Quantum Tunneling through the Iron Curtain:

How Max Born's Ideology Influenced his Marxist Refutation of Violent Revolution

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In the midst of the atomic arms race of the Cold War, physicist Max Born's lecture *Physics and Politics* urged politicians to step back from the brink and examine the conflict objectively (85). Born had little choice but to concern himself with politics: as a citizen of the world during the rise of communism and as a German Jew who had to flee the Nazi regime (Greenspan 224), Born was shaped by the ideologies surging around him and the events they caused. Suspecting that his turbulent environment had a discernible impact on his work in physics, I decided to search for such an impact.

I found that impact in Born's approach to the interpretation of quantum mechanics. In the 1920s, the physics community was tackling the task of attaching a physical understanding to the equations of quantum mechanics, which had been vindicated by experiment but not yet explained. One critical moment was the Fifth Solvay Conference in 1927, when Niels Bohr laid the groundwork for what he would later call the complementarity principle (Bacciagaluppi and Valentini 421). It was well-established that for both light and matter, either the particle description or the wave description applies to a given situation, but never both; Bohr inferred that "evidence obtained under different experimental conditions cannot be comprehended within a single picture, but must be regarded as complementary in the sense that only the totality of the phenomena exhausts the possible information about the objects" (Bohr). That is, no single perspective accounts for all possible quantum phenomena; a complete description of quantum mechanics requires multiple perspectives that are incomplete on their own and may even appear contradictory. Marxist physicist Léon Rosenfeld examined the development of this idea in a paper he titled "Strife about Complementarity," in which he claimed that the history of the complementarity principle was best understood through the Marxist doctrine of dialectical materialism (466).

Born objected; he wrote a paper "deny[ing] that the development of physics can be used as a paradigma for the truth of the Marxistic doctrine" (8), and he mailed it to Rosenfeld. Although he asked Rosenfeld not to distribute it, it has recently been rediscovered and published. I acquired the article and investigated, suspecting that Born's political bias influenced him to write the article. However, I first read an analysis of the article by Freire and Lehner; they argued that Born's "political dislike of communism" was a weak influence on his paper, and they proposed an alternative explanation (157). Reading it through on my own, however, I got the sense that political bias was a significant contributor to Born's motivation. In order to arrive at a conclusive decision on this issue, I decided to investigate how precisely Born's political environment influenced his defense of a Marx-less interpretation of quantum mechanics. I learned that Born's experiences led him to adopt a perspective on socialism which rejects the necessity of violent revolution as a means to a socialist state; he attacks dialectical materialism in order to justify this rejection.

Born relies heavily on a pamphlet by Stalin for his background on dialectical materialism; Stalin's pamphlet, together with Rosenfeld's paper, construct an argumentative chain that starts with the history of the complementarity principle and ends with the necessity of violent revolution. Born's objection to dialectical materialism arises from his rejection of the outcome of this chain and the resulting necessity to find a flaw in it. In order to elucidate Stalin's argument proceeding from dialectical materialism to the necessity of violent revolution, I will first examine Born's only cited reference on dialectical materialism, a pamphlet by Stalin called "Dialectical and Historical Materialism." This pamphlet will also provide Stalin's definition of dialectical materialism, which Born assumes is shared by all Marxists but is actually different from Rosenfeld's definition. Next, to complete the argumentative chain by linking the history of

the complementarity principle to dialectical materialism, I will examine the original Rosenfeld paper. I will also examine Rosenfeld's definition of dialectical materialism and show that, unlike Stalin's, it is consistent with the state of physics in the mid-1900s. Born intends his paper as a response to Rosenfeld, so I will examine it next in order to show that Born's ultimate aim is to refute the necessity of a violent revolution. In addition, this paper shows that Born takes a politically biased approach to his task, as evidenced by a poorly researched attempt to refute Rosenfeld's argument. In order to explain Born's bias, I will turn to his life. Born's association with Marxism induced him to classify socialist ideas as either ethical or Marxist economic: the former, non-Marxist ideas he embraced, while the latter he dismissed as belonging to those with "blind belief in Marxist theories" (Greenspan 241). I will show that the ethical–economic dichotomy explains Born's axiomatic rejection of the necessity of violent revolution, suggesting that this paradigm was the cause of his attack on dialectical materialism.

