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Individuals and collectives in the philosophy of Boris Hessen: An introduction

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Argument
This paper provides an introduction to three translations of articles by Soviet philosopher Boris Hessen: "Mechanical Materialism and Modern Physics," "On Comrade Timiryazev's Attitude towards Contemporary Science" and "Marian Smoluchowski (On the Tenth Anniversary of His Death)". It begins by presenting a central tension in Hessen's work; namely, how even though he is better known for the externalism of his 1931 Newton paper, much of his work has been considered exemplary of an internalist approach. I then show that for Hessen, the history of modern science was defined by the discovery of the dialectical unity in opposition between dynamic and statistical regularity. This not only sheds important light on Hessen's understanding of causation, but also reconciles the aforementioned tension by showing his approach to the relationship between individuals and collectives in the study of physical phenomena, along with the relationship between individual scientists and socioeconomic conditions.

Keywords: Boris Hessen; Soviet science; individuals; collectives; dynamic regularity; statistical regularity

In 1931, Soviet philosopher Boris Hessen[2] delivered a paper entitled "The Social and Economic Roots of Newton's *Principia*" at the Second International Congress of the History of Science and Technology in London. In this work, he provided a dialectical materialist reading of Sir Isaac Newton's natural philosophy, tracing the content of his theory to the socioeconomic development and technological progress of the England of his day. Hessen's other writings, however, are generally understood to be characteristically different from his 1931 text, as he wrote articles that appear to treat natural science as a wholly independent enterprise. Thus while Hessen's 1931 Newton text is often considered the founding document of the so-called 'externalist' approach to the history and philosophy of science, most of his work appears to be more "internalist" in character. In this paper, however, I argue that Hessen's 1931 text is not only compatible with his other writings, but that his studies on the topic of "dynamic and statistical regularity" address this gap by reconciling his approaches to scientific concepts and individuals of genius.

The paper proceeds over the course of four sections. The first section, "Boris Hessen: A Life," provides a brief introduction to Hessen's biography. The second, "The Hessen Paradox," proceeds with a presentation of the central tension in Hessen's work; namely, how even though he is better known for the externalism of his 1931 Newton paper, much of his work has been considered exemplary of an internalist approach. I enumerate three hypotheses which attempt to account for this discrepancy, then argue that while they do not reconcile the problem, they successfully

[1]The translations of Hessen's texts following this introduction were carried out by Sean Winkler with the aid of translation software, and were later revised by Alexei Kojevnikov. Translations of these same texts have also appeared in Olga Pattison and Chris Talbot's recent volume, *Boris Hessen: Physics and Philosophy in the Soviet Union, 1927 – 1931*. These translations are unrelated and were carried out independently of one another.

[2]Please note that references to English translations render his name according to the Ukrainian pronunciation of "Hessen," while references to the Russian originals render his name according to the Russian pronunciation of "Gessen."

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pinpoint the source of the problem in Hessen's contradictory approaches to scientific concepts and individuals of genius. Section three, "The Struggle for Scientific Socialism," contends that to reconcile this tension, one must first understand how Hessen, as a Soviet philosopher and scientist, would have understood the notion of science as such. We see that his understanding must be traced to the dialectical materialism/Machism debate in Russian Marxism, and to Lenin's *Materialism and Empirio-Criticism* prevailing as the ur-text of Soviet Marxism. In section four, "Dynamic and Statistical Regularity," we see that for Hessen, the history of modern science was defined by the discovery of the dialectical unity in opposition between dynamic and statistical regularity. This sheds important light on Hessen's understanding not only of causation, but of the relationship between individuals and collectives in the study of physical phenomena, as well as of the relationship between individual scientists and broader socioeconomic conditions. To support my claims, I draw from Hessen's translated and un-translated works, works from the history and philosophy of science, the Marxist tradition and the secondary literature therein. This paper is meant to provide an introduction to three translations of articles by Hessen —"Mechanical Materialism and Modern Physics," "On Comrade Timiryazev's Attitude towards Contemporary Science" and "Marian Smoluchowski (On the Tenth Anniversary of His Death)"— and convey to the reader the broader context and philosophical themes that informed his research.

1. Boris Hessen: A life

Who, then, exactly was Boris Hessen? Born in August 1893, Hessen was the child of Jewish parents in Elisavetgrad, which was then part of the Russian Empire and is today Kropyvnytskyi, Ukraine (Korsakov et al. 2015, 6–7). He studied physics and mathematics at the University of Edinburgh, as he had to seek education outside of the empire due to quotas on the number of Jewish students who were accepted into the Russian university system at the time (Ibid.). Hessen was already committed to Marxist ideas as a young man, and while first sympathetic to the Mensheviks, eventually went on to be more favorable to the Bolsheviks (Ibid., 10–11). When the October Revolution and subsequent Russian Civil War came, he joined the Red Army and the Communist Party, and played an important role in educating workers in mathematics and the natural sciences in his hometown. He was a true believer in the importance of bringing scientific education to the people to whom it had previously been denied (Chilvers 2007, 112). In the aftermath of the Civil War, he would go on to graduate from the Red Professor's Institute and later became the director of physics at Moscow State University (Ibid.).

As a philosopher and scientist, Hessen belonged to a group known as the "dialecticians," or "Deborinites" (so-called after Marxist philosopher Abram Moiseyevich Deborin). These were a wing of Marxists founded upon Lenin's initiative to encourage the study of the philosophy of Hegel for the sake of developing ever-improved accounts of materialist dialectics, and particularly, of persuading non-Marxists to adopt Marxist ideology (Schäfer 1988, 114). Among the Deborinites, Hessen took up this task by analyzing how contemporary scientific theories like quantum mechanics and relativity theory could be reconciled with dialectical materialism (Josephson 1991, 269; Freudenthal & McLaughlin 2009b, 255; Joravsky 2009, 286). In 1931, Hessen was selected to be a member of the Soviet contingent to the Second International Congress of the History of Science and Technology in London. The circumstances surrounding the decision to send Hessen (and to send a contingent at all) remain a matter of some speculation to this day (Werskey 1971, xi). For the conference, Hessen wrote what would become his most famous paper, entitled "The Social and Economic Roots of Newton's *Principia,*" a dialectical materialist reading of the emergence of Newtonian physics and, more generally, of the Scientific Revolution (Hessen 2009).

