ANNALES

Anali za istrske in mediteranske študije
Annali di Studi istriani e mediterranei
Annals for Istrian and Mediterranean Studies
Series Historia et Sociologia, 36, 2026, 3



UDK 009 Annales, Ser. hist. sociol., 36, 2026, 3, pp. 337-488, Koper 2026 ISSN1408-5348

UDK 009

ISSN 1408-5348
e-ISSN 2591-1775

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Series Historia et Sociologia, 36, 2026, 3

KOPER 2026

ISSN 1408-5348
e-ISSN 2591-1775

UDK 009

Letnik 36, leto 2026, številka 3

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Založnika/*Editori/Published by:* Zgodovinsko društvo za južno Primorsko - Koper / *Società storica del Litorale - Capodistria*© / Inštitut IRRIS za raziskave, razvoj in strategije družbe, kulture in okolja / *Institute IRRIS for Research, Development and Strategies of Society, Culture and Environment / Istituto IRRIS di ricerca, sviluppo e strategie della società, cultura e ambiente*©

Sedež uredništva/*Sede della redazione/Address of Editorial Board:* SI-6000 Koper/*Capodistria,* Garibaldijeva/*Via Garibaldi 18*
e-mail: annaleszdjp@gmail.com, ***internet:*** https://zdjp.si

Redakcija te številke je bila zaključena 30. 9. 2026.

Sofinancirajo/*Supporto finanziario/Financially supported by:* Javna agencija za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije (ARIS)

Annales - Series Historia et Sociologia izhaja štirikrat letno.

Maloprodajna cena tega zvezka je 11 EUR.

Naklada/*Tiratura/Circulation:* 300 izvodov/copie/copies

Revija Annales, Series Historia et Sociologia je vključena v naslednje podatkovne baze / *La rivista Annales, Series Historia et Sociologia è inserita nei seguenti data base / Articles appearing in this journal are abstracted and indexed in*: Clarivate Analytics (USA): Arts and Humanities Citation Index (A&HCI) in/and Current Contents / Arts & Humanities; IBZ, Internationale Bibliographie der Zeitschriftenliteratur (GER); Sociological Abstracts (USA); Referativnyi Zhurnal Viniti (RUS); European Reference Index for the Humanities and Social Sciences (ERIH PLUS); Elsevier B. V.: SCOPUS (NL); Directory of Open Access Journals (DOAJ).

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ANNALES · Ser. hist. sociol. · 36 · 2026 · 3

Anali za istrske in mediteranske študije - Annali di Studi istriani e mediterranei - Annals for Istrian and Mediterranean Studies

UDK 009 Volume 36, Koper 2026, issue 3 ISSN 1408-5348
e-ISSN 2591-1775

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received: 2025-10-03 DOI 10.19233/ASHS.2026.29

THE IDEOLOGY OF TECHNOLOGY AND ITS DEVELOPMENT MEETS THE POLYCRISIS OF MODERN CAPITALISM

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ABSTRACT

The article analyses the ideology of technology and its development as a constitutive ideological structure of contemporary capitalism and as an obstacle for developing sustainable, emancipatory, democratic solutions for the polycrisis that has began to radically destabilise the existing ecologically unsustainable system. By utilising a materialist neo-Luddite analytical framework it examines the central ideological notions through which technologies and their development were historically imagined. Additionally, it reflects on this ideological structure in connection to the wider justification and legitimisation of capitalism in its various historical iterations and points to the limiting nature of this structure that obstructs the articulation of alternative visions.

Keywords: ideology, technology, technological development, capitalism, polycrisis, industrial revolution, computational thinking

L'IDEOLOGIA DELLA TECNOLOGIA E DEL SUO SVILUPPO INCONTRA LA POLICRISI DEL CAPITALISMO MODERNO

SINTESI

L'articolo analizza l'ideologia della tecnologia e del suo sviluppo come struttura ideologica costitutiva del capitalismo contemporaneo e come ostacolo allo sviluppo di soluzioni sostenibili, emancipatorie e democratiche per la policrisi che ha iniziato a destabilizzare radicalmente l'attuale ordine capitalistico ecologicamente insostenibile. Utilizzando un quadro analitico neoluddista materialista, esamina le nozioni ideologiche centrali attraverso le quali le tecnologie e il loro sviluppo sono stati storicamente immaginati. Inoltre, riflette su questa struttura ideologica in relazione alle più ampie giustificazioni e legittimazioni del capitalismo nelle sue diverse iterazioni storiche e sottolinea la natura limitante di tale struttura, che ostacola l'articolazione di visioni alternative.

Parole chiave: ideologia, tecnologia, sviluppo tecnologico, capitalismo, policrisi, rivoluzione industriale, pensiero computazionale

INTRODUCTION

The article takes a critical look at a fundamental building block of the key ideological structures underlying society: the ideology of (capitalist) technologies and their development. We argue this ideological structure underpins the modern capitalist (neo)imperial order on both global and local levels. Along with other ideological structures (e.g., free market, private ownership of the means of production, citizenship, nation/nationalism), this ideology is crucial for (re)producing central socio-political and economic (class) relations, relations of power, stratifications, exploitation and domination that ossify existing unequal relationships among classes, genders, ethnicities/races etc., naturalise and objectify them, while giving legitimacy to the capitalist system generally and its various temporal variations (cf. Balibar & Wallerstein, 1991; Mau, 2022). The ideological structure is shown to be essential for the complex exercise of power in capitalism today, where unprecedented local and global destabilisations have led to a polycrisis (cf. Tooze, 2022). The intensification of several mutually reinforcing crises is responsible for a unique challenge to the conditions on which the capitalist order relies. Such crises include the ongoing political crises, epistemological/ideological crises of meaning, identity, belonging, and moral crises to do with wars and genocide (Palestine), economic stagnation, and the crisis of society with rising inequality and living costs and precarious employment, stronger geopolitical competition tied to destabilisation of the USA's global hegemony, and the dynamic, unpredictable and violent interregnum. Above all, there is the ever worse climate and wider ecological crisis, which has begun to severely affect living conditions not just in the Majority world (Alam, 2008) (which has been disproportionally affected), but also in the West. The described polycrisis is inextricably linked to the inherent contradictions of the current global capitalist and neo-imperialist system. This system rests on: past colonial hierarchies; private ownership of the means of production, which determines its hierarchical class structure; wage labour; unpaid gendered reproductive labour; competitive markets as the primary mechanism for allocating resources; and the nation-state form of socio-political organisation (Harris, 2023). It also relies on: an exploitative, destructive, resource- and energy-intensive, unsustainable discriminatory developmental model; structures, institutions and practices aimed chiefly at continuous and expansive economic growth and/or the accumulation of capital and the profits of capitalists and corporations; and the ever-growing scope of the commodification of life and consumption of goods produced solely for the market (primacy of exchange vs. use value) (Patel & Moore, 2017). Political, societal, economic and ecological crises are fundamental to the system, which places private capitalist interests above the public interest, especially when it could endanger the former interests. Until recently, the system was highly responsive to various crises, but has never resolved the central ecological contradictions; namely, the need for greater exploitation of natural resources and pollution, which is starting to undermine the conditions the system needs to exist given that the planet's resources and carrying capacity and ecological adaptability are finite (Wainwright & Mann, 2018).

