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CHAPTER 4

The Waring Worlds of H. G. Wells: The Entangled Histories of Education, Sociobiology, Post-genomics, and Science Fiction

Chessa Adsit-Morris

Education and Catastrophe

In 1937 the so-called father of modern science fiction, author H. G. Wells (1966, p. 1063), presented a paper to the British Association for the Advancement of Science's (BAAS) Educational Science Section (Section L), in which he declared that:

> [O]ur schools lag some fifty years behind contemporary knowledge. The past half-century has written a fascinating history of the succession of living things in time and made plain all sorts of processes in the prosperity, decline, extinction and replacement of species.[1]

Wells envisioned an education system that taught children about the world by providing a foundation in scientific knowledge through natural experience, informed by the latest advances in science and technology.[2] Wells rejected the existing nationalistic curriculum focused on "the scandals and revenges" that made up the "criminal history" of British royalty which "once passed

[1] Wells was referred to as the "father of science fiction" (along with Jules Verne) as well as the "Shakespeare of science fiction" (see Wagar, 2004).

[2] As Wells (1966, 1062) states: "we ought to make the weather and the mud pie our introduction to what Huxley christened long ago as Elementary Physiography. We ought to build up simple and clear ideas from natural experience."

C. Adsit-Morris (✉)
University of California, Santa Cruz, CA, USA
e-mail: cadsitmo@ucsc.edu

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as English history" (Wells, 1966, p. 1062). Instead he proposed a transnational scientific curriculum that taught students about the diverse historical and current ways humans and nonhumans occupy and negotiate their way through the world, including subjects such as social organization, politics, comparative religion, sociology, biology, chemistry, and natural history. Unbeknownst to many contemporary readers, Wells' first job after attending the Normal School of Science, where he learned biology under the tutelage of T. H. Huxley, was as a science teacher at Holt Academy, and his first book publication was the *Text-Book of Biology* (1893), which remained in print for thirty years.[3] Wells even attempted to become a Member of Parliament, running on a campaign platform of educational reform.[4] Wells was a socialist and revolutionary; he was a member of the Fabian Society who believed strongly that educational reform was fundamental to the social evolution of man, so much so that he declared in his popular publication *The Outline of History* (1920, p. 594): "human history becomes more and more a race between education and catastrophe."[5]

Wells presented his address to the British Association at a time of social, political, and intellectual ferment, in the wake of the first Great War, the industrial revolution and subsequent reform movements, the rebellious roaring twenties, and the burgeoning surrealist movement. It was a time of scientific and industrial innovation, advancement, and progress: the first X-ray machine was created by Wilhelm Conrad Röntgen in 1895; Svante Arrhenius derived the basic principles for the greenhouse effect in 1896; the Wright brothers took flight in the first modern powered aircraft in 1903; and in 1911 Ernest Rutherford provided evidence for his atomic model of the atom, leading to a reconceptualization of the modern atom by Niels Bohr in 1913 and subsequent quantum revolution. Between 1895 and the early 1920s scientists and engineers created faster and more efficient ways to extract, process, produce, transport, and sell consumer products. By the mid-1920s most cities had reliable transportation and communication networks that included refrigerated railroad cars, radios, public telephones, mail-order catalogues, and affordable silent motion pictures. By 1937, it was clear (at least to Wells) that humans were on a crash course toward catastrophe unless socio-cultural systems—including economic systems, social structures, political organizations, and educational systems—were reformed in ways that enabled humans to adequately grapple with the implications and impacts of the coming "great acceleration" of human activity. Wells' science fiction novels *War of the Worlds* (1897) and *The World Set Free* (1919) not only predicted the coming world

[3] Wells wrote a revised biology textbook, *The Science of Life*, in 1934 in collaboration with Julian Huxley (T. H. Huxley's grandson) and his son George P. Wells.

[4] See Adam Roberts (2019) "Education," which describes Wells growing interest in education echoed in his scholarship *Joan and Peter* (1918), *The Undying Fire* (1919), *Socialism and the Scientific Motive* (1923), and *The Story of a Great Schoolmaster* (1924).

