JOHN L. INGRAHAM, **Kin: How We Came to Know Our Microbe Relatives**. Cambridge, MA and London: Harvard University Press, 2017. Pp. x + 263. ISBN 978-0-674-66040-3. $29.95 (hardcover).
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In 1977, microbiologist Carl Woese at the University of Illinois discovered a new life form, right here on Earth. Not a new species – no, much more momentous than that. Woese had identified a new branch of organisms that would sit alongside bacteria and the plant–animal–fungi branch of eukaryotes. The discovery implied that the 'Tree of Life' – the branching representation of how living things have evolved – had not two, but three major limbs or 'domains'. Freshly minted, Archaea would join Bacteria and Eukarya. Woese's discovery involved a novel investigative technique. He cut up ribosomal RNA from the methane-producing microbe *Methanobacterium thermoautothrophicum*. The collection of fragments he found were so different from the pieces one got from chopping up bacterial RNA that Woese concluded that methanogens were not bacteria at all. They were something different. On realizing the significance, Woese's colleague recalled that 'he just went nuts. He ran into my lab and told me we had just discovered a new form of life' (p. 106).

In *Kin*, microbiologist John L. Ingraham takes the reader on a tour of twentieth-century microbiology. He is especially interested in how microbial genetics offers information useful for taxonomy. (Although *Kin* claims to trace Aristotle's ladder of living things through to the modern explication of the 'Tree of Life', this is misleading. The book is not about the development of classification systems for living organisms, which it discusses only briefly.) Ingraham is plenty knowledgeable about his topic, having worked in microbiology throughout the period he writes of and having known some of the figures whose work the book covers. The author's occasional personal recollections of microbiologists are enlivening touches.

Ingraham includes some fascinating titbits in the book – the discovery of a new antibiotic, teixobactin, with the unusual ability to block a bacterium's ability to repair its cell walls, is one such story. But the author does not have the easy explanatory style that others have brought to popular histories of biology. Paragraphs are sometimes strung-together dot points; heavy going en masse and confusing to the narrative. The reader feels less like a fellow adventurer in the microbial world than an undergraduate in a lecture.

The first section of the book gives an overview of microbes and the use of genetic tools to investigate relatedness. The structure of this section is awkward. The section about Archaea comes before the identification of Archaea, which in turn comes before pre-Archaea classification schemes. It's hard to convey that identifying Archaea was groundbreaking without having first established the ground. Similarly, the idea that tracers, such as rRNA fragments, can be used to estimate relatedness seems predicated on already having an idea of relatedness to compare with – something that the book does not fully address.

The second section deals with prokaryotes' ability to acquire genes laterally from their fellow microbes through a process termed 'transformation'. (Prokaryotes are single-celled organisms whose cell lacks a nucleus.) Genetic inheritance, Ingraham explains, is not confined to the parent-to-child, vertical inheritance we are most familiar with. While some prokaryotes acquire foreign DNA naturally, Ingraham explains that many cells can be forced to transform artificially. Forcing cells to accept foreign DNA is at the core of recombinant DNA technology.

Kin goes on to describe other mechanisms by which cells transfer DNA horizontally, including Lynn Margulis's 1967 theory that animal and plant cells acquired their mitochondria and chloroplasts by engulfing bacteria which could, respectively, metabolize oxygen or photosynthesize. Symbiotically, the cell and its enslaved bacterium evolved to become cell and organelles.

Ingraham raises the issue of whether all this horizontal churning of DNA might throw a spanner in the taxonomic works. Transformation, he explains, occurs most readily between fellow bacteria, but also happens across kingdoms with animals and plants pinching genetic material from bacteria as well. If lifeforms can just swap bits and pieces of DNA, does the whole project of mapping out evolutionary relationships between organisms fall apart? The 'Tree of Life' would be a knotted mass of interconnected, DNA-trading species. Ingraham thinks this messy vision is not the case. He feels that horizontal DNA transfer is not widespread enough, nor does it involve enough core cellular functions, to scupper branching classification.

The final part rounds out the story in a more speculative, philosophical mode. These are short discussions on the future potential of microbiology and some of its possibly unanswerable questions. What might that topic *du jour*, the human body's microbiome, have in store for us? Can microbiology illuminate the origins of life? *Kin* gestures to tantalizing pathways.

Microbes, as Ingraham reminds us, have remarkable characteristics and their investigation using genetic tools can help establish evolutionary relationships, a project begun with Charles Darwin's *Origin of Species*. *Kin* is both an intriguing and a frustrating guide to twentieth-century microbiology.

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Joanna Radin, **Life on Ice: A History of New Uses for Cold Blood**. Chicago and London: The University of Chicago Press, 2017. Pp. xii + 305. ISBN 978-0-226-41731-8. $40.00 (hardcover).
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Irradiated fruit flies, cell cultures and radioisotopes, as their spokespeople have shown, all crossed the threshold from *explanandum* to technology. Taking the next step, historians of the twentieth-century life sciences have gone from considering the ecological character of the scientific workplace – 'What Tools? Which Jobs? Why Right?' as Clarke and Fujimura put their series of interpenetrated questions in 1992 – to exposing the infrastructure that allows diverse sites of knowledge production to hang together. What can we learn by looking at blood, that humour of such storied intrigue throughout human history, in this way? In *Life on Ice*, Joanna Radin shows how banks of human blood outgrew the forms of inquiry they were intended to support. Her history takes us from a St Louis lab where a Catholic priest forged a science of life at low temperatures to the Solomon Islands, Melanesia and the Amazon on 'salvage biology' voyages aboard the *Alpha Helix*. Radin never takes the easy road when treating the ethical entanglements of extractive biomedicine, and her careful treatment does justice to the complex narratives contained in vials of human blood.

The chapters of *Life on Ice* are ordered roughly conceptually and chronologically, and a brisk introduction is all one needs from a writer as energetic and effortlessly synthetic as Radin. The first of three sections focuses on the development of blood and tissue freezing, introducing ideas about cold as intervening in the boundary between life and death as they developed in tandem with the new technology. The second section highlights two orientations of cold-blood accumulation in global Cold War science: as a resource to manage future risks to the health of changing populations, and as an anxiety-ridden effort to preserve lives from 'primitive' societies on the wane, understood as living relics of a shared human past. Radin then brings us into present ethical concerns around blood reuse in the third section, after charting the 1970s blood-collecting missions of the *Alpha Helix*, a floating laboratory funded by the National Science Foundation, which serves as an exemplar of the institutional heft and global aspirations undergirding human biological material gathering.

On the surface, this is a book about temperature, and Radin pays close attention to how the uptake of refrigeration technology was dependent on users endowing it with meanings and uses beyond those intended. The real payoff, however, is how cold storage allows her to discuss shifting notions of biological time. *Life on Ice* is topically (and institutionally) consanguineous with Keith Wailoo's *Drawing Blood* (1997), which observes at its outset that a key development in medical testing has been the idea of latent disease, or a spectrum of diseases-in-waiting. Where Wailoo