A proper response to the polycrisis calls for a fundamental rethinking and reorganisation of the mentioned order. We argue that to develop alternative democratic, sustainable and emancipatory visions of a reorganised system, we must first develop an appropriate critique of its underlying structures, and the root causes of the existing order's instability and unsustainability which structure the way we think and act. This makes it necessary to first address the blind spots in today's critiques. Although (capitalist) technology(is) and their development have always played a central role in the capitalist order, its transformations and visions of the future and, together with the ideological structure underlying it and capitalism generally, continues to be under-examined and on the fringes of critical thinking and analysis (Winner, 1977). In the present context, this is particularly dangerous given the radical ways in which the order has become destabilised as well as the dubious, undemocratic, authoritarian, power-centralising, dispossessing, and technology-centred non-solutions promoted and implemented by capitalist elites. The latter notably refer to the most prominent and powerful parts involved: Silicon Valley (USA) based/adjacent Big Tech elites, the "techno-oligarchs" (cf. Vrečko Ilc, 2025).

The overarching analytical framework guiding the article builds on the notion that the technology-centred ideological structure is central for capitalism, and at its foundations. And that this is inextricably tied to the centrality of the relationship between capitalism and technologies and their development (Costello, 2024; Winner, 1977). The foundations of this multidimensional relationship are best understood when we see it as tightly connected with the ways power functions in a capitalist system. Namely, how capitalist elites and the system generally re-produce themselves and the associated hierarchical exploitative relationships, how the imperatives and logic of the system organise and direct human activities and relationships, institutions and structures, and the manner in which resistance to it

is handled. Our analytical framework combines materialist and neo-Luddite insights concerning power and technology in capitalism. Building on Søren Mau's (2022) reinterpretation of Marx's understanding of power, we frame the ideological dimension of power in a materialist way such that the dimension is constitutively co-determined and co-enabled by the other two core dimensions of power: economic and repressive. The ideological dimension refers to epistemological frameworks (discourses) for perceiving, imagining, thinking about, and responding to the socio-political reality, which they in turn co-create. These frameworks include specific values and presuppositions, or *Truths*, regarding our place and role in society and the world, relationships among individuals, and groups. They also encompass rationalisations and legitimisations of multiple and multidimensional inequalities, hierarchical, exploitative, extractive relationships, and structures, thereby co-enabling reproduction of the capitalist system. In addition, they refer to specific historical narratives or fantasises that seek to give legitimacy to the status quo, which mystify historical transformations and obfuscate and silence certain struggles in history and resistance to capitalism today. They ultimately present the history of capitalism not as one of class struggle, colonial genocide, occupation and domination, or dynamic and non-linear, but as a steady and linear progression creating ever more wealth, freedom and opportunities. The ideological dimension is made up of several layers in that while some ideological frameworks are foundational and constitutive, others can appear and disappear in line with historically specific capitalist interests and struggles, changes in accumulation processes, and changes in geopolitical and geoeconomic relationships and hierarchies. The ideological structures behind all of this are not static and have instead developed along with the capitalist system's transformations and been influenced and thus influenced ideologies during particular periods in history. The ideological structures include an expansive discursive archive populated by a multitude of notions, suppositions, narratives, values and norms, categorisations and hierarchisations, legitimisations and rationalisations, normalisations and naturalisations. Moreover, these structures are continuously reproduced via a complex apparatus of various institutions and practices, different subjects in all spheres of society, ranging from political institutions, elites, intellectual, educational and scientific institutions to various media institutions through to corporate actors via their marketing and PR activities. The primary target of the ideological dimension of power is the minds of individuals and groups (Althusser, 2000; Foucault, 2001; Freeden, 1998; cf. Mau, 2022).

Even though we focus analytically on the ideological dimension of power in this article, this is done with the understanding that ideas and notions by themselves are devoid of power if they are not tied to the two other dimensions of power. First: the economic dimension, which refers to 'mute compulsion' in a capitalist system that forces those subjected to it to participate in the productive and reproductive processes, to work, not through force and ideology but by structuring the conditions of living in general. Second: the repressive dimension, which refers to state and corporate policies, institutions, techniques, and practices chiefly based on the repression and disciplining (control, surveillance, correction) of individuals and groups, and the threat of punishment when certain rules and behaviours are not followed properly (cf. Mau, 2022).

The neo-Luddite (e.g., Merchant, 2023; Mueller, 2021; Sadowski, 2025) perspective in turn enables us to understand technology and its development as never-neutral since they are determined by specific choices and interests of capitalists, and as inherently political concerning the direction of their development, their main characteristics, the way they are implemented and utilised, who owns and controls them, and to what ends, and how they affect particular groups of people, how they empower/disempower, and who exploits, surveils and controls them. Further, the Neo-Luddites provide us with the initial understanding that technology's societal benefits were never given but were mostly the result of public regulation of it fought for by various worker and other social movements. The perspective also brings awareness of the fact that the authoritarian capitalist nature of technological development, which excludes democratic interventions, deliberation, and decision-making, has not changed over history while alternative ways of developing are obfuscated and/or directly denounced for being irrational, impossible and counterproductive.