On 21 August 1936, Hessen was arrested on the false charges of "involvement in the terrorist activities of a Trotskyist-Zinovievist conspiracy," part of which involved "complicity in the 1934

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murder of S.M. Kirov and of planning terror attacks on leading officials" (Gorelik & Bouis 2005, 59; Freudenthal & McLaughlin 2009b, 255). He was brought to trial on 20 December 1936 and executed by firing squad on the same day, making him one of the first among what would become the countless victims of Stalin's regime in the so-called "Great Purge." To his family, friends and colleagues, he simply vanished without a trace, though in the midst of the increasingly volatile circumstances, it was not difficult to imagine his fate. Nothing of his apprehension and execution was made public until after his rehabilitation in 1955, and many of Hessen's biographical details have yet to be recovered (Gorelik & Bouis 2005, 59; Freudenthal & McLaughlin 2009b, 255).

2. The Hessen paradox

As previously indicated, Hessen is best known for his paper, "The Social and Economic Roots of Newton's *Principia*." This text is a curious artifact in the history and philosophy of science, as on one hand, perhaps no paper is more explicitly hated, while on the other hand, it is one of the most singularly influential papers of twentieth-century philosophy of science (H.F. Cohen 1994, 332; I.B. Cohen 1990, 55–56; Freudenthal 2005, 167; Freudenthal & McLaughlin 2009a, 32).[3] The work begins with Hessen challenging the conventional wisdom that ideas and individuals of genius drive scientific progress. Utilizing a dialectical materialist approach, he maintains that such progress rests on the basis of material practice and the movements of the masses. He takes Newtonian natural philosophy, a singular achievement in the history of science, as his case study and supports his position with three sub-theses,[4] which read as follows: (1) the content of Newtonian physics is traceable to the practical mechanics that was relevant for the incorporation of machinery in production in early capitalist manufacture in Newton's day; (2) the content of Newtonian metaphysics is rooted in the prevailing religious belief among Newton's class, namely the ascendant English bourgeoisie; (3) Newtonian natural philosophy does not address problems in thermodynamics, because the socioeconomic and technological conditions for theorizing such a science (i.e. the steam engine,) had yet to exist (Hessen 2009: 41–82).

Hessen's other papers take a substantially different approach to the history of science. His works in the Soviet Union primarily discuss the revolutionary developments in twentieth-century physics, such as quantum mechanics and relativity theory (Freudenthal & McLAughlin 2009b, 255; Graham 1985, 707; Joravsky 2009, 286; Josephson 2003, 584). While these works also take a historical approach, they pay almost no attention to socioeconomic conditions and technology, choosing instead to focus on the development of natural philosophical and scientific concepts in light of an almost dizzying number of figures. Thus, Hessen's oeuvre appears to be fundamentally paradoxical: on one hand, we find one of the (if not *the*) founders of externalist approach to the history and philosophy of science, while on the other hand, we find a thinker who devoted most of his career to an internalist approach to that field—a problem which I will subsequently refer to as the "Hessen paradox." The secondary literature has yielded three hypotheses that attempt to account for this paradox: (1) the Graham thesis, (2) the dialectical ontological thesis, and (3) the Machist thesis. This section will describe each of these hypotheses, followed by a critique and a distillation of their common insight.

In his seminal article, "The Socio-Political Roots of Boris Hessen," Loren Graham argues that a closer study of Hessen's oeuvre showed the Soviet philosopher to be, ultimately, an internalist—a hypothesis which will be referred to as the "Graham thesis." Hessen's 1931 Newton paper, Graham claims, appears to be an exception within the philosopher's oeuvre, as the bulk of his work focused on defending contemporary scientific developments and the independence of

[3]For a comprehensive survey of the influence of Hessen's 1931 Newton paper on twentieth-century history and philosophy of science, see Ienna & Rispoli 2019, 37–64.

[4]Hessen enumerates a fourth sub-thesis, but it does not include any mention of Newton (Hessen 2009, 82–89).

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scientific research, which he identifies as Hessen's true interest. Graham writes that in the Soviet Union, Hessen

> did not produce articles about the social context of science, but instead was engaged in a spirited defence of relativity theory and quantum mechanics against vulgar Marxist critiques of these revolutionary developments in physics. In these articles he maintained that a separation could be made between the intellectual content of a theory and the social context in which it was produced, a view that sounds very similar to the one which the more outspoken external historians of science in the West, citing his work, would eventually question. (Graham 1985, 707)

He stresses that the exceptional nature of Hessen's 1931 Newton paper was attributable to his being selected to attend the London conference in order to be put under surveillance. For Graham, Hessen's defenses of quantum mechanics and relativity theory were controversial in the early Soviet Union, as the origins of such theories in Western Europe and on the basis of certain philosophical premises led many Communist Party officials to deem them inherently "bourgeois," "idealistic" and "Machist" (Graham 1985, 710-711; Schäfer 1988, 114–115). By the early 1930s, then, Hessen would have been facing increasing scrutiny from the Communist Party due to a perceived lack of adherence to Marxist orthodoxy. Hessen, Graham argued, would have been keenly aware that he was under such surveillance and would have thus adopted a dogmatic Marxist position to appease his surveyors. Graham further suggests, however, that there is in fact evidence of Hessen subversively advancing an internalist position in the 1931 paper itself. The text contains, he states, a veiled argument that socioeconomic context dictated precisely those elements of Newton's natural philosophy that were superfluous (i.e. its philosophical and religious content), while his claims about physics were a product of his genuine scientific pursuits (Graham 1985, 715–716). Hessen would have meant for this argument to implicitly defend contemporary physicists like Bohr and Einstein, namely, that fellow Soviet Marxists "should similarly recognize the value of Einstein's and Bohr's physics while acknowledging that they arose in imperialist Europe and are often used to counter Marxism." Graham goes on to say that "the unwritten final line was that when Einstein wrote on religion or philosophy he also merely expressed his social context and therefore these views should not be held against his physics" (Ibid., 716–717). Ultimately then, Hessen was sending a "message to Bolshevik critics of relativity physics: 'What you do to Einstein and Bohr, I can do to Newton; so let's leave the physics alone'" (Ibid.).

