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COMMENTS ON THE ROLE OF TECHNICAL PROGRESS IN THE PROCESSES OF CIVILIZATION AND SOCIAL DEVELOPMENT IN THE PAST AND TODAY[2]

When, in 1769, the Scottish engineer James Watt obtained a patent to protect his steam engine design, he was one of many from the seventeenth century who attempted to use the forces of atmospheric pressure and steam to create a new source of propulsion, replacing the force of muscles and thereby the work of both people and animals. Water energy was also harnessed for the needs of work performed in connection with draining wetlands, supplying water to cities and homes, pumping water from mines, or putting out fires as well as turning the wheels in the mills[3]. Already at the beginning of the 18th century, in houses and other places such as gardens in and around London, the so-called Savery machine was bringing running water, whose popularity eventually gave way to a new design, called the Newcomen machine. Incidentally, the first Newcomen machine appeared in Poland only in 1788, at a time when England entered the industrial revolution for good. Over time, the Newcomen machine became quite a popular device, not only in England but also on the European continent. By 1733, a company had been founded for the purpose of constructing the Newcomen machine, leading to this device becoming quite popular in England by the 1860s. Nevertheless, work on improving the machine never ceased, it was about efficiency, that is, reducing energy losses which were so significant that the fuel costs far outweighed the benefits obtained. The solution to this fundamental problem was brought about by an invention of J. Watt, who, in the patent application, described its essence as "reducing the use of steam and fuel in fire machines"[4].

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[3] M. MICHALSKI, *Od I do IV rewolucji przemysłowej,* Człowiek w cyberprzestrzeni 2017, nr 1, s. 4.
[4] Ibidem.

However, as P. Mantoux notes, it is one thing to invent and something else to skilfully make use of it, also confirmed by the earlier fate of various steam engine prototypes[5].

In the case of J. Watt, the participation of third parties - John Roebuck and Matthew Boulton - as his business associates and investors ended with the Watt machine initially being used as an auxiliary device for a hydraulic machine then, from 1785, it replaced the hydraulic motor as a basic device[6]. Undoubtedly, the increase in popularity and universality of J. Watt's invention was also influenced by obtaining patent protection, which in the category of causative events can be considered one of those momentous circumstances that contributed to the popularization of the steam engine in its practical application. Over time, its use went beyond spinning centres to include mining, metallurgy, machine industry, railways, shipbuilding, giving rise to the unprecedented development of the English economy, which in turn gave rise to the transition to the factory system and transformed England into the first truly industrial country. In the mid-nineteenth century, it accounted for as much as 20% of global industrial production and the country became a leader in the global export of coal, metallurgical products, and steel[7].

Widespread use of the steam engine began the second - much more intensive - phase of the mechanization of production, because almost all the work was already being done by machines, which strongly influenced its organization and forced a new - significantly different from the previous and more appropriate in the workshop system - the division of labour.

In the eighteenth century, Adam Smith, in his work "Research on the nature and causes of the wealth of nations" had already noticed that all progress in technology is considered beneficial for every society because it allows the same number of workers to do the same amount of work with the help of cheaper machines and more easily than those previously used[8].

The importance of the development of technology for the progress of civilization, as pointed out by A. Smith, was also raised by one of the representatives of classical economic thought, D. Ricardo, who, formulating the theory of economic development, argued that the key to prosperity is technological progress, consisting of putting into use new or improved

[5] P. MANTOUX, Rewolucja przemysłowa w XVIII wieku, Warszawa 1957, s. 292.
[6] In 1785, the first steam-driven spinning mill was established, which started the process of its more and more common use, initially in the wool industry, por. P. MANTOUX, *op. cit.*, s. 304 i n.
[7] J. KALIŃSKI, *Historia gospodarcza XIX i XX w.*, Warszawa 2008, s. 49.
[8] A. SMITH, *Badania nad naturą i przyczynami bogactw narodów*, Warszawa 2007, t. 1, s. 318.