[5] For more detailed explanation of Wells' critique of the history curriculum and its nationalistic underpinnings in the interwar period—as well as a more general overview of what has been termed a "Wellsian education"—see Ken Osborne (2014).

wars—including the use of tanks, chemical warfare, and the atomic bomb—but also provided a prophetic warning for the Anthropocene, which he viewed as the inevitable result of man's complacent and yet negligent mastery of nature.[6]

Almost a century later we find ourselves at a similar juncture in history, on the precipice of a global catastrophe fueled by extractive capitalism and poorly regulated technological advancements, which have accompanied and exacerbated social, cultural, racial, economic, political, and militaristic inequalities.[7] Wells would have been disappointed but not surprised to hear of the continued political and military conflicts, and even more disheartened by the institutionalized necropolitics that shape the Anthropocene. As T. J. Demos (2018, p. 1) observes:

> The Anthropocene is proving to be an era of world war, or rather, worlds at war. Not that this is anything new. We are no doubt living in the continuation of longstanding onto-epistemological and politico-military conflicts set within (still unfolding) histories of colonial and global states of violence and dispossession.

Drawing on Wells' visionary texts, social critique, and revolutionary insights, this chapter revisits and recontextualizes questions raised by Wells almost a century ago around the adequacy of existing science curricula to grapple with the still unfolding Anthropocene. I deploy the methodological practice of "diffractive play" (see Adsit-Morris & Gough, 2020) by reading selected fictional, theoretical, scientific, and policy texts/discourses diffractively through each other in order to undo pervasive conceptions, trouble linear temporal logics, and foster collective imaginaries around what might yet still be possible. I begin by exploring the technological advances in molecular biology that have occurred over the last twenty years that have instigated an epistemological turn toward what many science studies scholars and social scientists are calling the *post-genomic era*, which not only entails a reconceptualization of scientific understandings of genes, genomes, and genetics, but the rise of biocapitalism, the commercialization of genetics, and the resurrection of a genetics of race (see Keller, 2015). I situate current education research and policy within the post-genomic era through new research in the field of sociobiology—what Robert Plomin (2018) calls the new genetics of intelligence—and further explore the gaps between current research in evolutionary biology and genomics, and the content of the contemporary science education curriculum.

[6] In the opening paragraph of *War of the Worlds* (1897, p. 1), Wells described man's relationship with nature: "With infinite complacency men went to and fro over this globe about their little affairs, serene in their assurance of their empire over matter."

[7] Of the many catastrophic threats humankind faces, catastrophic climate change—comprising anthropogenic global warming and sea-level rise, desertification and agricultural failures, ecosystem fragmentation and mass species extinction—is the most generally associated with the Anthropocene.

This diffractive narrative inquiry travels through various time periods and national borders as it jumps from pre-war Britain, to interwar Australia, to contemporary United States in order to explore the entanglements of science and education within the still unfolding histories of colonial and capitalistic processes of globalization. As Donna Haraway (1975, p. 446) notes: "It is a considerable leap from pre-war Britain to the recent past of the United States; there is danger that comparisons will be facile. But drawing parallels is tempting, and it might well be instructive in our own working out of the political nature of science and its pedagogy." So, proceeding with caution, I explore the possibility of a historically situated *transnational extended synthesis* within education and evolutionary biology that engages a "transknowledge" approach through *EcoEvoEdu*, allowing for the exploration of various gaps—knowledge and achievement gaps—which have been carefully constructed, maintained, and reified by existing onto-epistemological and socio-political systems.[8] Such a reconceptualization encourages critical examination of the impact of globalization, nationalism, and capitalism on science education and works to imagine how science education can be reformed, reimagined, and reconfigured to contribute to the radical actualization of a just, equitable, and sustainable world.

