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BIOLOGY IN CULTURE

Book Review: Biology in the Marvel Cinematic Universe

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Marvel Studios is on an unprecedented hot streak. Starting with *Iron Man* in 2008, the Disney-owned studio has produced more than twenty critically acclaimed blockbusters in a row. Some of these films belong to thriving serials (*Avengers*, *Iron Man*, *Thor*, *Captain America*, *Guardians of the Galaxy*, *Ant-Man*), while others are standalone films awaiting their sequels (*Incredible Hulk*, *Doctor Strange*, *Spider-Man*, *Black Panther*, *Captain Marvel*). They are critical darlings, boasting a stellar 83% average on Rotten Tomatoes, and they are box-office gold, earning more money than any other movie franchise in history (twice as much as *Star Wars* in a quarter of the time). They have even transformed the way movies are made, in large part because they all take place in the same fictional universe, the Marvel Cinematic Universe (MCU), where they share dozens of characters and countless interconnected storylines. There are powerful superheroes, multiple dimensions, and mysterious totems in the MCU, but there are also clearly discernable principles of biology.

Studying how biology is portrayed in fictional movies about web-slinging teenagers and hammer-wielding Asgardians might sound like a waste of time, but these types of exercises have real pedagogical value. David A. Kirby has shown that collaborations between filmmakers and science advisors influence popular perceptions of science in significant ways.[1] Sure enough, Marvel retains its own stable of science advisors to help the films retain scientific authenticity, logical consistency, and narrative continuity whenever possible. As a result, the films broadcast a very specific version of biology, one that intersects the history of biology in surprising ways. Some of these connections are incidental. Others propel entire meta-narratives. Rather than dismissing these movies as low-brow culture for the masses, we can use them to teach our students about the most important themes, episodes, and controversies in the history of biology. In other words, studying how biology is constructed in the MCU can help us understand how biology is constructed in *this* universe.

[1] David A. Kirby, *Lab Coats in Hollywood*: *Science*, *Scientists*, *and Cinema* (Cambridge, MA: MIT Press, 2011).

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The Earth that exists in the MCU (also known as Planet C-53) is very similar to our own, but there are significant differences. Most notably, a small number of people in the MCU possess incredible superpowers, with attendant consequences for niche construction and adaptive fitness. Powers are generally acquired rather than congenital, but relatively few superheroes obtain them from biological sources. T'Challa (Black Panther) is an exception. He owes his powers to the Heart-Shaped Herb, a Vibranium-infused plant that grows only in Wakanda. Students who are interested in this story may also be interested in the history of medicinal plants, African botany, and colonial science.[2] Peter Parker (Spider-Man), who acquired his powers when he was bitten by a radioactive spider, is another exception. His story offers a chance to discuss the history of interspecies hybridism with our students, including research on chimeras, xenografts, and, appropriately enough, the mass production of spider-silk via transgenic goats and silkworms.[3]

Most characters derive their powers from technology. Some, like Tony Stark (Iron Man) and Scott Lang (Ant-Man), must rely on technology-enhanced suits for their superpowers, which raises questions about an extended phenotype that can be donned at will. Others used technology to induce somatic enhancements. Steve Rogers (Captain America) gained his powers from a military experiment during World War II. He was injected with a secret serum and bombarded with fictional Vita-Rays until, presto, he turned into a superhero. Bruce Banner (Incredible Hulk) tried to re-create the experiment, but he was bombarded with gamma rays, causing him to occasionally metamorphose into a raging brute. One could read the dangers of radiation as a commentary on Cold War society (Hulk was created in 1961), but Captain America was created in 1941, and thus pre-dates the atomic bomb. For context, we can introduce our students to the history of radiation genetics, and we can inform them that the dream (or nightmare) of enhanced super-soldiers remains very real, as evinced by any number of DARPA projects.[4]

Other characters blur the line between biology and technology. Ultron looks like a robot, but he is technically an artificial intelligence (AI) that has achieved sentience. He was vanquished by Vision, another sentient AI who is portrayed as "something new" because he was created with a spark of the divine from Thor's lightning. Elsewhere in the MCU, the Kree have surrendered governance of their entire empire to an AI known as the Supreme Intelligence, while Nebula was transformed into a cyborg via cybernetic enhancements. Each of these characters takes a different route to the so-called biotechnological singularity that some futurists forecast. With lessons about the Cyborg Manifesto and the Promethean history of synthetic biology,

[2] Abena Dove Osseo-Asare, *Bitter Roots*: *The Search for Healing Plants in Africa* (Chicago, IL: University of Chicago Press, 2014).