The Stalin Pamphlet:

The Problems with his Materialism, and the Logic of a Violent Revolution

Born's only cited source on dialectical materialism is a pamphlet by Joseph Stalin called "Dialectical and Historical Materialism." This pamphlet provides Stalin's definition of dialectical materialism, the Marxist idea in question in Born's essay. First, I will show that while Stalin's definition of dialectics is mostly consistent with contemporary (mid-1900s) physics, his definition of materialism is not. Second, I will reveal Stalin's implied argument that dialectical materialism leads logically to the necessity of violent revolution.

The pamphlet does not provide a succinct definition of dialectical materialism. Stalin's closest approach is a tautology: "[dialectical materialism's] approach to the phenomena of nature…is *dialectical*, while its interpretation…of these phenomena…is *materialistic*" [cite;

italics in original]. However, he proceeds to describe dialectics in some depth, and then materialism.

Stalin's definition of dialectics is essentially consistent with the state of physics in the mid-1900s. According to Stalin's doctrine of dialectics, "no phenomenon in nature can be understood… if it is not considered in connection with the surrounding conditions…. [Furthermore,] internal contradictions are inherent in all things and phenomena of nature…[and] the process of development from the lower to the higher takes place… as a disclosure of the contradictions inherent in things and phenomena" (Stalin 1–3). Stalin begins with an assertion equivalent to the complementarity principle: physical phenomena observed can only be understood in the context of the conditions of observation. Next, he asserts the inherency of contradictions in nature, which parallels the apparently contradictory nature of complementary perspectives, e.g. the particulate and wave natures of matter. Stalin makes a distinction here between contradictions on two levels: first, the "contradictions… inherent" in nature, and second the "process of development," presumably of science, which depends on the discovery of these contradictions. The former is a postulate of dialectics, while the latter is an assertion based on that postulate. However, these two levels operate in parallel; just as nature evolves on the lower level through the struggle between contradicting forces, Stalin asserts that progress on the higher level takes place through the struggle of theoretical physics to explain evolving evidence. As Rosenfeld shows in his paper, this assertion is justified by the history of science (466). I have shown that this portion of Stalin's definition of dialectics can be reduced to (1) statements encapsulated by the complementarity principle and (2) the statement that scientific thought moves dialectically. Hence, it is resonant with the complementarity principle, and it properly explains the history of contemporary physics.

The one inaccurate feature of dialectics is that a quantitative change leads to a qualitative change. Stalin quotes the example from Engels of heating water until boils; the change in temperature is the imperceptible quantitative change, and the boiling is the resultant qualitative change (Stalin 2). Born shows in his paper that it is possible to convert water to steam without any salient qualitative change (7); hence, Stalin's assertion here is incorrect. However, the rest of Stalin's dialectics remains unaffected, so on the whole it is consistent with contemporary physics.

Stalin's definition of materialism, on the other hand, diverges strongly from the facts of physics. According to Stalin, the world is "an objective reality existing outside and independent of our consciousness…. [Hence,] our knowledge of the laws of nature… is authentic knowledge having the validity of objective truth, and… there are no things in the world which are unknowable" (Stalin 5). Whereas Stalin asserts the possibility of knowledge about anything whatsoever, presumably down to the precise movements of the smallest particles, the complementarity principle has certain implied limits to knowledge. As Rosenfeld shows, "[t]wo phenomena linked by [a relation of complementarity] can only be connected with each other by a statistical law" (469), i.e. a probabilistic law. If the complementarity principle allows only a probabilistic description of movement at such scales, it must regard perfect, deterministic knowledge as impossible. Consequently, Stalin's statement that there exists an objective reality cannot be verified or rejected, and thus it is a claim outside the realm of physics. Therefore, Stalin's definition of materialism is inconsistent with contemporary physics.

