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### Modulating Resistance

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Editors' Forum    Theorizing the Contemporary

# Modulating Resistance

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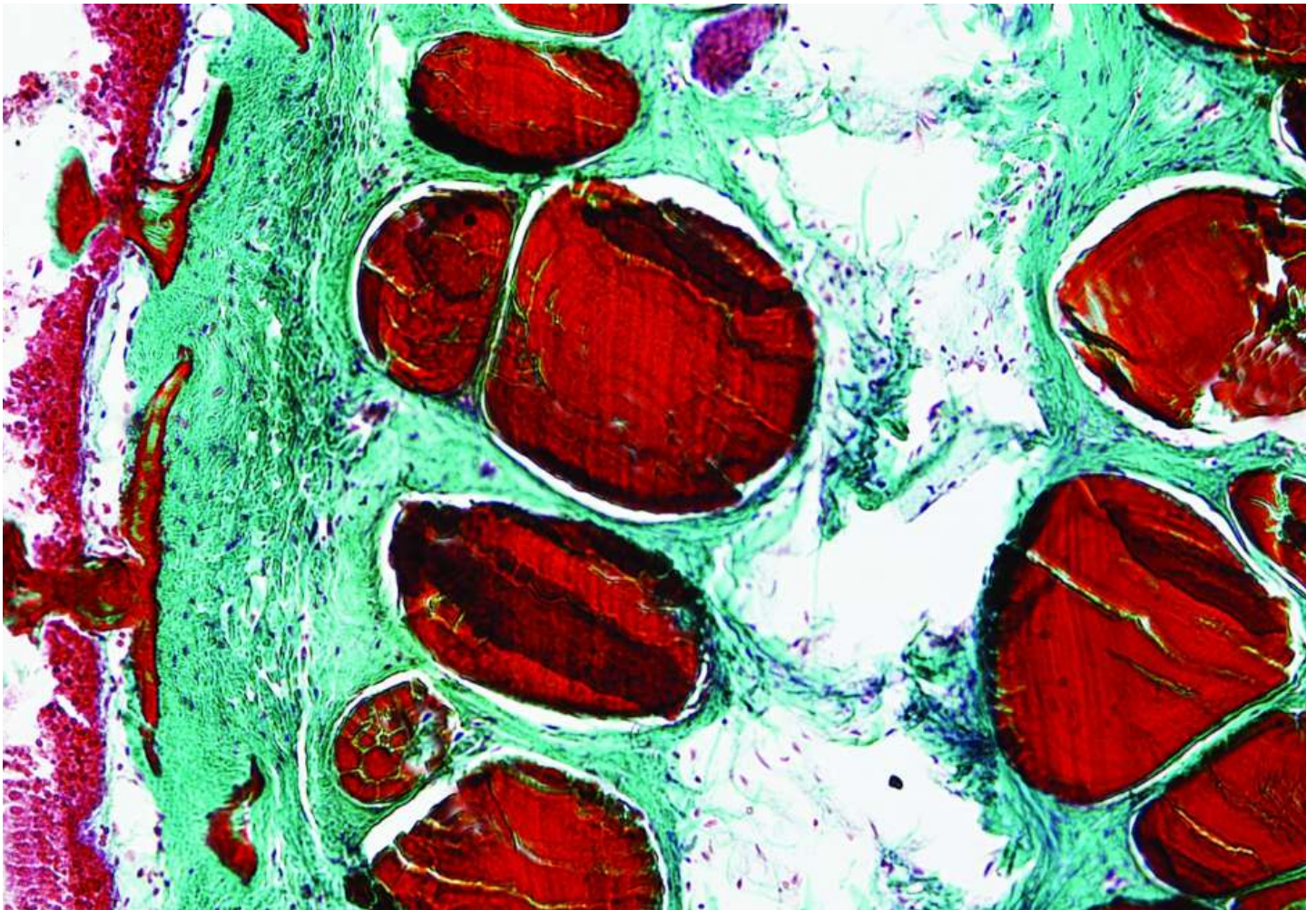


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In the most recent addition to the Star Trek lineage, *Star Trek: Discovery*, the body emerges as a modulator in microscopic multispecies entanglements. The series chronicles the development of an organic propulsion system referred to as the “spore drive.” The fantastical device can materialize matter anywhere within the intergalactic mycelial network, a microscopic structure reaching across the cosmos. The hitch in this system is that it requires a navigator able to embody the spore flow and direct the movement of matter through the network. In the show, the inventor of the drive, Paul Stamets,<sup>1</sup> alters his own genetic code by borrowing from a space-traveling tardigrade to become a mycelial symbiont, tapping into the network “to boldly go . . .”—well, you probably know the rest.

