

Books & arts



Refugees trying to cross the Croatian border into the European Union in 2015.

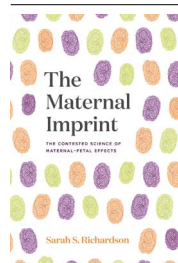
Are mothers too easy to blame?

A book critiques the evidence for epigenetic inheritance of trauma. **By Julian Nowogrodzki**

Like me, my grandmother lived with anxiety, although she wouldn't have described it like that. Unlike me, she fled Poland under forged papers at the outset of the Second World War, knowing that her twin sister and beloved stepmother remained in the occupied country.

When I read news coverage of Rachel Yehuda's 2016 study claiming that the children of Holocaust survivors have epigenetic changes at a particular site in the genome, and those changes make them more susceptible to stress (R. Yehuda *et al. Biol. Psychiatry* **80**, 372–380; 2016), it set me wondering. Did my

grandmother's traumatic experiences cause changes to the regulation of her DNA that her body transmitted to my father when she was pregnant, ultimately contributing to my



**The Maternal Imprint:
The Contested Science
of Maternal-Fetal Effects**
Sarah S. Richardson
Univ. Chicago Press
(2021)

anxiety? Or was my anxiety due to genetics, culture, upbringing or the chilling knowledge that something terrible had happened to my relatives? Or was it all of the above?

Yehuda's study has been criticized often for its small sample size, tiny control group and outsize claims of causality, although you might not know it from media coverage. Sarah Richardson's book *The Maternal Imprint* broadens this criticism to the field of human transgenerational epigenetics more generally. She argues that social assumptions about maternal responsibility lend ideas in this field more credibility than they deserve on the basis of the data. Her argument will be interesting to researchers, pregnant nerds and policymakers, although she could have done a better job of showing her working.

Epigenetics concerns chemical changes to DNA that don't alter the sequence itself, but do affect how genes are regulated; one such change is called methylation. Richardson discusses only transgenerational epigenetics, the kind that can be passed down to a gamete or embryo. This is distinct from epigenetic changes relayed between cells in a person's body. The latter is solidly supported and has a significant effect on the genomes of cancer cells, for example.

The first half of the book is an overlong tour of theories of maternal and paternal contributions to heredity since the late nineteenth century. Richardson, a historian of science, shows how each era's beliefs shaped its theories.

Prevailing thought has flip-flopped several times. In the 1880s, 'germ plasm' theory held that the sperm and egg contributed equally to heredity. Between the 1880s and early 1900s, a subgroup of eugenicists in the United States rejected these ideas and thought that a mother's mental state during pregnancy would be permanently imprinted on her child. For instance, an 1882 book by educational reformer Georgiana Bruce Kirby told pregnant women that to properly influence their fetuses, they should do mathematics and play music every day instead of taking part in "household drudgery" such as "making jam" and "hemming skirts". Then, in the 1910s, men were thought to bring the lion's share of risk to the offspring, owing to their more dangerous jobs and greater likelihood of drinking alcohol.

Finally, Richardson gets to her central critique of human epigenetics work. She pokes many holes in three groups of studies: Suzanne King's work on babies gestated during a 1998 ice storm in Quebec, Canada; Yehuda's studies of Holocaust survivors and their children; and

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research on babies gestated during the Dutch Hunger Winter famine of 1944–45.

The ice-storm studies looked at only 34 children, and had no control group. The Holocaust work had only eight parental controls and nine offspring controls. The Dutch studies involved 811 offspring — a large enough sample size, including plenty of controls. Yet Richardson points out that the effect sizes they found were low: differences in DNA methylation levels of between 0.7% and 2.7%. None of the studies took biological samples from the children at birth. Without those, Richardson argues, they can't rule out 'reverse causation'. In other words, they can't pin down whether epigenetic changes caused, say, increased susceptibility to stress, or whether susceptibility to stress caused the epigenetic changes.

Epigenetics studies typically use blood samples, but epigenetics varies by cell type, so if you're interested in effects in the brain, it's not clear that you would learn anything from changes in blood. And studies rarely collect much, if any, information about paternal contributions to the studied effects. One theory holds that maternal obesity during pregnancy causes higher rates of obesity in children; studies that expanded the research have found that paternal size explains the variation better.