Nevertheless, Stalin accepts this definition of dialectical materialism, and he argues that it leads logically to the conclusion that a violent revolution is a necessary path to socialism. According to Stalin, "First the productive forces of society change and develop, and then…

men's relations of production… change…. [H]owever much the relations of production may lag behind the development of the productive forces, they must, sooner or later, come into correspondence with—and actually do come into correspondence with—the level of development of the productive forces" (Stalin 11). Stalin asserts that men's economic circumstances ("relations of production") follow changes in industry ("productive forces"). Stalin identifies two levels here, echoing his discussion of dialectics; the human sphere of society is distinguished from the objectivity of industry, just as the human activity of science was distinguished from the underlying phenomena of nature. This analogy only works if social science obeys the same dialectical rules as physics, and Stalin's materialism proves this statement: since the material reality of industry is objective, it must adhere to certain knowable laws about nature, including the law of dialectics. Stalin is concludes logically that, just as progress in science proceeds from the discovery of discrepancies in nature, progress in society happens when men realize the discrepancy between the state of industry and their own economic circumstances. Based entirely on his definition of dialectical materialism, Stalin shows that society evolves through a dialectical process.

Stalin is in a position to argue that the rise of new productive forces must take place within the old system by means of a revolution. "Out of the conflict between the new productive forces and the old relations of production,… there arise new social ideas; the new ideas organize and mobilize the masses; the masses become welded into a new political army, create a new revolutionary power, and make use of it to abolish by force the old system of relations of production" (Stalin 15). Starting from a capitalist society, Stalin shows how the dialectical progress of society leads to a long chain of events that conclude with a violent revolution. This final argument also proceeds from Stalin's dialectics: imperceptible, quantitative changes in the

discrepancy between workers' economic situation and the state of industry must lead to a distinct event featuring a salient qualitative change: violent revolution. This concludes Stalin's argument that the necessity of violent revolution proceeds logically from his definition of dialectical materialism.

The Rosenfeld Paper:

Materialism Refined, and the Evidence for Dialectical Materialism

Born's paper is a response to a paper by Rosenfeld, "Strife about Complementarity." In this paper, Rosenfeld argues that the complementarity principle forces us to refine certain metaphysical assumptions characteristic of Western thought (466). First, I will show how Rosenfeld's refinement of materialism fixes the problems with Stalin's definition and leads to a dialectical materialism that is consistent with physical facts. Second, I will explicate Rosenfeld's implication that the history of the complementarity principle contains evidence in support of Rosenfeld's version of dialectical materialism. Finally, I will show that Rosenfeld and Stalin together almost, but not quite, constitute an argumentative chain linking the history of the complementarity principle to the necessity of violent revolution.

Rosenfeld proposes a new definition of materialism that entails a revised version of Stalinist dialectics. This new version of dialectical materialism is entirely consistent with the character of the scientific method and resonant with complementarity and its history. Rosenfeld's revised materialism stems from the following premise: "the formation of our ideas and concepts [is] the result of a process of gradual adaptation of mind to experience" (Rosenfeld 473). The materialism in this premise is encapsulated in the primacy of experience over mind: that is, experiment and observation are blind to human consciousness, and humans must and do adapt their theories to match. This definition is highly similar to Stalin's in that both mention the

irrelevancy of human consciousness; however, where Stalin resorts to the vagueness of ontological statements, Rosenfeld grounds his definition in the palpability of experiment. The result is reminiscent of the scientific method and based on a falsifiable claim, and thus it is physically justified.

Rosenfeld's dialectical doctrine remains essentially unchanged from Stalin's version, as it is characterized by the same two premises as the physically justified portion of Stalin's dialectics: the dialectical movement of scientific thought and the correctness of the complementarity principle. First, Rosenfeld's belief in the dialectics of scientific thought is evident from the overall trajectory of his paper. Rosenfeld bases his essay on the statement that "complementarity forces itself upon us with logical necessity," (466), by which he means that the complementarity principle is the only logical way to account for the new data presented by experiment. Accordingly, he argues, we must refine our conceptions of determinism, objectivity, and materialism as well, so that they too align with the new evidence (Rosenfeld 466). This approach implicates Rosenfeld's underlying belief that ideas must be constantly refined to match experience. This is a dialectical premise shared by Stalin. Second, Rosenfeld explicitly identifies complementarity with dialectics: "[T]he relation of complementarity is the first example of a precise dialectical scheme" (481). This shows his agreement with the other aspect of Stalinist dialectics. Rosenfeld's dialectics, however, ignores Stalin's premise that a quantitative change produces a qualitative change. Since Rosenfeld restricts himself to the physically justified aspects of Stalinist dialectics and he replaces Stalinist materialism with a physically justified version of his own, Rosenfeld's dialectics and materialism combine to produce a physically justified version of dialectical materialism.