[3] Andrea L. Bonnicksen, *Chimeras*, *Hybrids*, *and Interspecies Research* (Washington, DC: Georgetown University Press, 2009).

[4] Luis Campos, *Radium and the Secret of Life* (Chicago, IL: University of Chicago, 2015); Sharon Weinberger, *The Imagineers of War*: *The Untold Story of DARPA*, *the Pentagon Agency That Changed the World* (New York, NY: Knopf Doubleday, 2017).

we can help our students reconcile dire warnings from technophiles and Luddites alike.[5]

In addition to biological and technological sources, several characters in the MCU derive their powers from supernatural sources. Gods like Thor and Loki not only conclusively exist but also regularly meddle in the natural world and in human affairs. Wizards like Dr. Strange and the Ancient One derive their powers from black magic and dark sorcery. Scientists in our universe uniformly reject supernatural explanations, though students may be interested to learn that vitalism and mysticism once enjoyed widespread popularity among biologists.[6] Meanwhile, some characters acquired their powers from a set of cosmic crystals known as Infinity Stones. The twins Wanda and Pietro Maximoff (Scarlett Witch and Quicksilver) both acquired powers after their exposure to an Infinity Stone during human-subject experiments in war-torn Sokovia. Carol Devers (Captain Marvel) gained her cosmic abilities after she destroyed an Infinity Stone-powered light-speed engine and stood in the blast zone. We can direct curious students in several different directions, including the histories of epigenetics, crystallography, and pseudoscience.[7]

Even the characters who lack traditional or easily discernable powers offer considerable biological information. As the films have slowly expanded their narrative scope beyond Earth, they have revealed the breadth of biodiversity in the MCU. Audiences can glimpse some of this variation in the curiosity cabinet of Taneleer Tivan (The Collector), whose lust for novelty may hint at a wider appreciation for endangered species in the MCU. Among the most exotic characters is the living planet known as Ego. Whereas scientists in our universe have generally dismissed James Lovelock's suggestion that Earth is a living planet known as Gaia, scientists in the MCU could point to Ego as proof of concept. The Abilisk, a toothy, tentacled beast that travels between dimensions feeding on batteries, is also exotic, but not incomprehensible. In fact, most organisms in the MCU are vaguely familiar.

Take the Guardians of the Galaxy, for example. A multi-species collection of intergalactic anti-heroes, the team is led by a Terran (a human from Earth) named Peter Quill, or Star-Lord, and most of the group is humanoid in appearance. Drax the Destroyer belongs to an unnamed humanoid species with no concept of metaphor, which is really more of a cultural quirk than a biological one. Gamora belongs to the humanoid Zehoberei species. In the comics, she is the last of her kind, and would thus be known as an "endling" in modern scientific parlance, though her species suffers a different fate in the MCU (more on that shortly). Even the tree-like

[5] Donna Haraway, *Simians*, *Cyborgs*, *and Women: The Reinvention of Nature* (Routledge, 2013); Sophia Roosth, *Synthetic*: *How Life Got Made* (Chicago, IL: University of Chicago Press, 2017).

[6] Garland E. Allen, "Mechanism, Vitalism, and Organicism in Late Nineteenth and Twentieth-Century Biology: The Importance of Historical Context," *Studies in the History and Philosophy of Biological and Biomedical Sciences* 36 (2005): 261–283; Geoffrey E. R. Lloyd, *Magic*, *Reason*, *and Experience*: *Studies in the Origins and Development of Greek Science* (New York, NY: Cambridge University Press, 1979).