In her 2017 article, "Boris Hessen's Ideas and Russian Philosophy," Olga Stolyarova takes a different point of view on the paradox. She maintains that while Hessen does appear to favor an externalist approach in 1931 and an internalist approach in his other writings, he would have never seen these positions as mutually exclusive. Ultimately, she argues, Hessen espoused a 'dialectical ontological' approach, according to which there exists a "complex relationship between the historical *a priori* social, ideological and technical, on the one hand, and the cognitive content of scientific theories" (Stolyarova 2017, 121). She points out that Hessen treated materialism not as a static philosophical persuasion, but rather as one subject to perpetual revision over the course of history.

Stolyarova goes on to claim that by characterizing materialism as subject to perpetual revision, Hessen effectively undermines the distinction between materialism and idealism altogether. With such a transient character, the very features that identify a position as idealistic in one period may identify that same position as materialistic in another. Consequently, she argues, Hessen did not favor materialism or idealism at all, but the term that unites them, namely, "dialectics." As she notes, "the terms 'materialism' and 'idealism', separating philosophers on opposite sides of the barricades, are not as important as the concept of 'dialectical ontology' which unites them" (Ibid.). Hessen's overall position, then, can be better defined as follows: "[t]he meaning of Hessen's concept, as well as the meaning of the concepts of those philosophers who continue and develop the tradition of dialectical ontology, consists in the fact that by introducing the

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historical *a priori* of social things, the context of discovery is brought into 'dynamic balance' with the context of justification" (Ibid. 125). Moreover, Stolyarova states that Hessen did not misunderstand his own position, but rather, adopted a position common to the history of Russian philosophy. Hessen was neither an internalist or externalist, nor an idealist or materialist, but a dialectician, less in the manner of Marx, Engels and Lenin and more in the manner of thinkers like Pavel Florenskii, Evald Ilyenkov and Aleksei Losev (Ibid. 122–125; 127–128).

Finally, in their recent article, "Boris Hessen at the Crossroads of Science and Ideology," Gerardo Ienna and Giulia Rispoli argue for yet another position. They maintain that Hessen's oeuvre only appears to be inconsistent to the extent that his 1931 paper is understood to adopt a dialectical materialist approach. Instead, they argue, Hessen was through and through an adherent of Machist epistemology. As they note, "Hessen's views were closer to an understanding of materialism and scientific development that were rooted in Russian Machism rather than in dialectical materialism" (Ienna & Rispoli 2019, 58). He was certainly not a dialectician, they claim, insofar as he did not uphold the so-called "unity of opposites," but rather, of the "theory of equilibrium." Rather, "his ideas about the relationship between structure and superstructure are more akin to Bogdanov's theory of equilibrium which in turn inspired Nikolai Bukharin's account of the complementary relationship between theory and praxis" (Ibid., 54).

Moreover, they maintain, Hessen was, ultimately, indifferent to materialism and idealism. They write that "the importance of history for the understanding of scientific development as an open process in which material and ideal elements are interwoven dissociates Hessen's view from dialectical materialism" (Ibid., 56). Because he appeared to reject any notion of subject-object duality, Hessen instead articulated a view according to which subject and object form an identity and, likewise, in which historical development dictates the acquisition of knowledge. Just as Mach "rejected any form of dualism between subject and object in the process of knowledge, and believed that the contents of experience do not have an objective meaning," so too "Hessen seems to defend an *empiriomonistic* view of knowledge production that saw cognition as a historical process in Bogdanovite terms" (Ibid., 53–54).

Finally, Ienna and Rispoli assert that, like Bogdanov, Hessen believed that the historical process by which theories develop is no less important than the theory in its present form. In his *Cognition from a Historical Point of View*, Bogdanov writes that

> The history of the development of the human mind is an uninterrupted process of metamorphoses and transformations of old ideas into new ones, and there is no doubt that at every stage of understanding any new 'truth' sooner or later will turn wrong. But this does not characterize only history. Actually, even current ideas represent a struggle between 'old truths' and the 'new ones'.... Static epistemology has not sufficiently emphasized that the movement and change of reality can be rightly understood only if a historical point of view is adopted. (Bogdanov 1899, 10–19; See Ienna & Rispoli 2019, 55–56)

Likewise, in his unfinished textbook, *Materials and Documents on the History of Physics*, Hessen writes that "no matter how new and unaccustomed theories of modern physics are, no matter how radically they differ from the views of classical physics, the modern stage of the development of physics is still a historical stage in its general development. Therefore, knowledge on the history of the emergence and development of physical theories not only facilitates an understanding of their current state, but also helps to establish their historical roots and thereby clears the way for new research" (Gessen [1936], 6. See Ienna & Rispoli, 56).

While each of these hypotheses offers valuable insight into Hessen's oeuvre, I maintain that they nevertheless rest on several problematic assumptions. First and foremost, they each take for granted that Hessen's focus may have differed between the 1931 text and his other papers due to the difference in audiences to which they were addressed. He presented the 1931 Newton paper to an audience of primarily non-Marxists, while the others were written for a

