end of eighteenth and the beginning of nineteenth century, while the beginning of industrial civilization is typically ascribed to the year 1760. However, even before Watt many new concepts emerged, starting with Cartesians, Newton, French encyclopaedists, that formed a new *conceptual platform,* see Wierzbicki (1988). Thus, a reciprocal and preceding concept in relation to episteme is the concept of a conceptual platform, a set of new concepts that emerge towards the end of a civilization epoch and prepare the formation of a new episteme. I shall discuss in next chapters in more detail the concepts of conceptual platform and episteme, their prognostic use (Foucault used the concept of episteme only in a historical context), the process of destruction of an old episteme, etc.

Here I anticipate the results of future discussions by stating that in the second half of twentieth century, the process of destruction of old episteme resulted in a *divergent development of differing epistemai of three cultural spheres:*

- *Strict and natural ("hard") sciences;*
- *Social sciences and humanities ("soft sciences");*
- *Technical sciences.*

[6] The European Union gives a priority to counteracting the phenomenon of digital divide and teaching the use of digital techniques. In Poland, however, the dangers of digital divide are not fully perceived, see also final chapters of this book.

Thus, we should speak not about *two cultures* (Snow 1960), but about *three separate epistemai* characteristic of different cultural spheres (Wierzbicki 2005). These cultural spheres adhere to different values today, use different concepts and languages, different paradigms or hermeneutical horizons on which these paradigms are based; *such differences gradually increased together with the development of post-structuralism and postmodernism in social sciences and humanities, while hard and technical sciences found quite different ways to modify their research traditions.*

Technical sciences cooperate closely with strict and natural ("hard") sciences, but *these two cultural spheres differ essentially in their episteme: hard sciences are more paradigmatic*, see, e.g., (Kuhn 1962), *while technical sciences are more pragmatic than paradigmatic,* see (Laudan 1984). Some social philosophers of technology, such as (Latour 1987), speak about *technoscience*, but this is a mistake: it is true that technical and hard sciences closely cooperate, but they differ essentially in their values and episteme. Such misunderstanding of the epistemic character of contemporary technical sciences is characteristic of a large part of philosophy of technology; it will be discussed in more detail in final chapters of this book. *Both hard and technical sciences have understood for a long time already* (say, from interpreting the results about the uncertainty of measurements by Werner Heisenberg, 1927, or the epistemological theses of Van Orman Quine, 1964) *that knowledge can be only approximate and is a "fabric constructed by people that touches the reality only along its edges"* (as formulated by Quine)*, but interpret this fact differently between themselves, and even more differently from humanities and social sciences.*

Even if representatives of hard sciences know that all knowledge is constructed by people and there are no judgments objective and true in the absolute sense, they nevertheless believe that scientific theories are *laws of nature discovered by people, not only models of knowledge constructed by them.* Truth and objectivity are higher, ideal values for them; metaphorically, *a representative of hard sciences resembles a priest.*

A representative of technical sciences is much more relativistic and pragmatic in its episteme, agrees without resistance that *scientific theories are only models of knowledge,* but requires these theories to be *as objective as possible,* tested in practical applications, are *falsifiable* (in the sense proposed by Karl Popper 1934, even if he did not perceive technical practice as falsification). Metaphorically, *a technician resembles an artist* (see also Heidegger 1954; Wierzbicki 2005) and similarly as an artist gives much attention to tradition.

Since social sciences and humanities are most diversified in their episteme, I shall comment here on the cognitive perspective of postmodernism, typical of only a part of soft sciences.[7] A postmodernist representative of social sciences and

[7] From my personal contacts I know that not all representatives of humanities accept postmodernism, thus I speak here only about a currently dominating approach in soft sciences, particularly in sociology of science.

humanities believes that all knowledge is subjective, constructed by social discourse, negotiated, relativistic, local. Such an episteme contains internal traps and contradictions, see, e.g., (Kozakiewicz 1992); however, this internal crisis must be overcome by social sciences and humanities themselves. Metaphorically, *a representative of postmodern social sciences and humanities resembles a journalist:* all is admissible if it is interesting. A postmodernist also believes that if all (local) *worlds* are chaotic, changeable and virtual (created by our imagination of them), then he can use diverse words arbitrarily, without even checking whether the terms used by him have quite different meanings in other cultural spheres or not.[8]

These differences of episteme can be illustrated by diverse examples of controversies between those three cultural spheres, but in this book I shall give only a few of them, starting with the phenomenon of *science wars,* while further chapters discuss also the differences in understanding the concept of *feedback* and the conflict between *soft and hard systems analysis.*

