Colin Milburn*, **Mondo Nano: Fun and Games in the World of Digital Matter**, Durham, NC, and London, UK: Duke University Press, 2015, 424 pp., $109.95 (hardcover), $29.95 (paperback).

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Mondo Nano: Fun and Games in the World of Digital Matter posits play and games as the driving force behind futuristic sciences. For readers interested in how emerging technologies are realized, this book provides a rich portrayal of nanotechnology's potential being apprehended and embodied virtually, fictionally, and actually through play.

Drawing from video games, comics, and the hallmarks of geek culture, "nano"-innovators infuse their experiments, discoveries, and inventions with fun: they race microscopic cars to prove their utility (p. 23); Pac-Man is used to define the behavior of nanoparticles (p. 111). Some of the most groundbreaking advancements in this burgeoning field are informed by play, which is epitomized by Milburn's titular trope: *mondo nano*, an "alluring motto of 'shaping the world atom-by-atom'—the vertiginous seduction of total engineering, complete terraformation" (p. 16). The term invokes both the global and atomic, which interact in the book with equal value, along with the trivial and the vital, the playful and the serious.

The opening chapters dwell on the notion of "fun" and games as instrumental to experimentation and construction of nanotechnology: The manipulation and programming of atomic matter, exemplified in everything from the fictional Black Panther's suit in the Marvel Cinematic Universe to already commercially available odor-resistant clothing interwoven with silver nanoparticles.

Milburn highlights the many "games" that accompany scientific discoveries involving the technology. Academic journals are littered with examples of "nanosoccer" competitions, "Nano-Tic-Tac-Toe" and "NanoChess" to illustrate key findings about the handling and reading of atoms. Nano is further imagined through numerous fictions, including *Fantastic Voyage, Metal Gear Solid*, and *The Simpsons*. These fanciful interpretations are labeled early on as "ludicrous" (p. 9), recalling scholar Johan Huizinga's (1950) assertions of "ludus" or play, which the historian suggested preceded and subsequently suffuses contemporary culture. Experimentation is forging a similar path for "nano" as a global phenomenon.

The next two chapters move from activity to space, presenting a variety of playful laboratories, from Daedalus's labyrinth for the minotaur to Shakespearean dramas, digital games, and even online communities. These sites of "ludic experimentation" allude to another Huizingan concept: the magic circle, an "enchanted space outside the normal and the everyday" (p. 104) where freedom is granted to imagine nanotechnology's future. One of these labs is *Second Life*, the freeform massive multiplayer online game where islands abound with atomic scale models and avatars of every shape and size navigate the digital world around them. Such
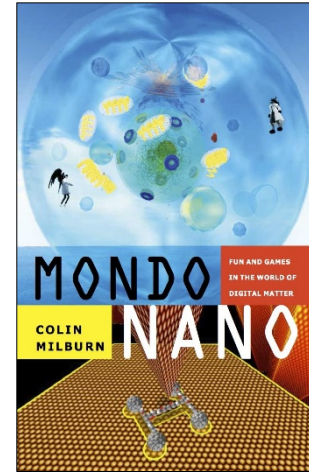
"virtual worlds open the sciences to democracy. As experimental zones for transforming scientific speculations into lived experience, they open portals to fully user-generated futures" (p. 134).

Moving from activities and space to playful personas, the following chapters deal with representations of mondo nano. Milburn analyzes how comics through their "play" between image and word depict nanotechnology for military purposes, as well as draft future possibilities of sciences and technology. They are "a type of game: a riddle, a puzzle. To play along, we must fill in the blanks with imaginary moving parts, connecting and reconnecting, animating stories on the fly" (p. 143). The subsequent chapter further explores militarization of nanotechnology through hypermasculinized "nanosuits" featured in games like *Crysis*, which provide templates for understanding uses of mondo nano on the battlefront by allowing players to have an embodied experience of it.