Education and Sociobiology

In 1901 Francis Galton, Charles Darwin's cousin, presented the Huxley Lecture of the Anthropological Institute titled "The Possible Improvement of the Human Breed under the Existing Conditions of Law and Sentiment,"

[8] Drawing on the recent shift in biology toward a more transdisciplinary approach—what has been termed EcoEvoDevo or ecological, evolutionary, and developmental biology—which is part of a larger "Extended Evolutionary Synthesis" (see Pigliucci & Müller, 2010; Jablonka & Lamb, 2020), Haraway (2017, M28) calls for such an extended synthesis to also include the arts in an attempt to draw together "human and nonhuman ecologies, evolution, development, history, affects, performances, technologies, and more." For example, in "The Camile Stories" (2016) Haraway puts forth a transknowledging approach called EcoEvoDevoHistoEthnoTechnoPsycho (Ecological Evolutionary Developmental Historical Ethnographic Technological Psychological). In this chapter I call for a "transnational extended synthesis" which engages the transknowledge approach EcoEvoEdu. Such an approach seeks to expand educational inquiry beyond national borders to encourage a more critical examination of the impact of globalization, nationalism, and capitalism on how science and education—including science education, education science, education research, etc.—is utilized to address (or reify) issues including gender and racial justice, human rights, the concerns of indigenous peoples, and poverty and social exclusion, drawing on current biological research at the intersection of ecology, evolution, and education (or behavioral and symbolic inheritance systems). My efforts in this chapter are specific to this inquiry and should not be interpreted as an attempt to solidify a particular field of inquiry, discipline, or general law of any kind. My diffractive narrative inquiry led me to explore the potential intersection between transnational curriculum inquiry and biology, but I encourage others to use my methods to explore other transknowledging approaches, including Haraway's EcoEvoDevoHistoEthnoTechnoPsycho.

which was republished a few months later in *Nature*. The paper built off his previous work on the heritability of reputation (eminence) and mental ability (genius), his research on nature vs. nurture, and his research on binomial distribution (i.e., the bell curve) (see Galton, 1869, 1876, 1889).[9] Known as the father of eugenics, Galton's research was instrumental in legitimizing eugenics, racial science, and establishing the conceptual foundation, methodological apparatus, and statistical tools for the future fields of behavioral, social, and educational psychology (i.e., psychobiology and sociobiology). Galton, along with his protégé Carl Pearson, had a lasting effect on education policy and practice, solidifying what Stephen Jay Gould (1981, p. 21) describes as "the theory of a measurable, genetically fixed, and unitary intelligence"—what became known as the "g" factor for "general intelligence" (Staub, 2018). They were also part of a larger shift in the eugenics movement, described by Ann Gibson Winfield (2007, pp. 59–75) as a move beyond simply "an adherence with science" to a more influential "social and public policy stance" as I.Q. testing "became a primary tool in efforts to limit immigration and create more efficient schools."[10] Indeed, Pearson and his influential associates, including Cyril Burt and Hans Eysenck in the UK, Charles B. Davenport, Robert Mearns Yerkes, Harry Hamilton Laughlin, and Carl Brinham (who created the SAT for the College Board in 1926) in the United States, established educational programs and laboratories at prominent universities, managed national records and archive offices, and held prominent positions on various governmental committees, influencing the establishment of national policies and laws managing immigration and implementing marriage restrictions, compulsory sterilization, and segregation (see Haraway, 1979).[11]

In response to Galton's Huxley Lecture, Wells (1903, p. 37) wrote an article for the *Fortnightly Review* describing Galton's system of classification for superior and inferior human types—based on race, class, and intelligence, evaluated using a normal distribution—subjecting it to considerable ridicule, stating that Galton "saturates the whole business in quantitative colour." Wells argued that traits such as ability, genius, and beauty were too complex to be subject to a "simple and uniform" quantitative evaluation as Galton had

[9] The First International Eugenics Congress held at the University of London in 1912, was held in Galton's honor as the founder of the "Science of Eugenics" (First International, 1912). Most of these methods and conceptual tools have been debunked as pseudoscience, including the nature/nurture debate (see Evelyn Fox Keller, 2010), twin studies (see Jay Joseph, 2017, 2018), and I.Q. testing (see Gould, 1981).

[10] Throughout the paper I will be using I.Q. to refer to the measurement of a person's intelligence quotient (per variations of the Simon–Binet Intelligence test) and IQ to refer to *Inuit Qaujimajatuqangit*.