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primarily Marxist audience. Hessen does not explicitly acknowledge this difference anywhere, but it would nevertheless be fair to assume that Hessen would have been more inclined to outline his premises in the former, while this would have been unnecessary in the latter (Winkler 2020, 217–218). Second, these hypotheses each assume that Hessen would have been under intense scrutiny for his studies of quantum mechanics and relativity theory. However, in the Soviet Union, these simply were not the forbidden topics that they are often made out to be in the academic literature. As Alexei Kojevnikov argues, while certain Marxists were indeed vehemently opposed to quantum mechanics and relativity theory, they were in fact the exception more than the rule. The Communist Party and Marxist intellectuals alike were often favorably disposed to the study of these theories and were preoccupied not with censoring them, but with reflecting on how these theories could be reconciled with dialectical materialist philosophy (Kojevnikov 2008, 126–127; Kojevnikov 2011, 213). Third, over the years, scholars have unearthed new evidence which suggests that the Soviet delegation to the London conference was not, in fact, set up to put Hessen under surveillance. As Sergei Korsakov has noted, minutes from a meeting of the Organizing Bureau and Secretariat of the Central Committee of the Communist Party attest to the London trip being subject to standard, bureaucratic procedures and arranged to spread interest and support for Soviet science abroad (Korsakov 2018, 203). Fourth, there is increasing reason to believe that Hessen was not targeted for his philosophical and scientific writings, but for his prior political affiliations. C.A.J. Chilvers has claimed, for instance, that Hessen may have come under scrutiny due to his loyalty to the Mensheviks before the October Revolution, among other matters (Chilvers 2007, 111–115). Fifth, the Machist thesis specifically is based on the claim that Hessen shared certain positions with the co-founder of the Bolsheviks, and later opponent of Lenin, Alexander Bogdanov. The commonalities between Bogdanov's and Hessen's positions, however, are in fact beliefs held among most Marxist philosophers. For instance, Hessen's assertion that scientific theories involve understanding the historical process from which they culminate can be found not only in the work of Bogdanov, but also in the writings of Marx, Engels and Lenin, as well as Hessen's immediate predecessor, Abram Deborin.[5] Likewise, in a co-authored article with Ivan Podvolotskiy, Hessen vehemently criticizes Bogdanov precisely for his Machist epistemology, as well as his opposition to dialectics in favor of equilibrium theory (Gessen & Podvolotskiy 1929: 1–29).

Nevertheless, each of these three hypotheses rightly pinpoints why Hessen's 1931 Newton paper is so fundamentally vexing in the context of his oeuvre. Hessen spends the entire opening of the 1931 piece criticizing the so-called idealistic predilections of most historians and philosophers of science, only to apparently adopt that very approach in most of his work. He spends most of his time in his writings, in fact, discussing philosophical and scientific ideas in light of the individuals of genius who developed them. Like the aforementioned hypotheses, then, this paper upholds the notion that Hessen's works seem to operate on two fundamentally different sets of premises. But to reconcile this apparent discrepancy, it will advance an altogether different strategy. Firstly, it will argue that it is necessary to grasp Hessen's treatment of natural philosophy and science in light of what "science" meant for Marxist dialectical materialists. Secondly, it will advance the claim that it is also necessary to understand Hessen's account of dynamic and statistical regularity, as it sheds important light on his understanding of the relationship between individuals and collectives (Winkler 2020, 212–218).

[5]For example, in *Hegel and Dialectical Materialism*, Deborin writes as follows: "It is wrong to think that the history of philosophy for more than two and a half thousand years was a fruitless struggle of various opinions about worthless things and that this struggle has now ended in nothing, a round zero. People who are not familiar with the history of philosophy and science usually think so . . . . Modern giant successes in the field of natural science and technology would be impossible and inconceivable without all the previous history of mankind . . . . [T]he same thing has to be said about philosophy. Moreover, philosophy and science have always been so closely interconnected that they mutually feed each other" (Deborin 1929).

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3. The struggle for scientific socialism

From its inception, Marxist theory was inextricably linked with the history and philosophy of science. Marx and Engels never claimed to be the forefathers of socialism or communism. Rather, they attributed their originality to the way they sought to bring about such a vision of society. Where so-called "utopian socialists" based their political programs on the design and establishment of model societies, Marx and Engels claimed to uphold "scientific socialism," according to which new societies do not spring ready-made from the minds of visionaries, but are produced by concrete struggles for power over the productive forces of society. If a socialist or communist society was to come about, they maintained, it would do so in the same way as the feudal and capitalist societies that had preceded it—out of the conflict between the preeminent social classes of the day.[6]

But, if Marx and Engels claimed their socialism to be scientific, this nevertheless raised the broader question as to what it meant to be scientific in the first place. Throughout the course of their oeuvre, Marx and Engels announced that their position was the culmination of the history of philosophy and science, but they used several names for their own philosophico-scientific position: "historical materialism," "modern materialism," "the new materialism," the "dialectical nature of modern materialism," etc. Ironically, the term which came to be most closely associated with them—"dialectical materialism"—was not a term that they ever actually used in their writings together (Graham 1987, 25). The term was coined, rather, by a leather tanner named Joseph Dietzgen, who developed a highly similar philosophy to that of Marx and Engels, and who even corresponded with them on occasion (Dietzgen 1906. See also Graham 1987, 25). The term was later adopted by the so-called "father of Russian Marxism," Georgi Plekhanov, and eventually became the basis of the leader of the October Revolution, V.I. Lenin's own dialectical materialist reading of Marxism (Plekhanov 1940a. See Graham 1987, 25).

To understand exactly what it meant for Marxism to be scientific socialism in the Soviet Union, then, it is necessary to understand Lenin's dialectical materialism and how his statement of this philosophy in his seminal work, *Materialism and Empirio-Criticism* took hold. Written between February and October 1908, the text was first published by Lenin under the pseudonym V. Il'in in May 1909, at Krumbügel's Zveno Publishing House in Moscow, which produced a mere 2,000 copies (Bakhurst 2018, 108). The text would not see a more significant impact until its re-release by Lenin in 1920, and upon Lenin's death, when it eventually "became an obligatory text studied in all institutions of higher learning in the Soviet Union" (Lenin 1977b, 21; Hedeler 2018, 260). The origins of *Materialism and Empirio-Criticism* are essential for understanding the parameters through which the debate about the nature of Marxism as scientific socialism eventually took shape in the Soviet Union. For this, we have to go back more than a decade, before the October Revolution.

