

Methodology of Science and the “Hierarchical” Logic of Dmytro Krivenko
(Dedicated to the 84th Anniversary of the Birth of Dmytro Tarasovych Krivenko (30 October 1941 — 4 October 1994))

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Abstract

This article examines the philosophical and methodological legacy of Dmytro Tarasovych Krivenko (1941–1994) on the occasion of the 84th anniversary of his birth. As one of the most original Ukrainian thinkers of the late Soviet period, Krivenko developed a *hierarchical model of cognition* and proposed *hierarchical logic* as a complement—rather than a negation—of dialectical logic. His works represent an attempt to reinterpret the epistemological foundations of science beyond both positivism and dogmatic materialism. Reconsidering the crisis of Western metaphysics from antiquity to the twentieth century, the study places Krivenko’s ideas within the broader context of the global discourse on materialism as a methodological principle rather than as a worldview.

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Historical and Philosophical Context

Viewed from the standpoint of an external observer, the history of Western philosophy appears as a sequence of attempts and subsequent crises of metaphysical systems [1]. During the Middle Ages, theology and scholasticism dominated intellectual life, while thinkers such as Thomas Aquinas and Duns Scotus integrated Aristotelian logic into Christian doctrine [2]. Beginning with the Renaissance, however, humanism and the revival of natural philosophy gradually displaced theistic explanations. The rise of empirical inquiry in the works of Francis Bacon and the mechanistic worldview of Galileo and Newton signaled a transition toward a *deistic* conception of the cosmos [3, 4].

In the seventeenth century, Descartes, Spinoza, and Leibniz sought to reconcile theology with scientific rationalism by constructing an *axiomatic metaphysics* modeled after Euclidean geometry [5]. This rationalist optimism entered crisis after the publication of Kant’s *Critique of Pure Reason* (1781), which revealed the limits of speculative metaphysics and demonstrated that knowledge is constrained by the conditions of possible experience [6]. In response, G. W. F. Hegel, in his *Phenomenology of Spirit* (1807), developed a dialectical philosophy aimed at overcoming Kant’s dualism between subject and object through the unfolding of Spirit (*Geist*) via contradiction and reconciliation [7]. Yet, as Karl Popper observed, the “all-embracing” system of Hegelianism suffered from a lack of empirical falsifiability [8].

In the nineteenth and twentieth centuries, philosophical thought underwent further fragmentation: Schopenhauer’s pessimism, Nietzsche’s critique of metaphysics, and Marx’s dialectical materialism all opposed Hegelian idealism, while Freud’s psychoanalysis and existentialism (Kierkegaard, Sartre) shifted attention to individual experience [9–12]. In the twentieth century, the so-called “linguistic turn” (Russell, Wittgenstein) sought to rebuild philosophy upon logic and language [13]. Even this approach, however, faced internal limitations—most notably Gödel’s incompleteness theorem (1931) and Russell’s paradox—which questioned the possibility of a fully self-consistent rational system [14]. Consequently, the most significant progress occurred not in metaphysics but in the *philosophy of science*, which focused on the methodology and interpretation of empirical knowledge [15].

It was precisely within this context that Krivenko’s thought emerged: his hierarchical approach sought to provide structure to scientific cognition without reverting to either pos-

itivism or Hegelian totality.

Dialectical and Materialist Approaches in Science

While speculative metaphysics wrestled with its internal contradictions, the philosophy of science increasingly turned to the question of *how scientific knowledge is justified* rather than *what ultimate reality is*. This shift—from ontology to methodology—can be traced through the transition from Hegelian dialectics to Marxist materialism, and later to twentieth-century scientific realism [16]. For Marx and Engels, dialectics was “placed on its feet”: instead of the self-development of the Absolute Spirit, material reality itself became the driving basis of development. In *Dialectics of Nature* (1883), Engels argued that the laws of thought are reflections of the objective dialectics of the world [17]. Lenin, in *Materialism and Empirio-criticism* (1909), defended scientific realism against the relativism of Mach and Avenarius, emphasizing that cognition reflects an external material world [18].