[11] The direct intellectual influences between these men can be clearly traced: Galton taught Pearson, Pearson taught Burt, Burt taught Eysenck, Jenson was taught by both Eysenck and Burt, Davenport met Pearson in London and regularly contributed to his journal *Biometrika*, Davenport worked with both Yerkes and Laughlin through the Eugenics Records Office, and Bringham collaborated with Yerkes on I.Q. testing during WWI.

proposed. However, the cultural authority of "science" toward the end of the nineteenth and beginning of the twentieth century had grown significantly, as many academic disciplines sought to legitimize their research by turning to more "rigorous" and "objective" positivist methods. For many of the social sciences, including education (see Selleck, 1967), this also meant establishing a grounding in the physical and biological sciences (Cravens, 1985). As Kimberly Hamlin (2014, p. 59) notes, by the turn of the century, if one wanted to engage in debates about social reform, one needed to be armed with "scientific, ideally evolutionary, evidence." The importance of biology (and biological literacy) in the early 1900s can be seen in a review published in *Nature* (1931, p. 478) of Wells' updated three-volume biology textbook *The Science of Life* (1931), written in collaboration with his son G. P. Wells and T. H. Huxley's grandson Julian Huxley, as the anonymous *Nature* reviewer wrote:

> If, as we believe, mankind is at the dawn of a new era—the biological era, when an all-round appeal will be made to the biological sciences, as already to the physical, for guidance in the control of human life—then the big book of Wells, Huxley, and Wells will come to be regarded as an instalment of the relevant 'Law and Prophets.'

A century later, we find ourselves at the dawn of a new biological era—the post-genomic era—also fraught with social, political, and intellectual ferment. The post-genomic era began in the wake of the Human Genome Project (HGP), the first large-scale project aimed at sequencing all of the 3 billion nucleotides that make up the human genome. By the end of the HGP most molecular biologists agreed that much more was going on during transcription and translation of the genome than could be imagined, resulting in a conceptual shift from the genocentrism and reductionism of classical genetics, toward a focus on the complex mechanisms regulating gene expression.[12] The central dogma of molecular genetics (DNA → RNA → protein) was proven to be much more complex through alternative splicing, messenger RNA editing, and post-translational protein modification, through which multiple proteins can be produced from a single gene. Additionally, contemporary research illustrates that complex traits are influenced by multiple genes spread across the genome, referred to as *polygenic inheritance*. For example, ongoing research on human height has shown that there are hundreds of loci associated with height scattered across the genome in coding and noncoding regions that explain only 20% of the heritability of height (see Allen et al., 2010; Marouli et al., 2017). As Evelynn Fox Keller (2015, p. 10) describes, post-genomics has "turned our understanding of the basic role of the genome on its head, transforming it from an executive suite of directional instructions to

[12] Gene expression encompasses the processes by which functional gene products are created, including various protein and RNA products.

an exquisitely sensitive and reactive system that enables cells to regulate gene expression in response to their immediate environment."

The post-genomic era has also ushered in a surge of biotechnological innovation at the intersection of data-intensive informatics and genomic science, what Ben Williamson (2018a) calls "big biodata" with potential implications for education research and policy. It took scientists 13 years and cost a total of $3 billion dollars to sequence the first human genome; now it costs less than $1,000 (Gibbs, 2020). The HGP was the first "Big Science" project with an open access policy—later termed the "Bermuda Principles"—which required genome sequence data to be publicly accessible within 24 hours of its assembly, allowing the network of labs funded by the project (~200 labs) to collaborate. Genome data was also accessible to the public, initiating the development of privately funded labs and institutions headed by a "new breed of investigator, the scientific entrepreneur" (Jackson, 2015, p. 2). These labs worked tirelessly in a "race to the genome" (see Reardon, 2005) that spurred faster paced advances in genomic sequencing technologies and helped to significantly reduce the cost and time required for sequencing. These technologies included databases and biobanks, microarray chips, next-generation high-throughput genome sequencing technologies, and commercial genome kits. For Sarah Richardson (2015, p. 3) these technological and methodological shifts signify the advent of the post-genomic era in which whole-genome technologies have become "a shared platform for biological research across many fields and social arenas." One such platform is Genome Wide Association Studies (GWAS), which have become one of the main methods for making sense of genetic variation over the last decade by measuring the statistical correlations between single nucleotide polymorphisms (SNPs)—variations across the genomes in nucleotide bases—in thousands of genomes of individuals with a particular phenotypic trait (i.e., height, disease, etc.).