Science wars occurred in the last decade of last century, when one of American physicists, frustrated by the opinions of sociologists of science about the alleged full subjectivity of science, wrote a pseudo-scientific sociological paper full of complex terms. The paper was published; afterwards, the author confessed that he wanted to prove full subjectivity, but of social, not hard science. This lead to huge discussions and controversies. In the opinion of a postmodern philosopher of technology, Val Dusek, about this phenomenon (Dusek 2006, p. 21): *"There are scientists and technologists who believe that objectivity of their field is wrongly denied by social, political and literary studies of science"*. The postmodern attitude of the book of Dusek suggests that such opinions are represented by few scientists and technologists, but a true humanist should know better. I believe, on the other hand, that practically all representatives of hard and technical sciences share such views, but not all are sufficiently frustrated to express them and take part in *science wars.* The phenomenon of *science wars is a clear example of controversies between different epistemai of these different cultural spheres.*

On this background, it is useful to stress the difference between *multidisciplinary* and an *interdisciplinary* approach, terms that are popular but often used imprecisely. Multidisciplinary approach is one encompassing the knowledge of several disciplines, interdisciplinary approach is a holistic approach which should, nevertheless, take into account the differences in episteme of the three cultural spheres discussed above, including results of social sciences and humanities, but also strict and natural sciences as well as technical sciences, and the concept of *technology proper* discussed in more detail in the next chapter.

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8 Particularly in fast and inadequate translation. See, e.g., (Agamben 2007), where the author used actually the concept of *dispositif,* but postmodernist translators into Polish used the technical word *urządzenie* (*assembly*). However, there are many more general examples, such as the sociologist use of the concept of *network* (a set of nodes and connections between them for a technician, a loosely defined set of people for a sociologist).

2.3 Main Elements of a New Conceptual Platform

Disintegration of the old episteme of the epoch of industrial civilization, called sometimes, not quite accurately, *modernism, scientism,* etc., was motivated by the emergence of a new *conceptual platform,* a set of new concepts inconsistent with the old episteme, contributed by the development of science or technology. We shall briefly list here commonly known concepts resulting from the development of science in twentieth century that contributed to the new conceptual platform:

- *Relativity theory and relativism (Einstein* 1905*),*
- *Logical pluralism (multivalued logics, their diversity, Łukasiewicz* 1911*),*
- *Indeterminism of measurements (Heisenberg* 1927*),*
- *Dependence of truth from meta-assumptions (Gödel* 1931; *Tarski* 1933*).*

Some of them were widely discussed and commented, some are known only to specialists. The relativity theory by Albert Einstein had a tremendous impact. Actually, it started from an attempt to modify classical theories assuming that the velocities of movements shall be simply summed up, in the face of the empirically established fact of a finite speed of light, independent from a coordinate system. However, it has eventually shown the relativity of perception of time and speed (lower than the speed of light) and further consequences, as the equivalence of mass and energy. It has had diverse interpretations, both in physics, especially quantum physics that until now cannot reconcile relativity theory with Heisenberg uncertainty principle, and in philosophy, or in common media interpretations that often went too far. However, there is no doubt that the relativity theory of Albert Einstein became a foundation of the critique and disintegration of the old episteme (modernism or scientism).

Logical pluralism started (and continued) with Polish achievements. The theory of multi-valued logics by Jan Łukasiewicz (1911) anteceded its epoch even more that the relativity theory, but was noticed at most by a few specialists in abstract logics. Its importance can be understood only today, when many variants of multi-valued logics were developed and many technical applications thereof occurred, together with the negation of the principle of excluded middle, with the broad application of the feedback principle where the effect reflexively influences the cause (while temporal logics necessary for describing the feedback are still not fully developed), etc. Lofti Zadeh (1965) invented anew multi-valued logics and their applications (see also Kacprzyk 2001), calling them *fuzzy set theory;* Zdzisław Pawlak (1991) has shown how a three-valued logic arises necessarily from the nature of big data sets, calling this *rough set theory.* Today, technicians know well that the classical binary logic is a great simplification in describing the world and that it is not adequate even for language analysis; thus, *it is necessary to select logic that is adequate for a given application*. Incomprehension of this fact even in philosophy has led to great mistakes that I discuss later while criticizing the logical errors of philosophical scepticism and analyzing the concept of feedback.