In the context of the failed Russian Revolution of 1905, the Russian Social-Democratic Labor Party (hereafter, RSDLP) was in a state of fundamental disarray. While the revolution did lead to a number of significant reforms, such as Tsar Nicholas II's concession to form a Duma, it was ultimately a failure, particularly for the RSDLP, who saw the revolution as the opening of radical possibilities, only to have them violently suppressed (Ilyenkov 1982). With the party already

[6]For example, Marx and Engels wrote in the *Communist Manifesto* that "Critical-Utopian Socialism and Communism .... dream of experimental realization of their social Utopias ... and to realize all these castles in the air, they are compelled to appeal to the feelings and purses of the bourgeois. By degrees they sink into the category of the reactionary [or] conservative Socialists depicted above, differing from these only by more systematic pedantry, and by their fanatical and superstitious belief in the miraculous effects of their social science" (Marx & Engels 2010, 516–517). Similarly, in *Socialism: Utopian and Scientific*, Engels writes that upon Marx's and his discovery, "from that time forward Socialism was no longer an accidental discovery of this or that ingenious brain, but the necessary outcome of the struggle between two historically developed classes—the proletariat and the bourgeoisie. Its task was no longer to manufacture a system of society as perfect as possible, but to examine the historic-economic succession of events from which these classes and their antagonism had of necessity sprung, and to discover in the economic conditions thus created the means of ending the conflict" (Engels 2010a, 304–305).

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divided between Bolshevik and Menshevik factions, 1905 only multiplied sub-faction upon sub-faction, threatening to collapse intra-party debate under its own weight.

Among the most influential figures within the party were the founding members of the Bolshevik faction, Bogdanov and Lenin, in whom two different paths to socialist science were set out. While serving a prison sentence, Bogdanov set out to charter a new philosophical foundation for Marxist revolutionary theory in his *Empiriomonism* (Ibid.). Upon reading the text, Lenin was immediately vexed, and in a flurry of retaliation, filled three notebooks with philosophical reflections in a work which came to be known as "Notes of an Ordinary Marxist on Philosophy," which has since been lost (Lenin 1978, 449, 532n156; See also Steila 2018, 97–99). In 1908, the poet Maxim Gorky, a fellow Bolshevik and mutual acquaintance of Bogdanov and Lenin, hosted a meeting between the two men in Capri, Italy with the hopes of resolving their feud. However, the encounter only left Lenin convinced that Bogdanov's position was not only philosophically dubious, but potentially disastrous to the RSDLP's approach to revolutionary strategy and tactics (Ilyenkov 1982). In the aftermath of the meeting, Bogdanov went on to assemble an edited volume, *Studies in Marxist Philosophy*, with contributions from fellow empirio-critics, such as Vladimir Bazarov, Alexander Bogdanov, Anatoly Lunacharsky, Jakov Berman, Osip Gelfond, Pavel Yushkevich and Sergey Suvorov (Bogdanov et al. 1910). Lenin would respond in due course with a series of his own articles—"Marxism and Revisionism," "An Evaluation of the Russian Revolution," "The Agrarian Question in Russia toward the End of the Nineteenth Century," "Leo Tolstoy as a Mirror of the Russian Revolution" and "The Agrarian Programme of Social Democracy in the Russian Revolution"—all culminating in *Materialism and Empirio-Criticism* (Ilyenkov 1982).

For Bogdanov, the 1905 Revolution did not call for an abandonment of Marxism, but it did demand a fundamental re-evaluation of the philosophico-scientific foundations of Marxist revolutionary theory. As he writes, the "old formulation of historical monism, without ceasing to be basically true, no longer fully satisfies us" (Bogdanov 1904, 35. See Lenin 1977b, 322). In the place of what he took to be the metaphysical archaisms of dialectical materialism, Bogdanov turned to what was, in his opinion, the most highly-developed philosophy of science of the day, namely, "Machism" and its descendent "empirio-criticism"—the philosophies of science attributable to, respectively, Ernst Mach and Richard Avenarius (Avenarius 1921; Bogdanov 2020, 6). The shared insight of these philosophies is, fundamentally, that "complexes of sensation," or experience, are primary to conceptions of body or mind. Mach stated this principle as "the world consists only of our sensations. In which case we have knowledge only of sensations," while Avenarius held that "We have recognized that the existing ... is substance endowed with sensation; substance falls away ..., sensation remains; we must then regard the existing as sensation, at the basis of which there is nothing which does not possess sensation" (Mach 1897, 10; Avenarius 1876, 65. See Lenin 1977b, 43, 49).

Though Bogdanov did not consider himself, strictly speaking, a Machist or an empirio-critic, he acknowledged that his own "empiriomonism" was heavily indebted to the basic insight of these two philosophies. He wrote, for instance, "I cannot consider myself to be a "Machist" in philosophy. In my general philosophical conception, I have taken only one thing from Mach: the idea of the neutrality of the elements of experience in regard to the "physical" and the "psychical," the idea of the dependence of these characteristics only on how they are *connected* in experience" (Bogdanov 2020, 296–297. See also Lenin 1977b, 57–58). Thus, like Mach and Avenarius, Bogdanov maintains that neither "bodies" nor "minds" constitute the proper starting point for proper natural scientific investigation. Experience communicates that we only encounter ephemeral qualities, without any contact with the underlying substrate of "things in-themselves." Because we never encounter such a thing, we may conclude that body and mind are nothing more than practical constructs, which dissolve upon deeper theoretical speculation.

As with peeling away the layers of an onion, stripping something of its series of profiles reveals, in fact, nothing underneath; that is, that there is no thing in-itself. As Bogdanov wrote, "we take

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"physical nature" to be a *derivative* of complexes of an immediate nature (among which "psychical" coordinations are also included), and we take it to be a reflection of such immediate complexes in other coordinations that are analogous to those coordinations, only of a most complex type (i.e. coordinations that are the socially-organized experience of living beings)" (Bogdanov 2020, 103. See Lenin 1977b, 228). Consequently, truth does not pertain to struggling to correlate the mind with mind-independent objects, but rather, to developing inter-subjective consensus. Bogdanov wrote, for instance, that "The criterion of 'objective truth' . . . does not exist. Truth is an ideological form—an organizing form for human experience" (Bogdanov 2020, 273. See Lenin 1977b, 123). Generally speaking, then, he maintains that

> the basis of "objectivity" must lie in the sphere of *collective* experience. We call those data of experience "objective" that have the same vital significance for us as for other people—those data on which not only we construct our activity without contradiction but on which other people should, in our opinion, also base their actions in order not to arrive at a contradiction. The objective character of the physical world consists in that it exists not only for me alone but for everyone, and it has a specific meaning for everyone that I am convinced is exactly the same as it has for me. The objectivity of the physical series consists in its *social validity*. (Bogdanov 2020, 18. See Lenin 1977b, 123-124)

Bogdanov also considered this to be consistent with contemporary studies in electricity, as he took this to mean that physics itself was increasingly proving that the fundamental unit of matter was not the atom (Bogdanov 2020, 279. See Lenin 1977b, 272).