To comprehensively interrogate the underlying ideological structure, we first examine the centrality of the capitalism–technology relationship, how it relates to both the polycrisis and the dominant ways used to respond to it. This is followed by an examination of the main characteristics of the ideological structure of the relationship. Here, focus is given to several crucial historical and geopolitical contexts tied to the major transformations that led to the contemporary capitalist system and ensured the establishing of the essential building blocks for its structure. We commence with analysis of certain notions developed during the genesis of the modern order, modern state, colonialism, and the capitalist mode of production, concentrating on pioneering political, social and scientific thought. The article

then interrogates the ideas and notions which legitimised and rationalised the Industrial Revolution and the rise of automation technologies and modern computational thinking. It is within these contexts that we expect to identify and reflect on ideological notions that are key coordinates of the underlying ideological framework. We conclude by briefly reflecting on the insights gained and the implications they hold.

TECHNOLOGICAL DEVELOPMENT, CAPITALISM, AND THE POLYCRISIS

Capitalism, technological development, and technologies are inextricably linked. The latter have been a product of capitalism's logic and imperatives of expanding accumulation and competition among capitalists, which forced them into continuous innovation. Still, the ongoing enhancing of the system's capabilities enabled it to transcend its European context and become truly global. Even more importantly for the history and future of humans, the system became planet-altering, radically transforming our relationship with nature and to other living beings that were rendered epistemologically/ideologically and ontologically totally subservient to the processes of both capital accumulation and human domination (Harris, 2023; Malm, 2016; Winner, 1977). Here, the factory system had a large role in transforming the nascent capitalist order into an industrial system. This role began in the early 19th century when automation machinery, surveillance, control and domination of workers combined with the utilisation of novel energy (primarily fossil fuel) sources permitted unprecedented levels of production and of resources (extending from ore to food and labour), unmatched expansive logistical/transportation networks (roads, railroads, ports), stable and fast communication, and consequently the radical altering of natural and human-built environments via extraction, destruction and pollution. Subsequent transformations of this system were especially linked to the development and implementation of central capitalist technologies (such as the internal combustion engine, logistics-shipping container, novel ICTs including radio, television and computer-digital technologies), which were used to establish new accumulation regimes whenever the old ones were stagnating, fading, and starting to collapse under the weight of their contradictions. Each transformation contributed to the massive expansion of the production of commodities (goods and services) as well as their variety and quantity, to the massive growth of consumption and the increasingly complex (global) value chains further integrating global societies in an ever wider and deeper world system. This was crucial for reproducing the legitimacy of the system since ordinary people could observe and (at least partly) participate in the continuous material progress by consuming an expanding range of novel commodities, which became conflated with improved well-being (Merchant, 2023; Patel & Moore, 2017). However, no transformation could resolve the constitutive contradictions of the capitalist system. The (eco)modernist hope that social, political, economic and ecological issues and crises could be resolved via a (technologically) improved accumulation regime has proven to be illusionary in the 21st century when all of these crises have intensified and created a polycrisis of the system, which precipitated the implementing of various quasi-solutions (more concentration and consolidation of markets, more commodification, more resource extraction, fewer worker rights), and have made the system more unstable, unequal, exploitative and authoritarian (Dunlap, 2024).

The solutions proposed are determined by the naive faith that continues to be present among the general public, political elites, and researchers/academics in strategies and policies in the inherent societal benefits of capitalist technological development and the corporate ownership/control and the neutral nature of technologies and the CEO/founders of Big-Tech corporations as inherent geniuses and conduits of these "transcendent" process that are to jointly solve all major dimensions of the polycrisis, including inventing and implementing 'magic' technologies (e.g., generative 'AI') to resolve the climate and wider ecological crisis, economic stagnation, poverty, hunger, and the issue of natural resources being finite coupled with the issues concerning our deteriorating liberal democracies (Sadowski, 2025). Such beliefs remain largely in place (Vrečko Ilc, 2025) despite successive hypes as to the capabilities of novel technologies (from social media to WEB 3.0, the crypto-hype, the Metaverse, autonomous vehicles, to automation) leading to resource and wealth destruction. Despite the extensively documented negative effects of technologies like their detrimental effects on democratic politics, science and education, work and leisure, the problematic behaviour of Big-Tech in the area of monopolistic anti-competitive practices, the breaching of citizen and consumer rights, the massive ICT-enabled surveillance and intrusive tailored advertising, deteriorating services (e.g., Google search), and the appalling behaviour and political ideas of techno-billionaires (e.g., Musk, Zuckerberg, Bezos, Gates, Thiel, Elison, Altman, Andreesen) striving for a dystopian techno-authoritarian/fascist, racist, sexist, eugenic, hierarchical, environment-destroying vision of society that would erase all the gains of

previous progressive and emancipatory struggles and place us on an even more unsustainable trajectory, and the capitalist states' utilisation of novel privately developed surveillance and automation technologies to stifle dissent and resistance to the increasingly unpopular status quo. It appears that no past broken promise, no horrible effect, no fascistic behaviour of the techno-oligarchs, or any authoritarian state intervention can destabilise these beliefs. The biggest reason for this is the multidimensional constitutive relationship between technologies, their development and the capitalist system, which is substantially older than the present permutation whereby the 'tech sector' enjoys a dominant position among capitalist industries due to its penetration and influence on all other pivotal industries (fossil fuels, transportation, heavy industries, finance etc.). Also relevant here are the underlying Teflon-like ideological structures which rationalise/legitimise and naturalise/normalise capitalist technologies and their development and play a substantial part in the reproduction of these power relations which hinder the expression of alternative solutions.

To unpack the mentioned ideological structure, we first analyse its key building blocks, notions, ideas, suppositions, subjects-objects as can be identified in pioneering modern socio-political and scientific thinking thought.

MODERN SOCIO-POLITICAL THOUGHT AND THE MAJOR BUILDING BLOCKS OF THE IDEOLOGICAL STRUCTURE

The key building blocks of the ideological structure can be discerned in socio-political and scientific thought expressed between the 17th to 19th centuries. It is crucial to demonstrate the obfuscated origins of certain still dominant notions and predispositions concerning technology and its development and to show how such thinking constitutes the rationalising and legitimising of the capitalist social form in the context of its genesis, transformations and consolidation. In this regard, we focus on the crucial revolutionary notions of modern thought related to material progress, the unclear divine–secular separation, the collective and individual privileged subject of development, the centrality of the capitalist property regime, and the notion of productivity as a building block for the nascent ideological structure.