From this perspective, it is almost trivial to conclude that the history of the complementarity principle is evidence in support of Rosenfeld's dialectical materialism. Rosenfeld summarizes briefly the development of the complementarity principle: "How were we to apply to the same physical agency two modes of description so utterly contrasting as that of material particle and wave-field of force without running into contradictions? It took years of hard thinking… [to develop] the resulting doctrine of 'complementarity'" (466). Rosenfeld shows that the complementarity principle is historically the result of a dialectical process: the traditional perception of matter was challenged by evidence of the dual nature of matter, and the complementarity principle resulted. This historical fact matches Rosenfeld's description of dialectics, and is thus evidence in support of it.

Rosenfeld's paper, taken with Stalin's, creates a nearly complete logical chain which infers the necessity of a violent revolution from the history of the complementarity principle. Rosenfeld's paper shows that the history of the complementarity principle is evidence in support of dialectical materialism. Stalin's paper shows that dialectical materialism proceeds logically to the necessity of a violent revolution. Together, it seems they would imply a logical chain. The only reason it fails is that Rosenfeld and Stalin operate based on different definitions of dialectical materialism. Since Stalin's definition relies on two additional, unjustified assumptions—the ontological statement about objectivity and the transition of quantity into quality—the chain is broken. Without ontological objectivity, Stalin cannot generalize inherent contradictions from nature to the economy. Without the transition of quantity into quality, Stalin cannot conclude that social progress must lead to a revolution. These two subtle points are all that keep this logical chain from being complete.

The Born Paper: Born's Prejudice Against the Necessity of Violent Revolution

Born intends his paper to be a response to Rosenfeld's. However, as a result of confusion between Stalin's and Rosenfeld's definitions of dialectical materialism and as a result of misinterpretation of Stalin's words, the paper proves to be more useful for showing that Born's political background must have influenced his thought. I will show that Born was duped by the logical chain, and that his attack on dialectical materialism was an attempt to undermine this chain in order to justify preexisting biases.

Born fails to distinguish between Rosenfeld's and Stalin's versions of dialectical materialism. Born begins his paper by dedicating it as a response to Rosenfeld's defense of dialectical materialism; however, he immediately proceeds to give part of Stalin's definition of dialectical materialism, which he legitimizes by stating that it is the "official statement of the Marxian doctrine" (Born 1), and he spends the bulk of his paper analyzing it. Clearly Born assumes that Stalin's dialectical materialism is the same as Rosenfeld's.

Indeed, Born appears to agree with Rosenfeld's version of dialectical materialism, although he does not know it. Regarding the development of quantum mechanics, Born writes, "For [the] purpose [of reconciling the wave and particle natures of light] a revision of the ideas about physical reality was necessary, and the traditional concept of determinism in physical laws had to be abandoned and replaced by a statistical interpretation of these laws. [This]… led Bohr to the complete elucidation of the situation, formulated in his principle of complementarity" (5). Born restates almost exactly Rosenfeld's account of the history of quantum mechanics. Born even mentions the necessity of revising determinism to bring it in accordance with new observations, a point which Rosenfeld makes in his paper. This necessity for revision encapsulates the aspect of dialectics concerning the evolution of science; combined with the fact

that Born accepts the complementarity principle, we can conclude that Born is entirely in agreement with Rosenfeld's dialectical philosophy.

The only aspect of dialectical materialism that Born soundly rejects belongs exclusively to Stalin's philosophy: the transition from quantity to quality. In order to show that water can turn to steam without boiling, Born writes, "by properly directing the changes of temperature and pressure the transition can be performed in a continuous way without a sudden (qualitative) change" (7). Clearly, this assertion about physics by Stalin was simply wrong. However, Born never completes such a rejection of any aspect of Rosenfeld's dialectics, and as such remains in complete agreement with it.