machines[9]. This can be illustrated by the fact that starting from the implementation of the steam engine industry based on J. Watt's thoughts, each year, up to 1000 HP of additional power was generated[10]. However, after the termination of this patent protection, the power increase rose to 4,000 HP per year. The widespread use of steam machines, more and more often as basic devices, meant that Europe was definitely moving away from a handicraft system based on muscle strength and water energy to a time that A. Toffler in his "The Third Wave" called industrial turmoil, and its most significant consequence he described as industriality, i.e. a new way of understanding and perceiving the world that will penetrate the entire civilization in all its areas of influence[11]. The expression of this new approach to the reality surrounding man will be the popularisation of the way of perceiving time from cyclic to linear. The first, associated with the unchanging series of seasons, in which there was a repetitive sequence of events guiding the framework of human existence, was attached and connected with the earth as the basic category determining the social and cultural position of man, while the latter - strengthening the development of the commodity economy - monetarily - e announced as openness to the unknown future. This industriality which A. Toffler wrote about, meant a change in the optics of seeing time, and, as a consequence, also resulted in a change in the way of organizing the lives of people of the industrial age, since it would henceforth be subject to factors that would bring order to all the complexities of reality which, until now, was based on continuity of traditions, local differences, diversity, and customs[12]. The technological advancement that has been rolling through Europe since the beginning of the 19th century has resulted in phenomena such as standardization and synchronization, which ordered the post-feudal world, giving reality a modern dimension, which is thus a visible sign of breaking with the past.

The exemplification - confirming the above statement of A. Toffler - is the impact on the reality and life of the nineteenth-century people developing railways. As noted by J. Riffkin - referring to our contemporary associations - steam-powered technology made of coal - including steam locomotives - introduced a new communication and energy matrix that provided a comprehensive technological mega platform for the first industrial revolution[13]. The dynamically developing railway[14] not only significantly shortened the distance and time to

[99] E. TAYLOR, *Historia rozwoju ekonomiki*, t. I, Lublin 1991, s. 126 i n.
[10] M. MICHALSKI, *op. cit.*, s. 5.
[11] A. TOEFFEL, *Trzecia fala*, Warszawa 1985, s. 96 i n.
[12] *Ibidem*.
[13] J. RIFFKIN, *Trzecia rewolucja przemysłowa,* Katowice 2012, ebook, 14 %.
[14] A. PAWŁOWSKI, *Powstanie i rozwój kolejnictwa w Anglii,* Inżynier kolejowy 1926, nr 8 – 9, s. 202 i n.

cover considerable distances but also enabled the transport of goods and then also people over a longer distance. As a consequence, thanks to the railways, Thomas Cook in 1841 initiated organized tourism, and with it, he developed a new - for those times - business model, i.e. a travel agency, which organizes mass trips, including the first organized trip around the world in 1872-1873[15]. The railway contributed to the transformation of Liverpool - connecting it with Manchester - into a centre of innovative industry in the nineteenth century and the city - a factory with housing estates, schools, churches, and offices, designed to meet the needs of an increasing number of workers, initiated the urbanization processes of industrial centres (an example of which is also 19th century Łódź).

Construction of ever newer railway lines - in 1848 there were already 8,022 km of railway lines in Great Britain, in France there were 2047 km, but in Spain only 28 km, while in the Kingdom of Poland, 329 km, and in Galicia 67 km (and in Austria a total of 1079 km), while in the Prussian partition it was 88 km (although in German countries combined, there were a total of 4989 km)[16] - on such a scale, it required large financial outlays, far exceeding the capabilities of individual units. Moreover, such undertakings constituted complex organizational and logistical challenges, also from the point of view of employment and supervision over the work of thousands of employees. Therefore, to meet these challenges, a new business model was developed, based on the one hand on a clear separation of ownership from management and supervision, and on the other hand on the formalized process of acquiring investment capital in the form of share issues, which logically followed the construction of a joint-stock company as an organizational model legally separating investors' financial commitments from liability[17].

Large and growing railway companies - large because railways bought mining areas to secure coal supplies for locomotives, financed steel mills to ensure a steady supply of steel for rails, and sometimes, like the Canadian Pacific Railroad[18], they even built and ran hotels near their stations for the passengers - they had to be managed by paid professional managers whose primary responsibility was to provide shareholders with a return on investment[19]. In this model

[15] Por. C. CRIPPS, *Thomas Cook: A history of one of the world's oldest travel firms,* https://edition.cnn.com/travel/article/thomas-cook-history-timeline/index.html (dostęp: 9.11.2019)
[16] C. KUKLO, J. ŁUKASIEWICZ, C. LESZCZYŃSKA, *Historia Polski w liczbach,* Warszawa 2014, s. 368.
[17] M. MICHALSKI, *O genezie spółek akcyjnych, czyli dlaczego wiek XIX ukształtował spółkę akcyjną* w: *Ius est ars boni et aequi. Księga pamiątkowa dedykowana Profesorowi Józefowi Frąckowiakowi,* Warszawa 2018, s. 758 i n. a także M. MICHALSKI, *Kształtowanie się organów w spółkach kapitałowych oraz jego wpływ na kształt regulacji w obszarze prawa polskiego*, PPH 2019, nr 6, s. 123 i n.
[18] J. RIFFKIN, *op. cit.,* 14 %.
[19] *Ibidem.*

– still functioning to this day - the workforce was deprived of the ownership of the means of production, i.e. tools used to manufacture products, and investors, to whom the companies belonged in the economic sense, were not able to control and manage their companies, managing such complex structures required effective rationalization of every aspect of the business[20].

