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Nathan Crowe, *Forgotten Clones: The Birth of Cloning and the Biological Revolution* (Pittsburgh: University of Pittsburgh Press, 2021), 299 pp, \$60.00 Cloth, ISBN 9780822946274

Gregory Radick

No biological technique has had a better run in speculative fiction than cloning. Consider two of the best-known scenarios, from either side of the period covered in *Forgotten Clones*. Aldous Huxley's *Brave New World* (1932) begins with notebook-clutching students on a tour of the Central London Hatchery and Conditioning Centre. Before long they encounter a machine that exposes artificially fertilized human eggs to "Bokanovsky's Process": first zapping them with X-rays, then chilling them, then dousing them in alcohol, in order to induce successive waves of budding. The facility's Director proudly bids the students to admire "one of the major instruments of social stability!", supplying the standardized factories with the standardized men and women who can most efficiently operate them. Almost half a century later, Ira Levin's *The Boys from Brazil* (1976) is set not in an extrapolated future but in a recognizable present, where the clones of interest are not from some embryonic factory-worker but – spoiler alert – a fully formed Adolf Hitler. In the 1978 movie version, when the Simon Wiesenthal-like Nazi hunter played by Laurence Olivier realizes what is up, he has just watched – as have viewers – a film explaining step by step how cloning gets done in the laboratory.

Anyone knowing little else about the pre-Dolly history of cloning could be forgiven for thinking that, between the 1930s and the 1970s, the path was one of steady, straightforward growth. Nathan Crowe's superb study shows otherwise. Weaving together

archival research, wide reading, and interviews with the surviving principals, he reconstructs a fascinatingly unstraightforward story. In *Brave New World*, he points out, Huxley never used the term “cloning.” Moreover, his book seems to have played no role at all in inspiring the people who actually went on, in the 1940s and 1950s, to pioneer what became the baseline cloning technique: the ability to transfer the chromosome-bearing nucleus of a donor cell into an egg cell from which the nucleus has been removed or otherwise inactivated, with the new hybrid cell going on to divide and develop as normal. That was first done successfully in 1951 by Robert Briggs, Thomas King, and Marie Di Berardino at the Lankenau Hospital Research Institute in Philadelphia. Their aim was not to figure out how to produce copies of mature organisms – Briggs doubted that anything other than an undifferentiated egg could furnish a nucleus capable of guiding development in a host cell – but to throw light on cancer as the result of cell differentiation gone awry. Accordingly, their work was celebrated in the popular press as a breakthrough in cancer medicine, provoking no scientific or public hand-wringing.

So how did “nuclear transplantation” (as Briggs and company called it) acquire its now-familiar identity, name, and attendant anxieties? Crowe does an outstanding job of charting several converging trajectories. One centers on the work of the English embryologist – and later Nobel Prize-winner – John Gurdon. Working from the late 1950s with a species of frog different from the species used by the Philadelphia team (*Xenopus laevis* instead of *Rana pipiens*), Gurdon first convinced himself and then, gradually, the rest of the field that previous failure to detect developmental potential in nuclei transferred from developing embryos was down to an unlucky choice in experimental system. Another trajectory concerns the post-WWII emergence of a new audience for science reportage, along with scientists with a taste for popular writing and, on the model of the atomic scientists, public moralizing about its social implications. In biology, the most prominent representative

of the new type was another Nobelist, the American microbiologist-turned-molecular-biologist Joshua Lederberg. It was Lederberg who, in the mid-1960s, first drew attention to the prospect of nuclear transfer being used to usher in a future of human “clonal reproduction” (a term imported from plant biology). Newly invested with world-altering power, cloning technology now took its place with the era’s other biological and biomedical innovations, from the deciphering of the genetic code to the development of the birth-control pill, in an unfolding, unsettling, and perhaps dangerously uncontrollable “biological revolution.”

From this first flush of public interest in human cloning as technoscience there were, Crowe shows, several legacies. The most conspicuous was the one for popular fiction, from Levin’s thriller through to such distinguished post-Dolly novels as Michel Houellebecq’s *The Possibility of an Island* (2005) and Kazuo Ishiguro’s *Never Let Me Go* (also 2005). Another was the emergence in the United States of a new class of academic professional who, under the banner of “bioethics,” claimed expertise in the moral questions raised by cloning and other products of revolutionary biology. It is here that *Brave New World* became a part of the nuclear-transfer story, as reading the novel energized a new postdoc in molecular biology, Leon Kass, to remonstrate in print with Lederberg for being insufficiently alarmist about the clonal future he invoked. Kass went on to become one of the leaders in bioethics, and the controversy he helped to stoke over human cloning was likewise pivotal for other founder figures in the new field, as well as for the institutions – the Hastings Center in New York, the Kennedy Institute of Ethics at Georgetown University – associated with them. But arguably the most important legacy was the canonization of a version of cloning’s history shorn of all the contingencies which Crowe has now so meticulously and thoughtfully restored. Organisms grown from transferred nuclei are not just like organisms grown from buds or cuttings, because the former undergo a developmental process whose intrinsic chanciness and

context dependency can make for highly variable outcomes. On Crowe's evidence, there was nothing inevitable about nuclear-transfer biology getting lumped so misleadingly with clonal biology, real and imagined, or for that lumping becoming so widely taken for granted, in and out of laboratory science. ("And this creature is an exact duplicate of itself? Oh, doctor how can that be?" the disbelieving Olivier asks, after being told about nuclear transfer and before being shown the skepticism-dispelling film.) In revealing how and why such a crucial distinction got lost, *Forgotten Clones* at once teaches us something new about our present and offers hope for a future that, better informed about our past, won't uncritically perpetuate it. If ever scholarly history of science needed a justification, that, surely, is it.

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