Born's inability to distinguish Rosenfeld's version of dialectical materialism from Stalin's shows poor research. In fact, Born displays poor research throughout his paper: in addition, he incorrectly paraphrases the thesis of Rosenfeld's paper (Born 1); he fails to notice the two-layered structure implied by Stalin's dialectics (Born 2); and he fallaciously argues against an assertion by Marx and Engels while professing to refute Rosenfeld, which implies that he equates the two (Born 4). Finally, Born misunderstands Stalin's application of dialectics to politics when he refers to the "struggle between capitalism (thesis) and communism (antithesis)" (5). In each of these cases, Born's misunderstanding leaves him with a gap in understanding, and in each case he picks an interpretation which allows him to criticize dialectical materialism. Born is compensating for his lack of information with his own biased interpretation—this strongly suggests that Born is somehow biased against Marxism.

Born's bias takes the form of an axiomatic rejection of the necessity of violent revolution. Born only perceives one version of dialectical materialism, Stalin's, and as a result he falls victim to the false logical chain connecting the history of the complementarity principle to the

necessity of violent revolution. Had Born realized that the logical chain was incomplete, he could simply have rejected its conclusion offhand; instead, he devotes his conclusion to refuting one of the two premises that were flaws in the logical chain, which we already examined: the transition from quantity to quality. However, Born does not stop there—he goes on to argue against Stalin's political conclusions. Water can be turned into steam without boiling; "[t]he [equivalent] analogy in the social structure of states would be something like the slow introduction of socialism without a violent revolution" (7). Born here rejects violent revolution as a necessary path to socialism, showing that he is concerned not only with the physical statements of dialectical materialism but also with the political it implies.

Born makes his position even clearer when he abandons physical facts entirely in favor of an economic argument against violent revolutions.

> "My personal view is that [whether a violent revolution is necessary] depends entirely on the peoples concerned and the historical situation. It may well be that the Czarist regime in Russia was so rotten and the standard [of living] of the Russian people so low that a violent explosion was necessary. But I see no reason why the same must happen in other countries with a higher standard of living and more developed methods of government." (Born 8)

The pre-existing axiom that violent revolution is not necessary appears to be the belief underlying Born's rejection of dialectical materialism. I present here a plausible etiology. On one hand Born believes that there are nonviolent paths to socialism. On the other, missing the intricacies involved, Born reads Rosenfeld's claim that the complementarity principle is evidence for dialectical materialism, and then Stalin's claim that dialectical materialism leads to the necessity of violent revolution, and he infers the logical chain I elucidated, but, due to his poor

research, fails to notice that it is flawed. In order to reconcile the one hand with the other, he attacks the physical foundations of Stalin's dialectical materialism, showing that violent revolution is indeed unnecessary. If this is the ulterior motive for Born's attack on dialectical materialism, it is clear that Born's ideological tendencies have had a strong influence on his intellectual work, and in the next section I will examine precisely how.

Born's Life: The ethical–economic dichotomy

I decided to start by looking at the circumstances of writing, suspecting that Born's immediate political surroundings influenced his writing. It turned out that in November 1955 Born had recently retired and his family was living "the quiet life they had planned 'indoors with books and music, out of doors in the garden, the Spa's park and in the forests'" (Greenspan 298). There was nothing pressing in Born's own life that would threaten him with political criticism from anyone. The closest instance mentioned in his biography is the political activism of the late 1950s, in which an antiwar manifesto (of which Born was an original signer) was signed by two Communist sympathizers, with whom the authors did not want to be associated (Greenspan 301). It is clear that the political commentary Born includes in his paper could not have been a response elicited by political pressure in his life.

Earlier in life, however, Born had been mistaken for a Marx sympathizer—twice. First, at the rise of the Nazi party, Born was accused of being a Communist. In 1933, Born was working at the university in Göttingen when the government came out with new civil service laws "legalizing the suspension of 'non-Aryan' employees" (Greenspan 175). In early April, the university put these into effect. Born, a Jew (Greenspan 224), was targeted by a student organization on campus, but not for being Jewish; "these students… labeled Born's institute of physics 'Communist-infested'" (Greenspan 176). As a result, Born was asked to leave and was

forced to flee. The second instance was during World War II, when Michael Polanyi, a founder of the Society for Freedom in Science, misinterpreted a letter from Born.