Education and Post-genomics

There has been a significant upsurge in the publication of research using GWAS to assess the correlation between race, socio-economic status, I.Q., and educational attainment (see Lee et al., 2018; Selzam et al., 2016; Kovas et al., 2016).[13] Through one of the largest genetic studies conducted to date, researchers generated a "polygenomic score" for educational attainment by comparing genomic data from the consumer genetics company 23andMe to self-reported educational data (EduYears) for one million individuals with

[13] One of the main researchers in the field of behavioral genetics, involved to some degree in all published studies, is Robert Plomin, who has recently published two books on the subject: *G is for Genes: The Impact of Genetics on Education and Achievement* (2014) and *Blueprint: How DNA Makes Us Who We Are* (2018). Plomin was an advocate of Herrnstein and Murray's *The Bell Curve* (1994), helping to initiate a statement of support for their book published in the *Wall Street Journal* and signed by 52 professors across the United States (Gottfredson, 1997).

European ancestry (Lee et al., 2018). Other research has been published on "the genetics of university success" (Smith-Woolley et al., 2018), DNA variants shared between personality traits and educational achievement (Smith-Woolley et al., 2019), and how "genetics affects choice of academic subjects as well as achievement" (Rimfeld et al., 2016). These studies have been touted for their ability to be used to "predict educational achievement for individuals directly from their DNA" (Selzam et al., 2016) and signals the emerging interest of biocapitalists in the development of "personal precision education" (see Williamson, 2018b). However, significant concerns have been raised around data bias, particularly disparities in the underlying ancestral diversity of genomic data, which has been dominated by participants of European ancestry (roughly < 80%) mainly from the United States, UK, and Iceland (see Mills & Rahal, 2019; Popejoy & Fullerton, 2016).[14] Additionally, concerns have been raised around the ambiguity of population categories via the use of "quasi-racial 'continental' terms" leading to fears around the "molecularization of race" (Panofsky & Bliss, 2017, p. 59).

Debates about the genetic (or hereditary) basis of race and I.Q.—which began with Galton's publication *Hereditary Genius* in 1869—have resurfaced time and time again, including the race and I.Q. debates (sparked by the *Brown vs. Board of Education* court case) in the 1960s and 1970s that pivoted around Hans Eysenck, Arthur Jensen, and Edward O. Wilson (founder of the field of sociobiology), provoking anti-racism protests and demonstrations at a number of universities including the University of Birmingham, the University of Sydney, the University of Melbourne, Harvard, and the University of California, Berkley; the publication of *The Bell Curve* in 1994 by Richard Herrnstein and Charles Murray; and the 2007 remarks made by James Watson (co-discoverer of the double helix structure with Francis Crick) stating that "people of African descent are not as intelligent as people of European descent" (Dean, 2007), igniting a critical uproar that prompted his resignation as chancellor of the Cold Spring Harbor Laboratory. Researchers such as Sarah Richardson (2011, p. 420) express concern that education research in the post-genomic age will "initiate a new era of scientific claims about the genetics of racial differences in I.Q." In a book review for *Nature* on behavioral geneticist Robert Plomin's book, *Blueprint: How DNA Makes Us Who We Are* (2018), Nathaniel Comfort (2018, para 1) begins:

> It's never a good time for another bout of genetic determinism, but it's hard to imagine a worse one than this. Social inequality gapes, exacerbated by climate change, driving hostility towards immigrants and flares of militant racism. At

[14] For example, studies on educational achievement at the college level exclude African Americans for several reasons; most important for this study is that African genomes have less linkage disequilibrium (LD) between alleles at different SNPs, and thus require a higher coverage platform in order to capture the variation across the African genome. Due to this, researchers found a "much lower predictive power in a sample of African-American individuals" (Lee et al., 2018, p. 116).

> such a juncture, yet another expression of the discredited, simplistic idea that genes alone control human nature seems particularly insidious.