The genesis of capitalism is ideologically characterised by a radical break from yet at the same time an obfuscated continuity of certain notions to do with the previous feudal order and its ideological legitimisation and justification. Fundamental works of modern political theory like Hobbes' *Leviathan* (1998) and Locke's *Two treaties on government* (2003) were simultaneously ideological visions of the gradually establishing Bourgeois-capitalist elites of the proper way for organising societies and reflections of transformations already made by then. A major part of this undertaking still nascent in Hobbes (1998, 19, 222) and fully formed in Locke (2003, 111–121) was the establishing of the material progress of society as fundamental and imperative for humans-as-a-species. Thinkers together with elites gradually established material progress, in the form of the expansion of material production, as a human duty, as what separates us from other living beings. A feature of this thinking was the notion of the technological domination and subjugation of nature (cf. Winner, 1977).[1] The subjugation and exploitation of other living beings and natural resources was seen as fundamental for the continued expansion of the material wealth of a society, thereby also creating a fundamental epistemological and ontological separation between humans and the natural world (Wainwright & Mann, 2018). Ideologically, the material progress and wealth of a society was directly tied to (the notion of) technological development and established as a direct expression of the moral character of a society and/or individuals.

In this context, a specific Christian eschatology was secularised and integrated into the notion of progress and (technological) development. This led to the development of technology being perceived as fundamental to the salvation of humanity*:* salvation in the form of a return to a perfect state of being, of harmony before the expulsion from the garden of Eden. It was imagined as a correction of Adam and Eve's transgression of eating from the tree of the knowledge of good and evil (Noble, 1999). In an ideological sense, technological innovations were connected with the secularised Christian idea of salvation that would make us immortal in the future. The secularised idea of immortality fundamentally influenced most Enlightenment thinkers, including Francis Bacon the father of modern empiricism. It is on this basis that *t*echnological development became equated with moral development. It became possible to delegitimise any kind of critique of technological development and any kind of regulatory obstacle placed in its path as morally suspect and/or an immoral obstacle to attaining human salvation (Geraci, 2008; Noble, 1999). Specific articulations of this ideological framework claim

1 The idea of nature held different roles in modern political thought not simply as something to be dominated but also as a determinant, explanans, origin and a (natural) state to be transcendent, cf. Pikalo & Lukšič (2013).

that technological development leads not only to our salvation in the sense of immortality (e.g., computer/A.I. fantasies of the digitalisation of our minds) but also to the creation of a technological God. The latter is a close approximation of the God in the Old Testament in that it will either absolve us from our sins or enact divine retribution. This legitimises extremely problematic policies and activities and the centralisation of power of those who are established or establish themselves as "prophets" of this technological God (Sadowski, 2025). The above ideas formed a fundamental element of a wider set of secular "Promethean" ideas, later established and perpetuated as part of the capitalist ideology, of thinking on and imagining technology(ies) (Merchant, 2023).

The genesis of modern theological and secular notions of technological prophets and Promethei can only be understood in a relationship of mutual support and influence with the capitalist-imperialist notions of universal and uni-linear objective development of human societies and the collective and individual agents of change, enlightenment, progress and evolution. The development of human societies was and is imagined as progressing via universal stages that follow specific inescapable "natural" laws (Lindqvist, 1996). European/Western societies were/remain (self-)imagined as naturally superior to all other societies based on their technological development and superiority. Depending on the historical and geopolitical and socio-political context, this superiority was also established via the notion of the biological superiority of European/Western populations in the sense of presumably possessing the most developed minds (intellect, reason) and bodies of any human group. Hence, Europeans/Westerners were established as holding a legitimate right to empires, to colonies, to intervention, as well as the capitalist-imperial appropriation and exploitation of societies deemed to be unenlightened and at a lower stages of development. The latter were imagined as in need of being led by the "enlightened" superior Europeans/Westerners (Lindqvist, 1996).

At the end of 19th century, capitalist Western elites added to these notions social Darwinism and eugenics (theories and practices of "racial hygiene"). Built upon the biopolitical notions of normality and possibility of the scientific identification and optimisation of developmental processes, these theories were based on the notion of the strict classification and hierarchising of individuals, groups and populations into distinctive 'natural' categories. These gave the basis for the specific regulation of populations and the disciplining (and exclusion) of individuals according to norms and the 'normality' of behaviour (e.g., social roles that certain categories of people could play in society) and appearance ('normal' bodies) corresponding to specific categories. A crucial component of these theories of normality and abnormality and hierarchical categorisations were the notions of the hereditary nature of these 'identified' characteristics/differences, and the notions tied to the inherently dangerous abnormality that would, if left unregulated, produce grave, degenerative effects for normal, superior populations and individuals (McWhorter, 2009).

These ideological frameworks simultaneously built on and naturalised sexist/gendered, racist/racial hierarchies and class hierarchies that had been established following the genesis of the capitalist social form in the early modern English context (Hall, 1995). The biggest difference was that they led to the novel authority of medical-biological-anatomical-anthropological-social sciences and that due to the European/Western imperial expansion these hierarchies and their novel biopolitical forms in particular were spread globally. However, the individual and population norm of the capitalist system remained only slightly changed to accommodate the novel scientific theories and local specifics concerning existing hierarchies. The Hobbesian and Lockean modern normal and normative political and economic subject thus remained in place. It continued to reflect the bourgeois man that is imagined to be autonomous, rational, intelligent, mentally, and physically fit (namely, Christian and white), and deemed to be cultured and civilised (McWhorter, 2009). Members of this category have established themselves and constantly re-established themselves as those who are inherently and naturally called upon to rule, lead, judge, subjugate, discipline and exclude those beneath them, and to be respected by all, and are not be subject to criticism. This individual norm has served and still serves to legitimate and rationalise the most brutal colonial-imperial and capitalist practices at home in the metropoles and abroad in (neo)colonial contexts.