As mentioned above, while Lenin wrote a series of articles against Bogdanov and the Russian Machists, his major statement in this polemic can be found in *Materialism and Empirio-Criticism*. In addition to being Lenin's foremost contribution to the intra-party philosophical debate, it stands, alongside his *Philosophical Notebooks*, as his major philosophical work. Throughout the text, Lenin advanced a series of arguments against Machism and its permutations—its redundancy in the history of philosophy, the privilege of practice over theory, a defense of objective reality (i.e. matter, space and time, chance and necessity), the importance of dialectics and a defense of partisanship in philosophy—which together may appear to advance nothing more than a simplistic materialism. The core of Lenin's position, however, is to challenge the notion that Machism could be a philosophical foundation consistent with Marxist revolutionary theory, because of its defense of the concept of the identity of consciousness and being. To the extent that capitalism is a global system, consciousness of capital and being of capital are, precisely, not identical. Furthermore, capitalism, like any class system, does not subsist on brute exploitation alone, but on the enclosure of institutions around capital such that there appears to be no genuine alternative to it. By assimilating consciousness with being, Machism risks simply being a way of affirming the contemporary order. As Lenin wrote:

> Social being and social consciousness are not identical, just as being in general and consciousness in general are not identical. From the fact that in their intercourse men act as conscious beings, it *does not follow* at all that social consciousness is identical with social being. In all social formations of any complexity—and in the capitalist social formation in particular—people in their intercourse *are not conscious* of what kind of social relations are being formed, in accordance with what laws they develop, etc. For instance, a peasant when he sells his grain enters into "intercourse" with the world producers of grain in the world market, but he is not conscious of it; nor is he conscious of the kind of social relations that are formed on the basis of exchange. Social consciousness *reflects* social being—that is Marx's teaching. A reflection may be an approximately true copy of the reflected, but to speak of identity is absurd. Consciousness in general *reflects* being—that is a general thesis of *all* materialism. It is

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> impossible not to see its direct and *inseparable* connection with the thesis of historical materialism: social consciousness *reflects* social being. (Lenin 1977b, 323)

He maintained that it is necessary to posit a thing in-itself to recognize the gap between consciousness and being, which can only partially be overcome not through mere sensation, but action. To act means doing so on the basis of incomplete knowledge, meaning that every situation entails risk and uncertainty; there is no perfect moment for revolution. Moreover, the truth of the capitalist system does not come from its mere observation, but through confrontation; the truth of the inherent conflict within the system comes through instigating antagonism to see where the lines of power are truly drawn and from where something new might emerge (Lenin 1977a, 400. See also Steila 2018, 90). For Lenin, the problems within the history and philosophy of science were animated by these very problems, and dialectical materialism was the culmination of this trajectory (Lenin 1977b, 130). It was this take on the scientific basis of Marxist theory that would win out in the October Revolution and form the basis of Soviet ideology about scientific socialism.

Also in this text, Lenin stressed that natural scientific theory is defined by a default philosophical persuasion of materialism (Ibid., 261). Nevertheless, scientific inquiry can oscillate between different philosophical orientations towards the nature of reality: "materialism" or "idealism" (with "agnosticism" being a possible third) (Ibid., 32–33). For Lenin, "materialism" can be understood as the belief in the existence of a mind-independent reality, explained solely in terms of "matter in motion," where motion refers to "change" (Ibid., 175). The fossil record, he maintained, effectively adjudicated this longstanding debate in favor of this philosophical position (Ibid., 72–77, 80–85, 115, 123, 132). However, Lenin also defended the logical position of "dialectics," to which he refers as the "law of the unity of opposites," which sufficiently complicates his position. While he claimed to have sufficiently proven the truth of the so-called "philosophical conception of matter," he also maintained that the so-called "physical conception of matter" had not been, and indeed could not be, solved for good, as it was subject to an endless process of discovery (Ibid., 261–262. See Gessen & Egorshin 1927a, 135).

The nature of this process would also not always proceed gradually, but would certainly be punctuated by major changes in the fundamental understanding of matter itself. For him, then, even though idealistic theories are incorrect insofar as they are idealist, their appearance continually betrays an important moment, wherein an outmoded conception of materialism is giving way to the new. A stubborn defense of materialism in the face of increasing evidence to its contrary would eventually render the theory abstract and meaningless (Lenin 1977b, 251. See Engels 2010b, 369–370).

Being a materialist in a dialectical sense means, on one hand, accepting the truth of mind-independent reality, while on the other hand, accepting that the conception of mind-independent reality will invariably change. The emergence of idealistic theories, then, requires a scrupulous effort to discern what elements can be rejected and which may form the basis of a new materialist foundation. Like the struggles of labor, the natural sciences are a human practice defined by the encounter between humanity and the limits of physical reality, meaning that its historical development is an essential part of the development of Marxism as scientific socialism. It was this conception of natural scientific theory to which Hessen adhered, and which explains why the history of science occupied a privileged object of study in discussions of dialectical materialist philosophy (Gessen 1927a, 118; Gessen & Egorshin 1927a, 135; Gessen & Egorshin 1927b, 194).