Indeed, Plomin (2018, p. 80) draws on Galton's research calling him the "nineteenth-century founder of behavioral genetics," arguing that environmental effects (including education) are "unsystematic, idiosyncratic, serendipitous events without lasting effects." Plomin falls unapologetically on the genetic side of the nature/nurture debate, what Comfort calls "vintage" genetic determinism, a stance that has historically adversely affected youth of color through the systematic exclusion of BIPOC students from adequate and equitable education through laws, policies, and social attitudes that result in resource disparities.

As educational theorists and practitioners, we know that intelligence, attainment, cognition, and learning are complex processes influenced simultaneously by socio-cultural, politico-economic, and biological factors. However, within this complex post-genomic landscape—in which genetic data is a shared central platform for researching human social, cultural, and biological difference within the wakes and waves of renewed biological determinisms—science education is essential to translating and mediating public health and educational applications of genomic research. Currently, there is a significant lag—as Wells warned against so long ago—in integrating genomic education with the foundational genetic principles taught in secondary and higher education classrooms (Reiss & Harms, 2019; Whitley et al., 2020; Zudaire & Napal Fraile, 2020). This leads students to a poor understanding of genomics based on reductive, deterministic, and gene-centered misconceptions; additionally, social media, movies, and television generally reinforce these outdated understandings of genomics (Stern & Kampourakis, 2017). Topics including the history and philosophy of science, bioethics, and feminist science studies are given little, if any, attention in the contemporary science classroom (Jones et al., 2010). Research has shown that teaching the history and philosophy of science helps students learn about genetics; better understand the nature of science; connect genetics to social, cultural, ethical, and political concerns; and enhance reasoning and critical thinking skills (Gericke & Smith, 2014).

Recently, the rapid growth of the #BlackLivesMatter movement in the United States in response to the unjust killings of Breonna Taylor, Rayshard Brooks, George Floyd, and countless others, has instigated radical calls for social reform including from Representative Dr. Eddie Bernice Johnson (2020, para. 3), who officially requested that the National Academies of Science, Engineering, and Medicine assemble a research committee to conduct a "rigorous and thoughtful analysis of the extent to which the U.S. scientific enterprise perpetuates systemic inequalities to the detriment of society as [a] whole, as well as how those inequities are manifest." As a fundamental component of the scientific enterprise, STEM education is implicated in this call for reform, particularly the complex relations between how scientific research

informs education policy and practice, and how STEM education perpetuates and privileges the production of particular types of scientific knowledge, both of which help manifest the ethnic, racial, gender, disability, and income "achievement gaps" we are so fervently (and ineffectually) trying to close. As we face a future of accelerating global social, cultural, economic, political, and environmental crises fueled by complex histories of extractive capitalism and inequitable distributions of wealth, knowledge, power, and privilege, the question we urgently need to ask is: What role can, and should, science education play in creating a just, equitable, and sustainable future?

Reconceptualizing I.Q.

While studying at the Normal School of Science, Wells became involved in the British socialist revival of the 1880s, presenting and publishing his emerging ideas in school debates and as editor of the *Science Schools Journal* (Partington, 2016). He advanced his own particular brand of democratic socialism—captured in this futurological works *Anticipations* (1902), *Mankind in the Making* (1903), and *A Modern Utopia* (1905)—greatly influenced by late Victorian socialists including William Morris, George Bernard Shaw, and Graham Wallace, as well as the "ethical evolution" propounded by his former professor T. H. Huxley (1895) in his influential lecture "Evolution and Ethics." In 1903 Wells became an active member of the Fabian Society—a collective of socialist intellectuals established in 1884 who advocated for gradualist and reformist democratic policies—until Wells broke ties with the group in 1908 due to conflicts with fellow Fabians George Bernard Shaw and Annie Besant. Following William Morris, many socialists—also referred to as Socialist Darwinists—were drawn to Lamarck's theory of the inheritance of acquired characteristics, rejecting the Malthusian naturalization of competition and social inequality, and taking up Lamarckian presumptions about social change instead (Hale, 2010). As Piers Hale (2010, p. 60) describes: "In an era in which evolution touched all aspects of politics, and in which Lamarckism remained credible, it is unsurprising that socialists speculated upon how humanity might quickly adapt to a changed environment and to new ways of living, and upon how the inheritance of these adaptations might affect human evolution." However, the publication of August Weismann's germplasm theory in 1892, invalidating Lamarck, proved a fatal blow for many socialist reformers (Amigoni & Wallace, 1995). By 1908, Wells could no longer tolerate anti-Malthusian neo-Lamarckian socialists, claiming that their theories were unscientific and their practice ineffectual.[15] Although Wells' adopted more of a neo-Darwinian bent after reviewing Weismann's research on heredity, he believed (following T. H. Huxley) that culture had a greater impact on social evolution than biology, and that "*cultural* characters might