The indeterminism of measurements was discovered by Werner Heisenberg and concerns quantum level, thus its importance was noticed, beside physicists, more by technicians (particularly in electronic engineering), less by philosophers of science. However if, on the quantum level, the very fact of measurement distorts the measured variable, then this phenomenon influences and changes the concept of measurement: there are no absolutely accurate measurements, every measurement is vitiated by an error. Naturally, we can construct diverse models, statistical and others, of measurement errors, but in this way the technical science anticipated later opinions of philosophy and sociology of science that a measurement depends on a theory used to prepare it. It is obvious for a technician that theories substantiating measurements can lead to diverse errors, including gross (systematic) errors, if selected in an inadequate way. This does not mean, however, at least from a cognitive perspective of technicians (and also that of experimental hard science), that they should resign from striving for measurements as accurate as it is possible or needed for a given application. We should stress once more that until today the construction of a theory combining the indeterminism of Heisenberg and the relativity of Einstein is an open question, by some physicist considered to be the most important problem of contemporary science.

The importance of the observation that truth depends on meta-assumptions, the results of Kurt Gödel. and Alfred Tarski, was noted by philosophy of science (and also by information techniques), and especially by philosophy of mathematics. However, it was interpreted in a specific way because it encountered the critique of the paradox of infinite regress and an incapacity to resolve this alleged paradox (because of using an inadequate logic), as it is discussed in Chap. 6. Only a more precise definition of the concept of hermeneutic horizon proposed by Zbigniew Król (2005) allows, in my opinion, a correct resolution of this paradox.

Beside hard sciences, technical sciences and technology, and especially information techniques had also a great impact on the emergence of new concepts. The new conceptual platform was influenced by the following developments in informational techniques (beside mechanization, electrification, assembly line production organization, and other aspects characteristic of industrial civilization):

- The beginnings of telecommunications, the concept of a *network*;
- The beginnings of radiocommunication, *transmitter* and *receiver*;
- The beginnings of television and resulting *spectacle society;*
- The beginnings of automatic control and the concept of *feedback*;
- First *analog computers*, their development and impact;
- The concept of a *flip-flop switch*, its applications;
- *Digital computers*, their beginnings and impact on episteme;
- Transistors and integrated circuits, law of Moore, *digitalization* of technology;
- Spontaneous emergence of *software* from a *hardware* approach to computers;
- Nonlinear dynamics, *pseudo-random number generator, deterministic chaos, order emerging out of chaos, emergence;*
- *Computational complexity* versus *systemic complexity* (*holism, synergy and emergence*);

- *Computer networks, hypertext*;
- *Personal computers*;
- *Mobile telephony*;
- *Robotics and automated factories*;
- *Internet and web services*;
- *Human-centred computing:* the role of *emotions* and *intuition*, of *tacit knowledge* as opposed to *artificial intelligence*.

All these developments had a ground-breaking impact on the set of concepts typical for contemporary world, on the perception of this world. As already mentioned, computer networks and personal computers date the caesura of the beginning of knowledge civilization epoch (even if this is only a beginning, such as the invention of Watt was only a beginning of the industrial civilization). However, in the conceptual sense to the most significant I include:

- *Feedback as a concept with a specific temporal logic resolving ostensible paradoxes (vicious circle, infinite regress* etc.*)*
- *Software versus hardware as an example of spontaneous emergence*;
- *Deterministic chaos and emergence of order out of chaos as a mathematical and technical justification of emergence principle*;
- *Computational complexity as a cognitive limitation;*
- *Technical justification of the power and fallibility of intuition as a basis of multimedia principle*.

For example, I believe that a good understanding of the logics and dynamics of feedback is equally important for the understanding of temporary world as apprehension of relativism or indeterminism. I mentioned above the emergence principle and multimedia principle that will be formulated and discussed in next chapters, similarly as all concepts mentioned above. Here it is necessary to stress that a chaotic and emergent understanding of the world seems to be the foundation of a new episteme of the knowledge civilization era:

> *The epoch of industrial civilization perceived the world as a great clock, turning with the regularity and inevitability of celestial spheres; today, we see the world as a plurality of chaotic systems, in which everything can happen, and new forms of order are likely to emerge.*

This is not a postmodern, but rather post-postmodern or *informed* view of the world. Even if postmodernism considers the concept of chaos as its own concept, co-defining the postmodern view of the world, yet I personally participated, as it is presented in more detail in further chapters, in the emergence and the rationalization of the contemporary concept of chaos, and it occurred earlier than the beginnings of postmodernism. In further chapters I shall repeat and enlarge the above observations, starting with general epistemological observations, continuing with a recall of fundamental occurrences in contemporary history of informational techniques, and ending with further and more detailed epistemological conclusions and some warnings concerning future developments.

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