According to M. Weber's optics, this aspect of the new business model could be described by a structure where decisions go down to the lower levels of the hierarchical model of the organization[21], and there was a great similarity between public administration and industrial administration, therefore, also in the business model the key moment was the correct procedures, as the condition of efficiency was - and in no way was the thesis outdated - strict compliance with the rules[22]. These changes in the business model developed during the growth of the industrial capitalism of the day and the industrial revolution consisted of the fact that, through developed and standardized procedures, tasks and methods of work were defined, as well as their evaluation at every stage of activity and every level of involvement. As a consequence, improvisation became foreign to such structures, because every step and every action had to be planned in advance and included in the division of duties. Each employee knew their place and knew exactly what work to do.

Thus, according to M. Weber, a perfectly organized capitalist enterprise had to be based on a hierarchical and rational bureaucracy, covering every aspect of its activity. So, everything should be calculated - in terms of costs - and rationalized - in terms of purpose and efficiency. The entire operation must be entangled within a hierarchical management structure, where railway management was to ensure efficient execution of management decisions directed to lower levels of the organizational structure. However, the whole was contained in an iron grip on the law.

The above considerations meant that the railway - as the largest undertaking in terms of scale and the number of engaged measures of the early days of the industrial revolution - quickly became the pioneer of changes brought about by the emerging industrial capitalism of the first half of the 19th century. Here, the railway companies - because of the size and level of complexity of the activity - were the first to understand that to achieve the assumed goals, and

[20] *Ibidem.*
[21] E. SOKALSKA, *Biurokracja jako metoda funkcjonowania nowoczesnej administracji w ujęciu Maxa Webera,* Studia Prawnoustrojowe 2003, nr 2, s. 122.
[22] *Ibidem.*

thus the location and maintenance of thousands of kilometres of tracks, observation of train movements over huge terrain, repair and production of thousands of equipment, coordination of shipping and delivery of goods, passenger traffic management, ensuring punctuality and supervision of the work of thousands of employees is a huge challenge and generates significant risks. Any error or failure can have unpredictable results. In 1895, the braking path incorrectly measured by a driver was the cause of a spectacular accident when the braking train at Gare Montparnasse in Paris broke through the glass wall of the station and fell straight onto the adjacent street, landing directly on a flower kiosk. The need to automate certain mechanical processes to exclude the human factor was then realized and the fruit of the work of the contemporary engineers would be a breakthrough in the form of the so-called continuous braking system, introduced at the beginning of the 20th century on all trains. This mechanism consisted of the train initially being blocked by a brake, and it was only when it was released that the journey continued. However, in the event of any failure, the brake returned to its place. The introduction of this solution for wider use meant launching the automation process on a mass scale.

It is worth making a general observation here. At its beginning, automation was a mechanism to support human activities, treated as the weaker link in the entire complex process, ensuring the ongoing operation of the railway. However, the role of automation then increased disproportionately and by the second half. of the nineteenth century, the developing railway employed more and more people, but today, the progressive automation and robotization are going in the opposite direction, i.e. excluding the activity of employees. J. Riffkin, in his Third Industrial Revolution, developed the topic of job reduction as a result of this automation process, previously undertaken at the end of the work. End of work[23]. The decline of the world's workforce and the beginning of the post-market era. Analysing the impact of the development of intelligent technology systems on mass employment, he rightly notes that maintaining hundreds of millions of jobs in the new reality is not guaranteed. However, this process already began in the era of the industrial revolution, and its first victims were those working in agriculture who, as a result of mechanization, had to look for work in the developing industrial centres. This mechanism is repeated along with technological development. Today, the problem

[23] J. RIFFKIN, *Koniec pracy. Schyłek siły roboczej na świecie i początek ery postrynkowej*, Wrocław 2001.

of so-called technological unemployment increases with every moment when new technological and innovative solutions are implemented [24].