[15] For a more detailed description of Wells' critiques of the Fabian Society see John Partington (2016).

still be transmitted and compounded across the generations" (Hale, 2010, p. 39, emphasis in original). Believing that biological evolution would take generations to affect change, Wells' turned wholeheartedly to education as a means to influence social evolution through learned social and behavioral traits.

New research emerging at the cutting edge of post-genomic science has led to expanded views of inheritance, epitomized by Eva Jablonka and Marion Lamb's (2014, 2020) provocation to think through evolution in four dimensions—genetic, epigenetic, behavioral (i.e., social learning), and symbolic (i.e., cultural)—putting forth a developmental and ecological view of the origin of heritable variations and an expanded notion of transmission and selection. Such research has inspired biologists to call for an *Extended Evolutionary Synthesis* based on the concept of "inclusive inheritance" or non-genetic forms of inheritance such as epigenetic inheritance, inherited symbionts (i.e., microbiota), cultural inheritance, and ecological inheritance (or niche inheritance) blurring the boundaries between natural and cultural mechanisms of evolution (see Pigliucci & Müller, 2010; Jablonka & Lamb, 2020). The underlying molecular basis of non-genetic inheritance is called *epigenetics*—from the Greek *ἐπί* meaning "upon" or "on top of" genetic factors—which are essentially non-DNA elements that affect gene function, plasticity, and expression. The new field of epigenetics comprises the study of heritable phenotype changes not caused by changes to the underlying DNA sequence. Although there are several processes associated with epigenetics, the most common process drawn upon in social science fields is DNA methylation: the attachment of a methyl group ($-CH_3$) to one of the four nucleotides, Cytosine, creating 5-methycytosine. This results in deactivation of the gene by blocking the transcription process, therefore altering gene function and expression. What is most important about this research for the social sciences, and specifically education, is that methylation can be affected by social, cultural, and environmental factors—nutrition, stress, lifestyle, exposure to toxins, etc.—and these changes are heritable.

Following other STS post-genomic scholars who have contributed to a fundamental reconceptualization of the science of genomics, critically analyzing the social implications of genomic research by drawing on feminist, queer, critical race and decolonial theories, this paper takes up the task of reconceptualizing intelligence and I.Q. testing, tracing the history of culturally biased and racist mental testing practices, the results of which have been misused to further the colonial agendas of cultural genocide through assimilation—what Jasbir Puar (2017) calls "weaponizing epigenetics." Such a reconceptualization, I argue, also requires an engagement with the discourses and cultural resources of popular media and non-Western knowings, which tend to be ignored or devalued in mainstream science and philosophy. For example, the Inuit lifelong learning philosophy known as *Inuit Qaujimajatuqangit* (IQ)—from the verb *qaujima* "to know" used to describe Inuit epistemology—can be viewed as a powerful case study of social, cultural, and

