

Peer Pressure:

Physicists' Cultural Context and their Examination of Relativity and Quantum Mechanics

Physics is in its own realm: abstract, absolute and objective, far removed from the preferences of the rest of the world. Any particular society at any particular time is free to have its own opinions regarding art, politics, morality, and other such issues, but scientific facts are true whether or not a culture feels like acknowledging them.

Admittedly, it is often irresistibly convenient for a society to perpetuate a mistruth (witness the 19th century Europe's fascination with craniology, which neatly "proved" the superiority of white males over women and other races and endured for far longer than its pseudoscientific foundation justified), and of course it is nigh-impossible to be certain when one has come upon a scientific truth: *is* the speed of light in a vacuum constant? How can we ever be thoroughly positive? However, it is physics' goal to come as close as possible to accurately recognizing and exploring these truths, even if absolute comprehension is beyond our reach.

Perhaps physics itself is pure and lofty, above such earthly considerations of culture, but how and why men and women go about researching and interpreting this knowledge is highly society-dependent. The varying considerations of Einstein's theory of relativity and the eager embrace of quantum physics in post-World War Germany are two cases where physicists' research focus and interpretation preferences were not merely unadulterated scientific analyses but enormously affected by the cultural clime of their periods.

After their defeat in 1919, the German public was stunned by the seemingly-sudden failure of their much-vaunted warfare technology and perceived military (not to mention cultural) superiority, especially after years of constant assurances from their leaders of victory's inevitability. In their quest to handle their new, humiliated position in the post-War world, German society turned towards the irrational, the mystical, the spiritual, disdaining the causal, rational interpretation of the world that had before been so popular. As theoretical physicist Arnold Sommerfeld despaired:

“Doesn't it strike one as a monstrous anachronism that in the twentieth century... wide circles of the educated or half-educated public are attracted more by astrology than astronomy?... Certainly in Germany this anachronism is based in part upon the misery of the present. The belief in the rational world order was shaken by the way the war ended and the peace dictated; consequently one seeks salvation in an irrational world order.”¹

Willhelm Ostwald, one of the principal founders of physical chemistry, agreed: “In Germany today we suffer again from a rampant mysticism, which... turns against science and reason as its most dangerous enemies.”²

Science and reason were not the only entities regarded with enmity. Their *creators*, physicists and mathematicians, also “felt themselves to be the particular objects of odium, both public and private.”³ Max Born's own wife, a “would-be poet and playwright,” remarked bitinglly that “it is always like a revelation to me whenever behind the *physicist* I suddenly discover the human being; there are, I mean, also inhuman physicists,” and contemptuously likened her interactions with physicists with “the feeling

¹ Paul Forman, “Weimar culture, causality, and quantum theory, 1918-1927: Adaptation by German physicists and mathematicians to a hostile intellectual environment,” in *Darwin to Einstein: Historical Studies on Science and Belief*, ed. Colin Chant and John Fauvel (New York: Longman, 1980), 274.

² Forman, “Weimar culture,” 274.

³ Forman, “Weimar culture,” 274.

of being cast upon an icy lunar landscape.”⁴ Perhaps Frau Born had more personal reasons for a low opinion of physicists, but it was nonetheless an opinion widely shared by the German public, desperately seeking scapegoats for their society’s post-war disgrace.

Malcontent with their unpopularity, German physicists abandoned in droves the tainting doctrine of causality whose disfavor so plagued them. These “quasi-religious conversions to acausality” of mid-1921⁵ were hardly forced upon the scientists, contends Paul Forman, curator for Modern Physics at the Smithsonian’s Museum of American History. “The crisis of the old quantum theory”—which for them was not yet “old” but still quite new—“was more than welcome.”⁶ Atomic physics provided the escape.

“Atomic physics has taken up again ‘the questions of the old alchemists,’” observed Richard von Mises, a professor of mechanics in Dresden in 1920. “Numerical harmonies, even numerical mysteries play a role, reminding one no less of the ideas of the pythagoreans than of some of the cabbalists.”⁷ This new physics was “a statistical phenomenon and as such fundamentally incompatible with the concept of causality.”⁸ It must have seemed, consciously or unconsciously, a perfect out for beleaguered physicists. One aspect, not notably addressed by Forman but still significant, is that quantum mechanics seems to be *right*—or at least has held up extraordinarily well to more than seventy-five years of scientific scrutiny. While the scientists of the time could hardly have justly predicted the theory’s durability, its early successes were encouraging indicators that served only to encourage its widespread acceptance.

⁴ Forman, “Weimar culture,” 273.

⁵ Forman, “Weimar culture,” 288.

⁶ Forman, “Weimar culture,” 283.

⁷ Forman, “Weimar culture,” 276.

⁸ Forman, “Weimar culture,” 288.