An important feature of this norm is that members of this category/norm were and are imagined as productive, which is directly linked to their ownership of the means of production, ownership of private property in the form of land, and even more crucially the ownership of technology(ies). The capitalist system is characterised by a historically singular understanding of private property. The latter is imagined as capital in the sense it is inextricably linked to the notions of exclusivity and improvement. The property of land was imagined as tied to the intentional process of increasing its productivity with the sole purpose of improving its profitability (cf. Locke, 2003). This notion was fundamental to

the ideological legitimation of colonial occupation and dispossession of the land of native populations and for privatising (e.g., enclosure of) the commons and the land of local farmers-tenants in the colonial metropoles. A legitimate and legal basis of ownership could now be established only based on productive labour, which leads to the realisation of profit (Armitage, 2004). Nonetheless, the term producer became exclusively tied to the individual who actively utilises their private property for profitable investment: the capitalist, the entrepreneur, the captain of industry, and the hero of capitalist social form. The actual producers, the employed labourers, and the undeniable fact of the always-already collective dimension of production were erased from the notion of producers (Wood, 2017). A similar logic was established regarding technological innovations and the ownership of technology(ies) under capitalism. The notion of exclusivity held a core role in establishing intellectual property over specific technology(ies) as exclusively tied to a particular individual (and later corporation). The fact this property right was/is recognised and enforced by the state enables those holding this right to not merely improve their own production process but to control its use by other capitalists and generate an income in the form of a rent paid by users of this technology that employ it to improve the production process and make higher profits. In this ideological framework, the innovator-inventor plays the part of the lonely hero (cf. Merchant, 2023).

The latter is always-already limited to individuals, who are able *to* legally privatise the invention of a novel technology. This obfuscates the inherent collective nature of any type of innovation, which is always a product of numerous people, their mutual relationships and influences, their multiple experiments, multiple mistakes, and dead-ends that were necessary for a given invention-innovation to emerge. Regardless of the individual genius of specific inventors, their innovation is always the result of unrecognised and unseen collective labour, structures, institutions, and relations (Johnson, 2010). In any case, this individualisation and exclusivity of ownership is heavily determined by the membership (proximity) of the individual-inventor to the norm-subject of the capitalist order. Ownership of technology(ies) was/is disproportionately attributed to those closer to the norm, yet is denied to members of hierarchically inferior categories (e.g., women, of non-European descent, common workers). While the former bathe in glory and wealth, the latter's contributions are largely obfuscated and erased. Ultimately, this ideological framework enables capitalists (individuals and corporations) to gain exclusive ownership of the technological innovations made by their workers. This process is similar to the usual process of extracting the surplus value from the work of labourers and in a capitalist order is also perceived to be completely legal and legitimate (cf. Sadowski, 2025).

The extent of material compensation and symbolic recognition for technological innovations that workers can receive was hierarchically structured and dependent on the capitalist ideological framework of 'natural' hierarchies among members of specific population categories and the hierarchies tied to the capitalist division of labour. Even though male engineers and management could be compensated and partly celebrated, the contribution made by ordinary male and female workers and most female engineers was/is silenced, and thus they are not compensated for their efforts. This should be understood as an important element of consolidating control over workers through their differentiation, hierarchisation, privileging and discrimination. Economic compensation and (limited) symbolic recognition of engineers/experts was/is an ideological instrument to subvert, to prevent their solidarity with ordinary workers, to prevent their mutual resistance to exploitative capitalist social relations, and as an instrument for establishing solidarity with capitalists, and for aligning their interests and values not with other workers but with their employers, thereby also valorising and reifying the subject-norm of the capitalist order (cf. Harris, 2023).

A closer look at today's richest and most influential people (e.g., Gates, Bezos, Zuckerberg, Musk, Thiel, Altman) – the owners and leaders of crucial technological mega corporations – shows that this norm largely remains intact in our modern globalised digital era. It also demonstrates the above-mentioned abstract structure in a concrete way since each of them has extremely successfully privatised an enormous set of innovations of other people and acquired global recognition for innovations they made no tangible contribution to with their own intellectual/engineering work. Further, their common traits and (self)representation, ranging from an affluent family background, attending Ivy League universities, being located in Silicon Valley, the heartland of the American empire and birthplace of American technological might, their very similar values and interests (profit above all else, commercially minded, hyper-egoistical mindset) makes them interesting not as individuals but as avatars and expressions of a certain dominant ideological-material order and the specific capitalism–technology relationship. This has allowed them to succeed and acquire unprecedented influence also due to the specific ideological structure from which they can still draw on in order to legitimate and rationalise their influence and attack and delegitimise any regulation that would seek to

reduce their power. Similarly to the earlier capitalists, they are (self)represented as being at once individual geniuses, brilliant engineers and inventors, as self-made men, entrepreneurs, who succeeded because of their capabilities, who should direct the masses and lead people and societies, whose genetic material is outstanding and superior, who are the primary conduits/messiahs of the transhistorical/godly forces of technological progress and at the same time and paradoxically extremely rational and all-knowing despite holding dubious esoteric and narcissistic beliefs in a utopian future that closer inspection reveals to be a techno-dystopia for the vast majority of humanity.

As shown in the following chapter, imagining technology(ies) as the primary solutions for crucial socio-economic and political issues is as old as industrial capitalism, as are the notions that technological progress will ultimately benefit the wellbeing of societies and eventually lead to a technologically enabled utopia. Yet, the industrial revolution was also the genesis of other central elements of the ideological structure, including the still very effective ideological tools used to combat any resistance against the introduction of novel technologies.

THE INDUSTRIAL REVOLUTION AND CONSOLIDATION OF THE IDEOLOGICAL STRUCTURE

The ideological legitimisation and rationalisation of the British industrial revolution in the early 19th century may be viewed as the critical historical context when several central coordinates of the underlying ideological structure were established. It was then that the capitalist drive towards innovating productive processes encountered serious opposition from those negatively affected by it. Hence, major ideas about technologies and their development were articulated, popularised and naturalised to simultaneously legitimise and rationalise technological innovation, and to silence/obfuscate ideological-material resistance to these processes as well as to delegitimise and pathologise critiques by individuals and social/worker movements. These ideas are today completely naturalised and normalised (Merchant, 2023; Mueller, 2021).