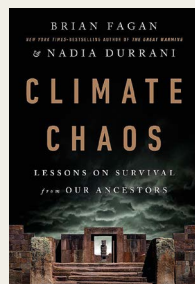
Richardson makes many good points, but references and counterpoints are too thin on the ground. Most problematic, she doesn't engage with the growing body of work designed to address some of the gaps in the Dutch studies — efforts such as the Avon Longitudinal Study of Parents and Children in the United Kingdom, and at least seven others covered by the Pregnancy And Childhood Epigenetics Consortium that have sample sizes in the thousands and collect umbilical-cord blood to address reverse causation. Richardson never explains how she selected the three groups of studies that she focuses on to the exclusion of others.

Her key contention is that weak epigenetics findings can exert too tenacious a hold because our culture teaches us to assume that mothers bear responsibility. It's true — women are much too easy to blame. But to make a strong case, other interpretations need to be addressed, such as the general frenzy for DNA-based explanations, or the cult of personal over societal responsibility.

Richardson is right, however, about how cultural assumptions diminish possibilities. As public-health specialist Liana Winett has written: "Asking, 'What would a woman do today if she wanted to help her baby avoid chronic disease?' is very different from, and much more limiting than asking, 'What would our society do and provide if we wanted to be the healthiest place to be born?'"

Julian Nowogrodzki is *Nature's* impact editor, based in Boston, Massachusetts.

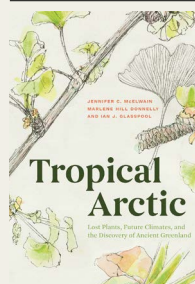
Books in brief



Climate Chaos

Brian Fagan & Nadia Durrani *Public Affairs* (2021)

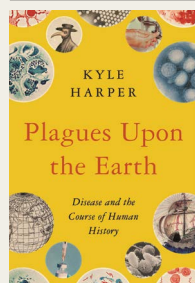
Earlier civilizations' responses to natural climate shifts are often assumed to be irrelevant to the current crisis. Not so, argue archaeologists Brian Fagan and Nadia Durrani in their rich survey of the past 30,000 years. A global drought from 2200 to 1900 BC first destabilized Egypt, then strengthened it, after pharaohs in supposed divine control of the Nile were replaced by provincial leaders who invested in dams and irrigation. Egypt's "organized oasis" flourished for two millennia, becoming ancient Rome's granary.



Tropical Arctic

Jennifer C. McElwain et al. *Univ. Chicago Press* (2021)

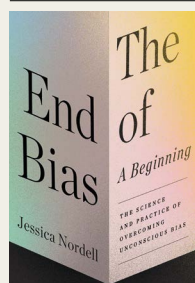
Ice-covered Greenland was named misleadingly by tenth-century Norse settlers hoping to attract others. But at the time of the dinosaurs, the label would have been accurate, judging from the fossilized plants intricately reconstructed and pictured in this fascinating study by palaeobotanists Jennifer McElwain and Ian Glasspool, with scientific illustrator Marlene Donnelly. They warn that current greenhouse-gas emissions are becoming comparable in impact to the volcanic emissions that triggered the collapse of Triassic Greenland's flora.



Plagues upon the Earth

Kyle Harper *Princeton Univ. Press* (2021)

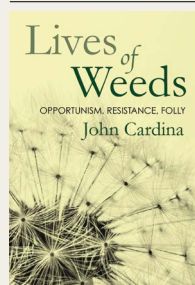
Classicist Kyle Harper's absorbing global history of disease from prehistoric times to today emerged from a study of ancient Roman plagues. Their details left him asking why the empire suffered giant epidemics; why these particular diseases; and why then? He explores how human history has shaped disease ecology and the evolution of pathogens, and vice versa — both predictably and unpredictably. The COVID-19 pandemic is part of this "deep pattern", he concludes: "expect the unexpected".



The End of Bias

Jessica Nordell *Metropolitan/Henry Holt* (2021)

When she was trying to break into journalism, Jessica Nordell had no response from editors — until she used a man's name on her pitches. Her first book (shortlisted for the 2021 Royal Society Science Book Prize) skilfully and sensitively explores ways to eradicate bias in society and oneself. Interviewing cognitive scientists and social psychologists, mostly in the United States, she covers a huge range of methods, such as doctors' diagnostic check lists for gender equality, and a police unit practising mindfulness to diminish its use of force.



Lives of Weeds

John Cardina *Cornell Univ. Press* (2021)

Of the roughly 400,000 species of flowering plants, how many are weeds? The answer depends on who, where and when you ask. "One person's weed is another's wildflower, food or medicine," notes plant ecologist John Cardina; think of cannabis. His penetrating analysis disentangles botany from history by offering eight interwoven stories, each focused on one weed, some familiar, others less so: dandelion, Florida beggarweed, velvetleaf, nutsedge, mare's tail, pigweed, ragweed and foxtail. **Andrew Robinson**