In Soviet tradition, this epistemological stance was often distorted into a form of *metaphysical atheism*. In fact, methodological materialism is closer to what modern philosophy of science calls an *ontological commitment* [19]. As Mario Bunge wrote, “materialism in science does not deny transcendence; it merely refuses to employ it as an explanatory variable” [20]. Even a critic of Marxism such as Popper acknowledged the strength of this approach, calling Lenin’s treatise “an excellent piece of epistemology” [21]. Thus, materialism as a method does not negate spirituality; it merely entails a temporary *suspension of metaphysical assumptions* for the sake of empirical verification [22]. This principle is vividly illustrated in the evolution of physics: the corpuscular and wave theories of light, unified within quantum mechanics, exemplify a dialectical yet structurally hierarchical process of cognition [23].

Dmytro Krivenko’s Hierarchical Logic

The intellectual climate of Ukrainian philosophy of science in the 1960s–1980s was characterized by a search for epistemological autonomy under ideological constraints. Thinkers such as Pavlo Kopnin, Serhii Krymskyi, and Dmytro Krivenko formed the *Kyiv methodological school*, which emphasized logical and structural organization of knowledge [24, 25]. In his book *The Logic of the Formation of Fundamental Physical Concepts* (1979), Krivenko

asked whether new scientific concepts always arise through contradiction or rather through a *successive refinement of structure* [26]. He demonstrated that the development of many physical notions occurs not through negation but through hierarchical deepening. From this emerged his central concept—the **hierarchical logic of cognition**, in which each level includes the previous one, ensuring continuity of development [27].

Krivenko emphasized that, in physics, conceptual change often proceeds not through opposition but through *hierarchical refinement*, where earlier levels are incorporated into broader structures [26], or, conversely, through radical replacement when a model fails empirically. Examples include the rejection of the caloric theory in favor of the kinetic definition of temperature, the replacement of Thomson’s “plum pudding” atom by Rutherford’s nuclear model, or the emergence of the quark model in particle physics. Thus, his hierarchical logic preserved dialectics but subordinated it to the principle of structure [27]. This approach anticipated later developments in complexity theory and multi-level information models (e.g., Simon [32]).

Subsequent works—*Informational Levels of Physical Concepts* (1984) and *Aggregation as a Method for Studying Complex Systems* (1988)—expanded the theory into a model of multi-level cognition [28, 29]. In the 1990s, Krivenko extended it to the socio-humanitarian sphere (*De-Imperialization and De-Fascization*, 1992; *Prinat and Prinatika*, 1996) [30, 31]. His concept anticipated modern trends in systems thinking, where structural complexity and level interactions play a fundamental role.

Influence, Legacy, and Contemporary Relevance

Dmytro Krivenko’s philosophical legacy occupies a unique place in the development of Ukrainian philosophy of science. By integrating dialectical, logical, and systemic approaches, he transformed the Soviet conceptual apparatus into a form of *post-dialectical epistemology*. His focus on structure, levels, and regularities of cognition parallels the ideas of Kuhn, Lakatos, and Simon [15, 32, 33]. Krivenko’s views can serve as a methodological bridge between the Soviet and post-Soviet scientific traditions. Some of his students and colleagues (e.g., Y. D. Krivenko-Emetov and others) continued to develop hierarchical modeling in philosophy and physics [34, 35].

Krivenko’s ideas resonated with the development of systems analysis, cybernetics, and



Figure 1: Dmytro Tarasovych Krivenko

the philosophy of information in Ukraine (Institute for Applied Systems Analysis, Institute of Philosophy of the NAS of Ukraine) [36]. His concept of informational levels anticipated both Bunge's *systemism* [37] and Nicolescu's *transdisciplinarity* [38]. Today, in the age of interdisciplinary research, the idea of structural multi-levelness that he defended acquires renewed relevance—akin to Wilson's concept of the “unity of knowledge” and Cartwright’s “dappled world” [39, 40]. Thus, Krivenko appears as a thinker who foresaw the modern understanding of science as a hierarchical, self-organizing, and open system.

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