One of the central notions is techno optimist and techno determinist, which has framed technological progress and the implementation of novel technologies as inevitable (a force of its own), an inherent good that should not be questioned with respect to its immediate negative impacts on workers and/or normal citizens, or its negative short-mezzo-long-term impact on the environment, negative impact on social relations, institutions and structures, including democratic political rights and processes, and the further precarisation of workers, ossified divisions of labour, and concentration of wealth and power. The discourses that legitimised the genesis of industrial capitalism (implementation of the factory system and automation technologies powered by the steam engine and later the internal combustion engine, and electricity) were suffused with the already addressed notions of material progress, especially the ideas of Adam Smith. These became the ruling political dogma of economic and political elites. Smith's ideas became crucial in factory owners' legitimisation of and the elite's and state's support for the unregulated implementation of the factory system and the machinery for the mass automation of work that undergirds it (Merchant, 2023). In particular, Smith's ideas about the "free market" (e.g., the necessity of pro-trade, pro-entrepreneur, anti-regulation policies) as the fuel that drives the motor of economic (and societal) prosperity and his ideas of the division of labour as the motor for generating prosperity (cf. Munger, 2018) were instrumentalised to prevent any 'obstructive' regulation and demolish existing rules preventing the unregulated use of technology(ies) and the factory system. The notion of the (strict) division of labour being needed for prosperity was inextricably linked to the notion of the necessity of the automation of work and systematic control and surveillance of working processes and workers, which were linked to the heroising of industrial capitalists and the derogatory claims about workers (Merchant, 2023; Mueller, 2021). Here the idea of the maverick entrepreneur, the top of the division of labour who is solely responsible for the progress of society, as well as for wealth creation, and providing jobs and opportunities, became dominant and hegemonic. Simultaneously, it was in this context that industrial capitalists made their instrumental image of the inherently lazy worker, who is child-like, undisciplined, unpredictable, ungrateful, which has become the dominant framework for the way society imagines workers, that is still present today (e.g., Bezos' rationalisation of the hyper-surveillance of workers in Amazon's warehouses) (Harris, 2023). The need for the division of labour and the interlinked notion regarding the characteristics of capitalists and workers implied that capitalists – the overseers, the '*producers*' – should be in charge and control the division of labour as they see fit, while the automation of work processes began to be imagined as a central element of enacting and controlling it.

The notion of the automation of human work is older than industrial capitalism because it was present in antiquity and initially tied to hopeful visions of a future in which work would become unnecessary for human prosperity (Mayor, 2018).

This utopian vision of the automation of labour was retained in the industrial revolution, albeit with specific twists and linked to the ideological legitimisation of the factory system. It was/remains a vital element of techno-deterministic and utopian notions of automation technologies, including the newest generative AI. Still, from the outset the industrial capitalist notion was imagined as inevitable, as part of the transhistorical process of technological development and not a set of choices of the industrial capitalists. Accordingly, its *n*egative effects on workers and communities had to be seen as unfortunate but unavoidable given the wealth the factory system, built on the automation of labour processes, had already created for the state, and notably for the elites. However, above all, due to its contribution to a prosperous future for all of society, including the now destitute, poor, exploited and expropriated workers who, following A. Smith, would benefit in the long run since new, better jobs would be created (Merchant, 2023). The latter was never the case as automation in itself has never led to the creation of better jobs and working conditions. These have instead always been an outcome of the collective struggle of workers (Mueller, 2021).

An insidious aspect of the notion of automation is tied to the central logic of the capitalist mode of production, the law of value, and the fact that value is primarily produced through human labour. The capitalist fantasy that can never be achieved but was and still is very popular among the most ruthless industrial capitalists (e.g., Bezos, Musk), political, media and scientific elites as well as engineers is the fantasy of automation completely replacing workers, the fantasy of a fully automated profit machine. This notion was/is used to discipline and control workers. It has frightened workers regarding their future 'inevitable' unemployment and thereby led them to accept the worsening of their working conditions and compensation. Moreover, it was and is utilised to disguise the fact of the inescapable need of human labour, of constant human intervention for any kind of automation to work properly in the long run (Benanav, 2022). The 'ghost work' that enables generative AI to not be completely useless is not historically exceptional but a contemporary materialisation of these processes that enable capitalists to further exploit workers by hiding their crucial contribution – their work – and in this way having even greater control over the production process, turning people into invisible cogs in the machine (Gray & Suri, 2019). This fantasy was/is part of a wider notion of the need for the factory system where the requirement to automate as much of the productive process as technologically and financially viable was key. Another key part were the notions of the need to organise a mass of workers into a massively substantial productive force achieving maximum efficiency to compete and dominate in national and global markets in the context of strong competition among imperial states. The factory system was imagined as (and actually was) the backbone of the British global hegemony established over the world capitalist system (Merchant, 2023). Consequently, these ideas were inextricably linked to the notions of the need to implement systemic and systematic surveillance of workers and minutiae control of workers activity in various steps of the productive process. This included the notion of the need for a strict shifts-based regime of production and the necessity to continuously further segment the process of commodity production into smaller and smaller steps that require ever fewer individual skills of workers. The basic motivation for automating the productive process was that complex, skilled human labour can be divided into a set of multiple simpler steps which can be more efficiently performed by automated machines; that these can be operated by presumably unskilled labour whose work is directed by these machines to which they are expected to adapt; and that these should be controlled by overseers-managers-entrepreneurs-capitalists as the proper rational autonomous subjects in this process. The ideas of automating capitalist production were labour-saving in a very specific way in the sense of adding further to capitalists' power vis-à-vis workers. They were explicitly anti-democratic, hierarchical and authoritarian, and an instrument of the rationalisation of capitalist asymmetrical power relations between capital and labour (Benanav, 2022; Harris, 2023; Merchant, 2023).

They shunned all ideas about ordinary workers and citizens having the right to participate in and influence the development and implementation of technologies. These ideas were crucial in legitimating ever novel technologies for automating the work of humans regardless of their negative effects on workers and societies, irrespective of who develops them, who makes the central but always obfuscated decisions on their characteristics, who owns them, who directs and oversees their operations, who reaps enormous profits from them, and who gains unprecedented power due to them. The ruthless industrialist strived to present their introduction of the factory system as a moral good, as morally just, since progress is just and morally good. At the same time, they were hailed by the political elites, the media, and the government for being beneficial to society (cf. Merchant, 2023).