> "Born had received one of their pamphlets, which implied that socialism restricted freethinking. He sent a letter questioning this premise, and his old friend Polanyi responded by cajoling, 'Socialists like yourself who wish to renew society on the economic side, while keeping mental freedom intact, should join us.'… Born retorted that he was 'not a socialist, as you seem to think, if this expression means blind belief in Marxist theories.' Dialectical materialism was to him 'rubbish.'" (Greenspan 240–241)

In this letter, Born defended his position against Marxism by denigrating dialectical materialism, just as he does in this paper. Furthermore, Born's rejection of "blind belief in Marxist theories" jibes with what we have seen in his paper. This adds an interesting twist: by the time Born wrote the paper I examined, he had become predisposed against dialectical materialism. This does not invalidate the etiology I presented at the end of the previous section; Born's prejudice against dialectical materialism alone does not explain the strong presence of Born's ideas on violent revolution in the paper.

Born's statement above also implies a fine distinction that Born makes between socialism and Marxism, which deserves further study. It turns out that Born's background in Marxism began with a traveling companion named Lachmann whom he met just after high school (called Gymnasium). "[According to Born,] 'I owe to him not only the deciding direction of my scientific interest, but also a general widening of my outlook on life.' He was a socialist…. He offered up the troika of Marx, Kant, and Hegel to Max and asked probing questions" (Greenspan 20–21). Lachmann was evidently a foundational element of Born's ideology, and he encouraged both socialism and constant questioning. As a result, when Born befriended dermatologist Alfred

Blaschko in the 1920s, it became clear that Born "believed in a socialism of ethics and compassion—not one of Marxist economic doctrine[, e]specially after laboring through the 'extremely dull and boring' *Das Kapital*" (Greenspan 76). This quotation exposes Born's notable socialist paradigm. Born distinguished between the ethical ideas underlying socialism and the Marxist economic ones; the ethical ideas, based on compassion and presumably free of Marxist ideas, he accepts, while the Marxist ideas he rejects on principle.

Based on the importance of compassion in Born's conception of socialism, I infer that he prefers the idea of a gradual transition to the thought of a violent revolution. Since Born rejects Marxism, he has no reason to accept the necessity of violent revolution. This doctrine is a highly plausible candidate for the reason that Born reacted against the use of dialectical materialism to support the necessity of a violent revolution. This paradigm also likely caused Born to reject Rosenfeld's Marxist ideas offhand and interpret Stalin's less than favorably, which led to the confusion I demonstrated above. Hence, Born's perspective on socialism accounts for all of the idiosyncrasies I identified in Born's paper.

The Born Paper, revisited

Born's ethical–economic dichotomy hampered his ability to understand the assertions of the Marxist authors he referenced, and as a result it had a deleterious influence on his ability to communicate his ideas cohesively and convincingly. Even more significantly, it prevents Born from realizing the importance of an idea he mentions in passing: the interpretation of capitalism as the thesis and communism as the antithesis. As we saw above, this is in fact a misinterpretation of Stalin's application of dialectics to economy; however, considered on its own, it becomes a surprisingly lucid explanation of the situation of communism in the mid-1950s. Stalin's exposition of the socialist state shows how the dialectic between industry and

workers within the capitalist state produces the communist state, but he commits a critical error in dialectics by failing to consider the new communist state in relation to its surroundings. Unless the entire industrial world experienced a simultaneous communist revolution, the communist state would have to come into existence in a capitalist world. As a result, a new dialectic is established, which Born unwittingly characterizes when he refers to the "struggle between capitalism (thesis) and communism (antithesis)" (5).

Had Born realized that this was in fact a legitimate interpretation, he may have been able to point to the real-world struggle between the U.S.S.R. and the U.S. as evidence of a complementarity principle at work at the political level. That is, neither capitalism nor communism is on its own sufficient for governance; a complete political theory must take into account both ideas. This idea fits excellently into Born's message in *Physics and Politics* that politicians need to step back from the brink, look beyond the rhetoric of the conflict, and evaluate objectively the benefits of each type of government.

Instead, Born allows his political prejudice to interfere with his ideas, and he dismisses this interpretation as nonsensical for the express purpose of emphasizing the nonsensicality of dialectical materialism. Born's example should serve as a warning to physicists and other academicians that their ideology can prejudice them towards certain interpretations, to their loss.

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