An earlier world, before the industrial revolution, a world based on a cyclical understanding of time, whose rhythm was determined by changing seasons, a world in which the superior value - constituting a reference point - was the earth, although it was changing, but slow and almost imperceptible from the perspective of the life of the individual. It was a world in which everyone lived in their own local bubble, where the rhythm of everyday life was determined by sunrise and sunset. Only the popularization of railways drew attention to the need for standardizing time measurement[25]. It was the nineteenth century and the technological changes that took place in it made people realize that time and its control are of special value. Earlier, it was based on solar time, so it was different in different places because it was local. This locality of time was felt especially in such large countries as France, where cities such as Strasbourg and Brest were separated by a considerable distance, which influenced the diversity of local time. Time standardization proved necessary from the point of view of work organization and management of such a complicated structure as railways. Before the development of the railway, the cities were isolated from each other, the railway lines combined them into one coherent whole. Since the distance possible to travel without having to top up the steam and water was 150 km, further stations were built at this distance. And arrival at a particular station and departure from it had to take place at the same time, so as to be able to coordinate these events with the arrivals and departures of other trains nationwide. And the length of railway lines, e.g. in France in 1866, was already 13,951 km[26]. From the logistical point of view, it was a huge challenge.

Nevertheless, the railway provided something more than just standardizing time, as its participation was the organizational and administrative unification of the entire country. In France, for example, the central organization of railways was adopted, based on a series of main and additional lines connecting all major cities, where Paris remains the focal point. The nineteenth-century railway facilitated the transport of troops and goods, the travel of officials, and reaching administrative centres. Moreover - by shortening the distance between people - it contributed to the unification of the language. Also in Poland, after regaining independence in

[24] J. RIFFKIN, *Trzecia, op. cit.,* 92 %.
[25] M. MICHALSKI, *Prawo, op. cit.,* s.93.
[26] *Le journal dse gares*, 15 novembre 1867, https://gallica.bnf.fr/ark:/12148/bpt6k6103076h/f11.item (dostęp: 8.11.2019).

1918, railways became one of the main tools for modernizing the country, becoming at the same time a clamp connecting the three different districts that were still alive at that time, still living with their separateness, established for over 100 years.

The first and second industrial revolutions did not exhaust the potential for changes reconfiguring our reality. Since the mid-1950s, another process has been taking place whose essence - researchers such as the aforementioned A. Toffler or P. Drucker - are associated with the following era of the knowledge society[27]. According to them, knowledge replaces the previous values building socio-economic systems, such as land, labour, and capital. The key moment for these changes was the moment when the number of white-collar workers exceeded the number of manual workers, and the development of new technologies not only consolidated this state (e.g. by increasing the share of production automation processes, followed by their robotization) but more and more deepened it by increasing the competitiveness of knowledge-based economies. According to this vision, knowledge is becoming the main potential, implying major shifts between sectors of the economy. The changes that came with the 1990s and then in the following decades of the 21st century confirmed the validity of the direction outlined in the concepts of A. Toffler or P. F. Drucker, leading to the emergence of a post-industrial knowledge-based economy. We are currently observing something that J. Riffkin defined as entropy of the industrial era, and slowly entering the collective era, which is to be characterized by creative fun and partner interactions, while increasing the importance of social capital and participation in open communities with unlimited access to global networks[28]. However, J. Rifkin's predictions are not at all optimistic because it links them with the negative effects of progressing globalization, climate change and the problem of depletion of fossil energy resources, and finally the growing importance of intangible assets, i.e. intellectual technology.

The dynamics of technological and socio-civilization changes launched by the digital revolution draws new - unknown - dilemmas (and threats unknown so far), leading to a radical re-evaluation of relationships between people not only on a local, but also a global scale, which undoubtedly affects various aspects of human activity, both in private and public life. These changes are certainly different from those of industrial revolutions. As a result, we are observing today the growing process of progressive pantechnologism, i.e. the giving of technological (non-biological) reality[29]. The human world surrounding modern man becomes, at will,

[27] P. F. DRUCKER *Społeczeństwo pokapitalistyczne*, Warszawa 1999, s. 22 i n.
[28] J. RIFFKIN, *Trzecia, op. cit.,* 91 %.
[29] M. MICHALSKI, *Prawo, op. cit.,* s. 93.

dominated by technology that begins to affect, on an unprecedented scale, also its existence, while introducing to the public discourse - but also to the research spectrum from the cognitive point of view - the problems of trashumanism.

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