The final chapters delve into larger questions of policy and philosophy surrounding mondo nano's playful vision of the world. Milburn describes a "NanoCity" (p. 203) in which the interplay between future and present cities must be dealt with by nanopolitanism: "a way of imagining the currencies of everyday life in relation to an always deferred future, a state of endless anticipation" (p. 224). This chapter is followed by "My Little Avatar," a series of emails that Milburn writes to "PerkyPat," an avatar in *Second Life*. Throughout this exchange, he links various strands of history, literature, science, and play to investigate the meaning of avatars in mondo nano. His nine "incarnations" explore the magic of avatars, how they are used to play with scale, and how they are proxies for nanotechnology (p. 282).

In the final chapter, Milburn asserts his thesis that play is an approach to the "bewildering complexity of technoculture in a time of rapid globalization" (p. 294). Playing is a means of accommodating those things out of one's control, and at the same time, pushes the limits of imposed rules in an environment where we are often as insignificant as atoms.

This book comes as a refreshing response to "gamification" literature, which tends to focus on how games can be extended to solve problems. From Jane McGonigal's (2011) *Reality is Broken* to Brian Burke's (2016) *Gamify* or Karl M. Kapp's (2012) *The Gamification of Learning and Instruction*, these works rely heavily on game elements, design, and mechanics to explain relationships between play and the larger world.

Milburn successfully eschews this course by instead letting games and play occupy the same space and intermingle with myriad media. In this way, he is playful with play itself, not defining it or operationalizing it, but rather observing it and invoking a deeper tradition of ludology and anthropology, from Huizinga to Geertz's (1972) work on "Deep Play" to the multifaceted rhetorics of Brian Sutton-Smith (1997). Milburn modernizes and complicates play for a contemporary and increasingly "ludic society" (Zimmerman & Chaplin, 2013). He suggests a delicate balance between playfulness and futurity in a culture where the two are increasingly enmeshed.

His work constructs a fascinating feedback loop between emerging technology and play. Play gives innovators agency, while simultaneously molding their activity and image of each other. His nano-enthusiasts are "playborers" and "weisurers," who expend hours discovering and engineering the

microscopic elements of our world. For instance (and, ironically, like McGonigal), Milburn discusses *Foldit*, where researchers used an online protein folding game to, among other accomplishments, crowdsource the discovery of a Simian AIDS retrovirus's structure. However, Milburn focuses on how scientists also became gamers in the process, using the play of *Foldit* to tweak and work around the standards of scientific authorship and research.

This points to a second important aspect of Milburn's ludological focus. Play is omnipresent, from the military, to naming objects, experiments, cities, media, and science fiction. His work serves as a primer for how the exciting, ironic, and often tongue-in-cheek interplay between "a variety of novels, comic books, and video games from around the world . . . provides the critical vocabularies and conceptual resources for addressing the relations among speculative science and the speculative economy, the configurations of a speculative globality" (p. 225). Through play we not only ascribe a common language for our future, but also embody and experiment with that language. In other words, it sets the rules of the game in which we all encounter digital and emerging technology.

Milburn is also an active participant in this type of play. Throughout the book, he toys with language, concepts, and even the reader. Chapter subheadings are loading instructions or website titles. The reader is invited to "fire it up . . . for the win!" (p. 76). The result is a sometimes slightly bewildering "choose-your-own-adventure" or puzzle for the reader to decipher and so extricate meaning from the wide variety of sources—scientists, comic theorists, ludologists, video game economists, and technologists— presented with the facility of someone long imbued in the various networks and tendrils of study that preoccupy the author. However, ignorance of the rules can cause exclusion from the game all together; the book at times may feel disconnected and insular because of the mastery Milburn has with his subject matter and the speed at which his references, examples, and text blend.

It is here where we encounter one final mondo nano. If in fact Milburn has captured a global and all-too-common phenomenon of play and its relationship with digital matter and society, then the book itself is a kind of microcosm or "nano" version of what he describes. It is a tiny and fascinating lens showing how our increasingly ludified culture is simultaneously shaped by and shaping global forces of innovation.

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