4. Dynamic and statistical regularity

The question remains, however, as to why Hessen mostly devotes his attention to the works of scientific geniuses as opposed to the movements of the masses that he favors in his 1931 paper. To completely reconcile this aspect of the discrepancy, we must now turn our attention to his

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discussions of the concepts of dynamic and statistical regularity. Hessen's writings in this area are based upon a mounting crisis in physics, which was reaching its apogee in the 1920s. English scientist J.J. Thompson had confirmed the existence of subatomic particles in 1897 with his discovery of the electron in a series of cathode ray experiments, and ironically, the more this particle came to be studied, the less sense its behavior seemed to make. With its unpredictable, even totally random behavior, it confounded century's worth of scientific wisdom (Gessen 1929, 60). Indeed, the two leading scientific minds of the day, Albert Einstein and Niels Bohr, confessed that the law of causality of old was done for, and that, for some, this could be perceived as a threat to the integrity of physics as such.[7] For Hessen, the electron's behavior could be explained neither by chance nor by hidden necessity, but rather, through a dialectical unity in opposition of dynamic and statistical regularity. Understanding this dialectic depended on whether one examined the electron as an individual or as part of a collective, both of which were necessary. In this section, I outline Hessen's explanation of how the history of modern science was marked by the development of understanding causation as the dialectical unity in opposition of dynamic and statistical regularity, paired with that of the individual and the collective. I conclude by showing that this position was consistent with Hessen's dialectical materialism as he saw it confirmed not only in experimental science, but in the historical experience of the labor movement.

Hessen's works on dynamic and statistical regularity begin by explaining that at the dawn of the Scientific Revolution, natural philosophers and scientists took for granted that causation or natural law was synonymous with one kind of observed regularity in nature, namely, dynamic regularity. Hessen defined this notion as necessary connection, or "that regularity of phenomena in which the state of the system at a given time determines its future and past state" (Hessen 2019, 94). Where such a relationship had yet to be established, natural philosophers and scientists relied upon statistical regularity, which he defined as probabilistic connection, or "the distribution of the probability of a given state" (Hessen 2019, 96). The overarching assumption was that causation was synonymous with dynamic regularity, and that any statistical analysis was simply a placeholder for where the human mind had yet to arrive at an objective understanding (Gessen 1928, 35). This position is perhaps best encapsulated in what is known as, "Laplace's demon":

> an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently vast to submit these data to analysis— . . . would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes. (Marquis de Laplace 1902, 4; See also Gessen 1928, 25)

Over the course of the modern period, however, it would become increasingly unclear that dynamic regularity alone held precedent, particularly in the mid-nineteenth century, with the ascent of thermodynamics. The laws of thermodynamics were first explicated in their mature form in 1850, by the German physicist and mathematician Rudolf Clausius (Gessen 1928, 15). The first law, Clausius states, is that "the energy of the universe is constant," while the second law is that "the entropy of the universe tends to a maximum" (Clausius 1867, 365. See Gessen 1928, 20).

[7]In his "The Mechanics of Newton and Their Influence on the Development of Physics," Einstein claims that "[t]he Broglie-Schrödinger method . . . does indeed deduce the existence of only discrete states, in surprising agreement with empirical facts . . . , but it has to give up the localization of particles and strictly causal laws . . . . Who would presume today to decide the question whether the law of causation and the differential law, these ultimate premises of the Newtonian view of nature, must definitely be abandoned?" (Einstein 1954, 261. See Hessen 2019, 94; Gessen 1929, 64). Likewise, in his "The Quantum Postulate and the Recent Development of Atomic Theory," Bohr states that "the quantum theory is characterized by the acknowledgement of a fundamental limitation in the classical physical ideas when applied to atomic phenomena . . . . The postulate implies a renunciation as regards the causal space-time co-ordination of atomic processes" (Bohr 1928, 580. See Hessen 2019, 94; Gessen 1929, 64).

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Taken together, they indicate that while the amount of energy in the universe remains constant, energy tends toward maximum entropy. This led Clausius to an interesting conclusion about the origin and the destiny of the universe; namely, that the combination of the first and second laws of thermodynamics meant that the universe would have had to have begun with an initial impulse and, conversely, would inevitably terminate in "heat death." This position has come to be known as "Clausius's paradox" (Gessen 1928, 21).

At the heart of Clausius's paradox, Hessen maintained, there appeared to be an unresolved tension between so-called "reversible" and "irreversible" processes (Ibid, 19). One example of a reversible process would be that of a pendulum swing, where "if we subtract the friction of the pendulum through the air and the friction in the thread on which it is suspended, these oscillations, associated with the transformation of energy from potential to kinetic, will occur indefinitely, in one direction or the other" (Ibid). In other words, a reversible process is one in which a given system can return to its original state without any loss of energy. An example of an irreversible process would be that of throwing a stone, where "I throw a stone from a certain height. Raised to a certain height, the stone has a known amount of (potential) energy. Falling to the ground, a stone produces a certain amount of heat—thermal energy, produces a sound—disturbing the air—a certain amount of mechanical energy, a visible deformation of the soil, etc." (Ibid, 18). In other words, an irreversible process is one in which a given system would lose energy when returning to its original state.

Hessen described the conflict between reversible and irreversible processes in thermodynamics as follows, asking: "[If t]he thermal motion of molecules is a mechanical process" and "all mechanical movements are reversible," why is it that "processes, which from the point of view of the kinetic theory of matter represent nothing more than the mechanical movements of billions of molecules, act as irreversible processes?" (Ibid., 22. See also Gessen 1927b, 145). In other words, if molecular motion could be described as an example of reversible process, why does it result in the irreversible process of increasing entropy? How could a reversible process be the basis of an irreversible one?

The resolution to Clausius' paradox came in the studies of gases by figures like Scottish physicist James Clerk Maxwell and Austrian philosopher and physicist Ludwig Boltzmann, both of whom share credit for introducing the "statistical approach to molecular processes" (Gessen 1927b, 145). Boltzmann posited a compelling solution, according to which

> we assume that molecules with different speeds are evenly distributed in space. In other words: if we set a certain speed for a molecule, then a molecule with a given speed can be found at any point in space with the same probability. Molecules possessing a given velocity do not accumulate in one place, but are distributed evenly over the entire volume of the gas . . . . In a gas, as a whole, in the aggregate of molecules, laws appear that are specifically different from the purely mechanical laws governing the actions of a single molecules. These laws are not the result of the equations of mechanics alone. (Gessen 1928, 23)

The temperature of a gas, then, cannot be based on a single configuration of molecular particles. On the contrary, the temperature depends upon molecular particles perpetually colliding with one another in such a way that their position at any given moment is entirely random. That being the case, the relationship between the molecular level and the phenomenal level is not one of necessary connection, but of a combination of chance and necessity. Understood as singular individuals, molecules behave according to determined laws of motion, but understood as part of a collective, the molecules behave according to statistical probability.