[7] Erik Peterson, *The Life Organic*: *The Theoretical Biology Club and the Roots of Epigenetics* (Pittsburgh, PA: University of Pittsburgh Press, 2016); André Authier, *Early Days of X-ray Crystallography* (Oxford University Press, 2013); Allison B. Kaufman and James C. Kaufman, *Pseudoscience*: *The Conspiracy Against Science* (Cambridge, MA: MIT Press, 2018).

Groot is humanoid in appearance, with his bipedal gait, opposable thumbs, and (admittedly limited) human vocalizations.[8] The widespread distribution of humanoids would seemingly settle the debate over the evolutionary significance of contingency and convergence in favor of the latter. Put differently, if we re-played Stephen Jay Gould's tape of life in the MCU, we would still end up with bipedal humanoids.[9]

Finally, it is significant that Marvel's biggest supervillain also provides the most glaring connection between the MCU and the history of biology. In *Avengers*: *Infinity War*, a Titan warlord named Thanos plots to kill half of all living things. In the comics, he was motivated by his obsessive love for Mistress Death. In the movies, he articulates his desire in explicitly Malthusian logic. "It's a simple calculus," Thanos explains. "This universe is finite, it's resources finite. If life is left unchecked, life will cease to exist. It needs correction." When he is explaining to Gamora why he murdered half of her species, he notes that they had been overpopulated and scrounging for scraps prior to his genocidal campaign, but that the survivors had enjoyed a much better quality of life ever since. Most people recoiled from the Mad Titan's plan to kill half the universe, but some people found themselves seduced by his logic. We know this because they have openly acknowledged as much in articles, blogs, and tweets.

This provides historians of biology with a unique opportunity. We rightly teach our students about Francis Galton and Carrie Buck, but we do them a disservice if we treat eugenics as an aberration. As historian Nathaniel Comfort recently observed, eugenics is "a constant, continuous impulse" throughout recent history. It follows that some of our students will sympathize with Thanos and his rationale. As historians of biology, we can and should decry the inhumanity of Nazi eugenicists (as well as the Americans who inspired them), but this will not dissuade everyone. We must also explain that even the most well-intentioned eugenic campaigns overvalue hereditary determinism, and that doing so leaves all of us more impoverished.[10]

Marvel's latest film, *Avengers*: *Endgame*, provides historians of biology and their students with an opportunity to identify still more biological principles in the MCU. Even if we do not wait in line for the midnight premieres, we would do well to recognize how these films influence our culture and our profession. Millions of people watch these movies, and, knowingly or not, they imbibe the biological imaginary the films promote. As historians, we can design lectures, discussions, and assignments that challenge our students to place cinematic representations of biology in historical context. We can ask them to explain how certain characters, powers, or

[8] Rocket's biological identity is unclear. He looks like a racoon, but he reacts violently if anybody calls him one. Some of his lamentations ("I didn't ask to get made!") hint at a synthetic origin, but details remain obscure.

[9] Stephen Jay Gould, *Wonderful Life*: *The Burgess Shale and the Nature of History* (New York, NY: Norton, 1989).

[10] Nathaniel Comfort, *The Science of Human Perfection*: *How Genes Became the Heart of American Medicine* (New Haven, CT: Yale University Press, 2012), 245; James Q. Whitman, *Hitler's American Model*: *The United States and the Making of the Nazi Race Law* (Princeton, NJ: Princeton University Press, 2017).

storylines draw from the history of biology, and to explore similar connections in different movie franchises, from the DC Universe to Deadpool. For that matter, we can ask them to consider why the MCU and the history of biology are both overwhelmingly male and white.[11] Perhaps most importantly, we can help our students confront the looming specter of eugenics in the twenty-first century. History offers countless examples of people mobilizing biology to political ends, of people trying to steer the future of human evolution in a certain direction. As historians of biology, we can explain that eugenic campaigns employ the faulty logic of hereditary determinism, and that they devalue the human experience as a result. We can use our pulpit to insist on the inherent equality of all humans throughout our universe, and, in doing so, we can save the day.

[11] Jill Lepore, *The Secret History of Wonder Woman* (New York, NY: Vintage, 2014).