The original thinkers of quantum theory, however, had not been so eager to break away from classical notions of the world; Max Planck had gone so far as to call his radical idea of quantization “an act of desperation.”⁹ Indeterminism’s underpinning of the probabilistic interpretation of the wavefunction was introduced later by Born, who tended to side with Heisenberg and not Schrödinger in the scuffle over their formulations of quantum mechanics, which later turned into a tussle over physical interpretation once their approaches were shown to be mathematically equivalent.¹⁰ Despite Thomas Kuhn’s observation that, in general, “scientists will strenuously resist recognizing that their discoveries were the product of beliefs and theories incompatible with those to which the discoveries themselves gave rise.”¹¹ Born did not claim to have at first deemed his suggestion remarkably revolutionary. “I did not consider it very philosophical,” he later recalled. “[P]robability... seemed to be not so very important.... We were so accustomed to making statistical considerations, and to shift it one layer deeper seemed to us not so very important.”¹²

Not all were pleased with this new philosophical direction physics was taking, however, either at the time or later. “That nonsense is not merely nonsense. It is objectionable nonsense,” said Albert Einstein in 1932. “Quantum physics has presented us with very complex processes and to meet them we must further enlarge and refine our concept of causality,”¹³ and *not* handily abandon it. Einstein had many major ideological contentions with the German interpretation of quantum mechanics,¹⁴ refusing to “believe

⁹ Emilio Segrè, *From X-Rays to Quarks: Modern Physicists and Their Discoveries* (San Francisco: W. H. Freeman, 1980), 76.

¹⁰ Mara Beller, “Born’s probabilistic interpretation: A case study of ‘concepts in flux,’” *Studies in History and Philosophy of Science* (1990): 572.

¹¹ Thomas Kuhn, “Revisiting Planck,” *Historical Studies in the Physical Sciences* (1984): 248.

¹² Beller, “Born’s probabilistic interpretation,” 578.

¹³ Forman, “Weimar culture,” 293.

¹⁴ Niels Bohr, “The Bohr-Einstein dialogue,” in *Niels Bohr: A Centenary Volume*, ed. A. P. French and P. J. Kennedy (Cambridge: Harvard University Press, 1985), 121-40.

that the providential authorities took recourse to dice-playing.”¹⁵

Ironically, it was Einstein’s own theory of relativity which, though first ignored, became wildly popular with the nonscientific public, despite his personal conviction that “the present fashion of applying the axioms of physical science to human life is not only a mistake but has something reprehensible to it.”¹⁶ Arthur Eddington and Vladimir Fock, the primary popular interpreters of relativity in Britain and the Soviet Union respectively,¹⁷ were both accomplished scientists who “won acclaim with nonscientists in [their] society because [their] interpretation[s] of relativity physics accorded with the nonscientific predispositions (some would say prejudices) of many members of that society.”¹⁸ Instead of modifying their scientific beliefs to fit the changing whims of the public, as did physicists in post-World War I Germany, these men met public opinion head-on and gave people what they wanted from the start: authoritative comfort from the threat of the collapse of absolute principles and values. After all, “relativity” must mean that everything is relative, right?

No one can please everyone, however. Somewhat ironically, Fock was attacked both by Stalinist philosophers charging inadequate Marxism and by Soviet physicists accusing insufficient science.¹⁹ The latter were to eventually win out when, in the late 1950s and ‘60s, Soviet politics began to relax and his authority quickly deteriorated, declining from a high of two Orders of Lenin and authorship of the relativity entry (complete with many Lenin quotations) in the second edition of the *Large Soviet*

¹⁵ Bohr, “The Bohr-Einstein dialogue,” 129.

¹⁶ Loren Graham, “The reception of Einstein’s ideas: Two examples from contrasting political cultures,” in *Albert Einstein: Historical and Cultural Perspectives*, ed. Gerald Holton and Yehudah Elkana (Princeton: Princeton University Press, 1982), 107.

¹⁷ Graham, “Reception,” 108, 109.

¹⁸ Graham, “Reception,” 110.

¹⁹ Graham, “Reception,” 110.

Encyclopedia to a mere citation in the 1974 third edition.²⁰ Eddington too was sometimes rebuked for his leanings towards a religious interpretation, though he dutifully maintained that relativity did not *directly* authenticate religion and free will, but rather “removed obstacles to them.”²¹ (This criticism was somewhat less worrying, however, since in Britain a lack of idealism—particularly patriotic—wasn’t nearly as likely as in the Soviet Union to lead to a government-facilitated untimely demise!)

The cultural influences on relativity and quantum mechanics’ development and interpretation were profound, for both the public and the specialist. The theories of relativity and quantum mechanics would not have been so readily accepted by the societies, technical and non-technical, of their introduction had they not managed to strike a resonant chord in the culture’s expectations and needs. Research motivations and subsequent understandings of scientists were (and *are*, inescapably so) firmly fashioned by what their particular societies coveted. The way we think and thought shape the way we interpret and understand.

²⁰ Graham, “Reception,” 126-127.

²¹ Graham, “Reception,” 117.

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