The British industrial revolution was also the context in which the ideological structure was expanded with the discourse to counter resistance

to capitalist technologies and their development. Here the Luddite movement and the response of industrialists, political elites, the state and the media to it had a central role. The Luddite movement was the first collective systematic resistance to implementation of the factory system and as such faced the ultimately successful brutal repression and ideological denigration by the elites in society. In fact, the elite's efforts were so successful that the term Luddite even today remains a derogatory term for people who supposedly irrationally oppose technological progress, and are techno-phobes as they lack understanding of the benefits brought by novel technologies. Nonetheless, this negative fantasy is far from the truth because they were knowledgeable machinists and lucid critics of specific technologies and their implementation; namely, those that concentrated power in the hands of industrialists, disempowered workers and destroyed communities. Despite being among the first to articulate various ideas that benefited worker's wellbeing (e.g., the minimum wage) later adopted by workers movements in their generally successful fight for material benefits, their critical perspective on technology was silenced. What remained even in revolutionary left circles was quite a naïve understanding of technology(ies) as a neutral instrument that can be harnessed for emancipatory ends without issues even though their characteristics are in line with the imperatives and logic of capitalist accumulation. Contrary to today's fatalistic and deterministic visions of industrialisation, its total dominance was not a given but a product of powerful societal forces that prevailed in their struggles with workers (Merchant, 2023; Mueller, 2021; cf. Noble, 1999).

In the final part of our analysis, we consider certain ideological notions that consolidated and expanded the ideological structure and appeared in the context of the genesis of modern computational thinking. This is important since our contemporary context is ideologically and materially dominated by digital computer technologies, which obfuscate the relative oldness of computational thinking and its deep connections with the factory system, industrial automation, colonial slave plantations, and the subsequent establishment of the post-war neo-imperial, regulatory welfare state.

MODERN COMPUTATIONAL THINKING, MODERN ICTs, AND EXPANSION OF THE IDEOLOGICAL STRUCTURE

The fact that the father of modern computational thinking Charles Babbage was a major proponent of the interests of British industrial capitalists and a proclaimed enemy of organised labour and democracy that he believed was incompatible with capitalism can be seen as predictive of later computer technologies (cf. McQuillan, 2023). Babbage developed his notions and proto computers (difference and analytical engine) as part of an answer to the question faced by industrial capitalists about how to establish general control over and discipline the workers to assure stable production and stability of the factory system in order to consolidate the hegemony of the British empire around the world. This issue became especially relevant after the abolition of slavery, which called for a reorganisation of the industrial production processes that had relied heavily on a primary commodity (e.g., cotton) production by a slave population. That reorganisation transformed the nominally free workers into docile, disciplined cogs in the machine whose work was segmented, directed and surveilled for maximum efficiency and to minimise resistance it had to be seen as a legitimate step. Babbage's design of his analytical engine and the characteristics of the factory system indicate a deep connection with slave plantations. He was directly inspired by the operation and features of the modern slave plantation whose goal was to totally control, direct and surveil the slaves' lives to maximise their exploitation (Whittaker, 2023). Productive quotas, the exact number of workers, and time limits tied to specific work tasks developed via measurements, and the specification of tools and skills required to optimally perform specific tasks were techniques developed on slave plantations. They provided direct inspiration for developing the factory system and Babbage's analytical machine. Controlling and disciplining workers at a distance via automated machinery that enabled complex tasks to be broken up into simpler tasks for which a worker's movements were precisely defined and the time needed was at the heart of not only the modern factory system but modern computational thinking and computers as well (cf. Whittaker, 2023).

Babbage's computers were built on the notion of the automation of mathematical calculation by segmenting complex mathematical processes into parts able to be done by workers possessing rudimentary mathematical skills. His programmable analytical engine represents the central paradigm of modern computer technologies not simply because of the large amount of automated calculations. It specifically established the stark division of work and hierarchy between developers of computer programmes, the engineers who set the design and function of a computer, and the workers and other users who are deskilled and disciplined by the machine-programme they are working on or using without any possibility to substantially alter it (McQuillan, 2023; Whittaker, 2023). Similarly, to automation, the notions and presuppositions of computational thinking and machines were

developed not to support the emancipation of humanity and workers in particular, but following the imperatives of the capitalist social form and its need to control, discipline and subjugate workers.

The arguably final foundational expansion and consolidation of the ideological structure linked to computational thinking concerning the notions associated with the technological solutionism of central socio-political and economic issues can be traced to the proper birth of modern computers and computer networks (modern ICT) during the Second World War. This was constitutively connected with the emergence of the novel US-dominated global order built on its technological capabilities, its supremacy in novel computer-based technologies which enabled the USA to supplant the British empire as the centre of the capitalist world system, as the centre of technological innovation (Harris, 2023). It was connected with the capitalist state's material and ideological reorganisation into its modern administrative, regulatory, welfare and neo-imperial form. Here the novel computational thinking and technologies played a core role, and they had an inherently post-democratic, post-political, authoritarian and anti-emancipatory characteristic because they were a main element of the novel postwar technocratic and techno-solutionist ideological framework for governing, regulating, disciplining, normalising and optimising national and global populations predicated on faith in being able to solve any conceivable societal issue technologically. The principal purpose of this framework was to establish the conditions for stability, social cohesion, and unprecedented expansion for capitalist accumulation. Liberal democratic politics were seen as too unpredictable, irrational, and as an unproductive clash of interests compared to technological-based solutions, which were framed as a superior substitute for potentially destabilising politics (Levine, 2019). This could only be claimed in relation to the particular reductive understanding of humans, society and nature on which the pioneering computer engineers based their expansion of computational thinking during and after the Second World War and which became a major addition to the ideological structure underlying postwar capitalist society. Such an understanding stemmed from the notion that computer models for ordering, classifying, regulating populations and for creating hierarchical, stabilising and prediction-based imagining of the social and natural world were a neutral mirror of it. Still, the world established by these models was always-already characterised by its conservative and reactionary nature since it reified existing capitalist structures, institutions, relationships, interests, and values. It obfuscated the existing asymmetrical power relations together with the various choices made while developing these models, their implicit characteristics, preferences, and the interests and values embedded in those choices. These models of computation and their societal proliferation did/do not expand the agency of common citizens and instead were/are a vehicle for the further concentration of power, as made even more opaque by describing the decisions/solutions based on them as neutral and optimal (Bridle, 2018; Weizenbaum, 1993). Models and computer technologies became a fixed part of the corporate sector and welfare institutions and of the state's repressive apparatus as instruments of surveillance and control, and of counterintelligence, for preventing and tackling domestic and foreign resistance to the existing imperialist-capitalist national and global order (Levine, 2019; McGuigan, 2023).