For Boltzmann, taken together, the statistical approach to molecular processes effectively resolved Clausius' paradox as it indicated that the relationship between the molecular level and the phenomenal level was not necessarily connected, but was subject to a complex interplay of chance and necessity. This led to astonishing speculations that while it was more likely for an

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excitation of molecular particles to result in the release of heat, it was not wholly impossible for such an event to lead to freezing (Gessen 1927b, 145). More importantly, it succeeded in eliminating the conflict between reversible and irreversible processes, as well as the question of the origins and fate of the universe (Gessen 1928, 45. See Gessen 1927b, 144). Even more importantly, Hessen notes, Boltzmann opened the door to understanding the dialectical unity in opposition between dynamic and statistical regularity, which would aid in the future study of the electron. Part of such an endeavor would entail understanding the shifting perspectives which would be necessary to understanding its behavior: on one hand, as an individual and, on the other hand, as part of an aggregate.

While these concerns might appear remote to questions of socioeconomic conditions, we should note that throughout his writings on dynamic and statistical regularity, Hessen continually mentions the aforementioned father of Russian Marxism, Georgi Plekhanov, pairing his writings with analyses of statistical analysis. Likewise, Hessen specifically mentions a particular work by Plekhanov, entitled *The Role of the Individual in History* (Hessen 2019, 93; Gessen 1927b, 148; Gessen 1928, 40). In this text, Plekhanov responds to a common criticism of materialism: that it occludes any possibility of individuals possessing free will. For Plekhanov, these criticisms constructed a false dichotomy between voluntarism and determinism. An individual, he maintained, is not free to the extent that he/she is able to act wholly out of step with his/her time. Not even so-called "great individuals" can act outside of the possibilities available to them. Thus, he writes, "even at the height of his power Bismarck could not cause Germany to revert to natural economy" (Plekhanov 1940b, 60).

Plekhanov argues instead that individuals do indeed possess free will, but they exercise it efficaciously to the extent that they can affect their pre-existent social milieu. To be free, one individual or a group of individuals must familiarize themselves with the constraints of the time. For Plekhanov, this was one of the central insights of the experience of the labor movement, as theorized in Marxism. To be free meant acting in such a way as to affect one's social context in light of the determined limits of the productive forces. He outlines this position in a lengthy passage, where he writes:

> Who makes history? It is made by the *social man*, who is its *sole "factor"*. The social man creates his own, social, relationships. But if in a given period he creates given relationships and not others, there must be some cause for it, of course; it is determined by the state of his productive forces. No great man can foist on society relations which *no longer* conform to the state of these forces, or which *do not yet* conform to them. In this sense, indeed, he cannot make history, and in this sense he would advance the hands of his clock in vain; he would not hasten the passage of time, nor turn it back . . . . Social relationships have their inherent logic: as long as people live in given mutual relationships they will feel, think and act in a given way, and no other. Attempts on the part of public men to combat this logic would also be fruitless; the natural course of things (this logic of social relationships) would reduce all his (sic) effort to naught. But if I know in what direction social relations are changing owing to given changes in the social-economic process of production, I also know in what direction social mentality is changing; consequently, I am able to influence it. Influencing social mentality means influencing historical events. Hence, in a certain sense, I *can make history*, and there is no need for me to wait while "it is being made". (Ibid., 60–61)

Applied to Hessen's approach to individuals of genius in the natural sciences, we can understand that while he takes socioeconomic conditions to dictate specific parameters of philosophical and scientific debate, individuals nevertheless play an important role in articulating those parameters through the explication of scientific concepts. All scientific theories are bound by the limits of the conditions of their time, but individual theories can still map out those conditions in a particular way where they would otherwise be opaque. In light of the whole, of course, they could always

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have been different, but they nevertheless provide a possible reading of the broader socioeconomic milieu. In this way, Hessen's writings on dynamic and statistical regularity provide an important bridge between his 1931 Newton text and his other writings, as they illustrate not a deterministic account of the relationship between socioeconomic conditions and natural science, but one characterized by the complex interplay between chance and necessity.

Conclusion

This paper sought to provide the reader with a reflection upon a central tension in the writings of Soviet philosopher, Boris Hessen. While Hessen is best known for his 1931 paper, in which he enumerates a dialectical materialist "externalist" reading of Sir Isaac Newton's natural philosophy, his other works seem to betray a much more conventional "internalist" methodology. We traced this tension to Hessen's adoption of seemingly contradictory premises: in the 1931 text, he holds that the history of science is defined by material practice and the masses, while in his other works, he implies that it must be understood through the development of ideas and the works of individuals of genius.

This paper argued that the best way to reconcile this tension was by adopting a two-fold approach. Firstly, it was necessary to better understand the extent to which Hessen approached Marxism as a form of scientific socialism via dialectical materialism. From this standpoint, the historical development of the natural sciences, like the labor movement, is inextricably linked with the development of Marxism as scientific socialism, since both are articulations of the encounter between human consciousness and the limits of physical reality. Secondly, it was necessary to focus specifically on Hessen's writings on dynamic and statistical regularity, and his complex understanding of the individual and the collective. Scientific understanding could no longer presuppose that natural law was reducible to necessity; rather, it required an understanding of the complex interplay of chance and necessity.

The confirmation for this position lay not only in experimental science, but in the historical experience of the labor movement. While socioeconomic conditions and technological progress, then, laid out the broad parameters of scientific possibility, individual scientists nevertheless played a role in explicating those parameters. In this way, Hessen's work is in fact characterized by a remarkable consistency, one which negotiates the complex interplay of the forces of history, economics, politics, science and technology. Sadly, Hessen was not able unfold his vision much further, though the works of subsequent figures, like Dimitri Blokhintsev and Lev Landau and Evgeny Lifshitz, do echo Hessen's insights in certain respects (See Blokhintsev 1964; Landau & Lifshitz 1980). One can only wonder, then, what would have lain ahead of this promising figure, whose journey was ultimately much too brief.

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