What is important to foreground here is the popular scientific vision for how bodies come to matter as modulators for environments that were previously unperceivable. The body, imagined as a *holobiont*—a multispecies assemblage of host, symbiont, and parasitic relations—is a figure whose boundaries remain contentious within the life sciences (Skillings 2016). Within the social sciences, Stefan Helmreich characterized the holobiotic body as [the figure of \*Homo microbis\*](#) in response to an understanding of the human body as composed of far more microbial DNA than that of *Homo sapiens*. The holobiotic body is often framed as a host-centric figure: a fairly stable multispecies assemblage, a passive locus of geospatially informed interactions, a vessel for “the multitudes” that are said to shape the health and well-being of the singular human. By contrast, the body as a modulator offers a frame to consider human–microbe–environment relations in a way that does not privilege impact on the host.

I first encountered the trope of the modulating holobiont while studying human–microbe relations in light of the looming global health crisis known as antimicrobial resistance. This refers to microbes’ ability to resist and persist beyond harmful presences in their environment, such as antibiotic molecules. In this context, the resistome is the collection of all microbial resistance genes, as well as related molecules and structures that facilitate gene movements between microbes, both within a community and across habitats.

The genes that encode resistant capabilities are conceived of by metagenomics scientists as part of “an ancient reservoir” (Dantas and Sommer 2014, 48) of genetic material. Resistome researchers describe resistance genes as omnipresent, harbored by nonpathogenic—and thus historically ignored—microbes in any given ecosystem. Decades of industrialized antibiotic production and their extensive use among humans have

amplified and enriched the presence of resistance genes in the global environment. These genes are disseminated across the microbial transmission network, in which human bodies are lively pit stops and sites of collection.

Counter to the long-held biomedical belief that resistance is a phenomenon occurring when antibiotics and pathogens mingle within the confines of bodies, resistome scientists present resistance genes as a “natural feature of diverse microbial ecosystems” (Crofts, Gasparri, and Dantas 2017, 1) that include the human microbiome. Therefore, their focus is the microbial network through which genes move. As life scientists grapple with the clinical implications of the environmental resistome, a refocusing on the natural history of resistance and its productive capacities gets framed as a possible path forward “to shape a new postresistance era” (Surette and Wright 2017, 311).

For the scientists I worked with at Washington University in St. Louis, the postresistance era requires living *with* resistance, rather than *against* it. An “ecological lens,” as it is being called, affords a view of alternative therapeutics to antibiotics. The head of a microbial genomics lab described this way of thinking to me as “the thirty-thousand-foot view,” a high-altitude observation point from which the vastness of the microbial ecosystem could be monitored as it comes to bear on human health.

For instance, a bioengineered probiotic *E. coli* organism was recently developed, using a series of resistance genes found in soil environments that encode the ability for microbes to break down antibiotics and convert them into microbial food. These probiotics are designed with the intention of performing bioremediation, cleaning up antibiotic contamination in environments. Another vision for such probiotics is to develop them into clinical therapeutics capable of locating pathogens within a human microbiome and producing a hyperspecific molecule that will eliminate the pathogen from the microbial community. “It is like personalized medicine for ecosystems,” one of the scientists explained. “It’s not sci-fi; it’s just around the corner.”

Resistome research rethinks the holobiotic body as a modulator, allowing scientists to explore how resistance passes through bodies but is not contingent upon them—making resistance a concern of networks and not bodies. In the case of the resistome, the individual human body is refigured as a modulating environment, a biological location able to regulate and be regulated by an ecological network. The trope of the modulator opens



theoretical space to assess how bodies, microbiomes, and the ecosystems they coexist within are being conceptualized as extensions of one another, coproducers of infectious risk and joint futures.

Communing with the microbial transmission network and navigating microscopic phenomena through embodied attunement may still be a speculative imaginary of what human bodies can do or be, but as both Donna Haraway (1985, 66) and my laboratory informants remind us, what is science and what is fiction is a question of optics.

## Note

1. Does this character's name sound familiar? He isn't entirely fictional. The real-life Paul Stamets is a contemporary mycologist, most notable in relation to this essay for his conceptualization of mycelial networks as "nature's internet."

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