Paradoxically, the subsequent expansion of this ideological framework in the 1980s managed to retain the mentioned model-based techno-solutionist framing, while adding a techno-utopian notion of computer/network technologies as being inherently emancipatory, liberating, decentralising (as inherently good) and democratic/anti-authoritarian. This helped conceal the military origin of computer/network technologies, while also legitimating and rationalising the later monopolisation of the digital technology sector by delegitimising any public regulation of it as authoritarian and anti-innovation, and obfuscated the inherent emancipatory limits of these technologies of atomisation, surveillance, control and concentration of power in the hands of a few technological mega corporations and the US state (Harris, 2023; Levine, 2019).

CONCLUSION

In the article, the ideology of technology and its development was analysed as a vital underlying ideological structure of the modern capitalist neo-imperial order that was/is very important in the genesis and the (re)production, justification and legitimisation of this system and its asymmetrical power relations. We explained why this under-analysed ideological structure must be viewed as one of the primary ideological obstacles for imagining and implementing sustainable, democratic and emancipatory transformations of the system. Such transformations in the context of the polycrisis of the modern order today are existentially needed given that various dimensions of the crisis, above all the ecological/climate crisis, are rattling the system's foundations and clearly reveal its ecologically unsustainable nature. Yet, to imagine the alternatives we claimed a critical interrogation of the underlying ideological structure is needed since the latter remains the naturalised framework in which

dominant solutions to the polycrisis are formulated; solutions reliant on unwavering, albeit misplaced faith in capitalist technological development, technologies and the corporations and techno-oligarchs that own and/or control them. Namely, faith in the simultaneous inevitability of specific technological solutions, their inherent emancipatory nature, the neutral nature of technologies and their implementation, their neutral and singular development, and their inevitable benefit for society, politics and the environment, and the non-problematic nature of excluding the public from decisions about the direction of technological development. A prime example of the latter is the development and implementation of ecologically, socially and politically unsustainable generative AI technologies owned and controlled by unaccountable corporations/oligarchs as universal solutions to the polycrisis. This led us to critically interrogate the genesis and development of the major foundational elements of the ideological structure underlying technology, which has enabled, reproduced and naturalised such faith from its beginnings in modern political thought to the industrial revolution and digital-computer revolution. We reflected on technological determinism, utopianism, solutionism, the secularised divinisation of technological development, the obfuscated privileged individual (bourgeois, white, Christian male) and collective (Western men) subject of technological development, and the notion of technology(ies) being owned exclusively by the capitalist as the only subjects imagined to be productive (not actual labours). The analysis considered the notions of automation being inherently good irrespective of the destitution, poverty, deskilling and disempowering of workers and centralisation of power in the hands of capitalists which rationalised industrialisation. Also examined was the notion that technologies and their development are neutral, part of a transcendent process that should neither be stopped nor regulated, that there is no alternative to their implementation because in the long rung they will benefit all of society. We reflected on the ideological tools used to combat resistance to technologies centred on the notion of the Luddites, who contrary to historical facts were framed as irrational, anti-modern haters of technology. We analysed the anti-emancipatory, authoritarian, disempowering nature of computational thinking in the contexts of industrialisation, the postwar computer revolution, and birth of the notion of computer-based models of the natural and social world. These provided the foundation of the postwar neo-imperial capitalist regulatory welfare state. Models remain an inherent part of the technocratic dimension of our present order which views democratic politics as messy, unpredictable and unproductive and obfuscates the inherent limits and repressive dimensions of these classificatory, predictive and decision-making models built around techno-solutionism. Finally, we briefly reflected on the modernisation of techno-utopianism thinking with the birth of personal computers and the Internet where these have been framed as inherently empowering, emancipatory and democratic, which with the hindsight provided by our current context of corporate monopolies that dominate these technologies and our lives have proven to be problematic and an obstacle to the articulation of proper alternative emancipatory solutions to the polycrisis.

IDEOLOGIJA TEHNOLOGIJE IN NJENEGA RAZVOJA IN POLIKRIZA SODOBNEGA KAPITALIZMA

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POVZETEK

Članek kritično reflektira ideologijo tehnološkega razvoja in tehnologije kot konstitutivno ideološko strukturo modernega kapitalizma in kot hkrati temeljno oviro za razvoj trajnostnih, emancipatornih in demokratičnih rešitev in vizij za razreševanje politikrize. Slednja večdimenzionalna kriza, ki zajema tako politično, geopolitično, ekonomsko kot ekološko dimenzijo, je namreč pričela korenito destabilizirati obstoječo kapitalistično ureditev na lokalni in globalni ravni ter spodkopavati same temelje njenega obstoja. Kljub temu, da dosedanje naslavljanje krize ni bilo uspešno, so rešitve in vizije razreševanja še vedno osrediščene na problematični veri v zmožnosti tehnološkega razvoja, novih tehnologij in tehnoloških korporacij ter tehnoloških oligarhov, ki izhaja iz utemeljujoče ideološke strukture. Opirajoč se na materialistično-neoludistični analitični okvir članek najprej naslovi temeljno razmerje med kapitalizmom in tehnološkim razvojem ter vlogo ideološke moči v (re)produkciji ureditve. Glavni analitični del pa je osredotočen na identifikacijo in analizo idej, ki so v specifičnih temeljnih prelomnicah razvoja kapitalistične ureditve zamejevali razumevanje tehnologij in tehnološkega razvoja in širše legitimirali in racionalizirali kapitalistično ureditev njene imperative in logiko nenehnega večanja akumulacije kapitala v okviru teh zgodovinskih prelomnicah, kot tudi omejevali alternativne vizije razvoja tehnologij in njihovih značilnosti ter lastništva in učinka. Najprej so analizirane ideje, ki se pojavijo s pojavom moderne politične in družbene misli. Temu sledi analiza idej v okviru industrijske revolucije. Analiza se zaključi z osredotočanjem na ideje v okviru geneze in razvoja računalniške miselnosti, ki vzajemno omejujejo alternativne vizije tehnološkega razvoja in tehnologij preko utrjevanja idej tehnološkega determinizma, optimizma, solucionizma in neizogibnosti zasebnega usmerjanja tehnološkega razvoja in zasebnega nadzora nad tehnologijami.

Ključne besede: ideologija, tehnologija, tehnološki razvoj, kapitalizem, polikriza, industrijska revolucija, računalniška miselnost

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