political resistance to historic eugenic policies including the use of I.Q. testing in compulsory sterilization practices and epigenetic violence inflicted through residential schooling.[16] IQ was formally adopted by the Government of Nunavut in 1999, and work to reform the Nunavut education system to incorporate IQ began in 2000 (Igloliorte, 2017). IQ as a philosophy is a complex indigenous cosmology that encompasses Inuit beliefs, values, worldview, social organization, life skills, language, and environmental knowledge (Canadian Council on Learning, 2007). IQ is based on the integration of three types of laws—natural laws (*maligarjuat*), cultural laws (*piqujat*), and communal laws (*tirigusuusiit*)—and guided by thirty-eight values, including cooperation, conservation, adaptability, consensus, endurance, generosity, respect, interconnectedness, and equality (to name a few). As a form of political resistance, IQ works to subvert the logics of Western science, the modern developmental state, and its colonial legacy, which continually attempts to reduce IQ to "traditional ecological knowledge" useful for informing scientific knowledge, instead of viewing IQ as an integrated holistic knowledge system (Tester & Irniq, 2008). As a holistic onto-epistemological system, IQ is a radical worlding practice that not only attempts to subvert Western logics and reductive epistemological practices, but advocates for—and *actualizes*—a collective vision for a more just, equitable, and sustainable world.

"We Know Better Now"

In 1939 Wells was invited to present at the Australian and New Zealand Association for the Advancement of Science (ANZAAS) conference to speak to the Education Section to discuss the role of science in world affairs, during which he stated:

> What spendthrift ancestors we have had! What wastrels we still are! And all because history teaches us no better. Man burns and cuts down forests, he destroys soil, he acclimatizes destructive animals. A map of the world showing the devastated regions, where devastation is due to mankind, would amaze most people. It ought to be put in every child's atlas. (Walkom, 1939)

Well's visionary insight, political philosophy, and advocacy for human rights and education make him an interesting figuration to think through in relation to contemporary discourses around the Anthropocene. As Liam Gearon (2018, p. 765) notes: "His early science fiction was—with its social and political commentary—invariably related to the future of the planet and humanity. With a characteristically pessimistic view he shared with many of

[16] The epigenetic and intergenerational violence—cultural genocide—inflicted on Indigenous children (First Nations, Métis, and Inuit) included separation of children from their communities, not allowing children to speak their first languages or practice cultural traditions, malnutrition, poor sanitation, lack of medical treatment, medical experimentation, and physical, sexual, and psychological abuse.

his 19th-century peers, Wells' vision has arguably even more resonance with environmental and related concerns today." Indeed, Wells' writing and ideas exemplify the rapidly growing discourse of the Anthropocene—albeit written a century earlier—by setting the human species (and human history) within cosmic, geological, and evolutionary scales; blurring the boundaries between science fiction and science fact; and exploring the speculative implications of the entanglements between human exceptionalism and techno-scientific capitalism. Along with *Men Like Gods*, Wells' influential and highly popular publication *The Outline of History* (1920)—which sold over two million copies, was translated into several languages, and had a significant impact on the teaching of history—was a pioneering work aimed at constructing a universal story of the "Anthropos" set within the history of the planet from its formation. Although the publication has been subject to critiques about its Euro-centric universalizing tendencies (Wrong, 1921)—as has similarly (and rightly) been launched against the concept of the Anthropocene (see Haraway et al., 2016; Malm, 2015; Todd, 2015)—it was an attempt to establish a transnational history that provided a foundation for people to discuss issues of human rights and social justice that arise from national, ethnic, religious, and colonial conflicts. For Wells *The Outline of History* (1920) was a history of *worlds at war* that echoes to the present as a series of onto-epistemological, nationalistic, politico-military conflicts set within the still unfolding Anthropocene. On the centenary anniversary of its publication, Wells' (1938, p. 41) words are more prophetic and poignant than ever, as he states: "We know better now. Now the consequences of this change of scale force themselves upon our attention everywhere."

We know, as Bruno Latour (2017) states, that the Anthropocene is an era in which nature and culture can no longer be studied independently, where science and capitalism touch everything, and (as a result) science education can no longer avoid engaging with the critical discourses of the social sciences, arts, and humanities. As Wells stated in a conversation with Stalin in 1934: "There can be no revolution without a radical change in the educational system" (Stalin, 1978, p. 40). The dominant science education and communication paradigm fails to adequately address the complex world-historical workings of power and privilege within (and outside of) the scientific enterprise. As Haraway (1975, p. 442) notes: "Science education for responsible political behavior naturally does not encourage a radical activist approach to environmental, population, or armament issues." For example, although the concept of the Anthropocene has spurred critical debate and received various conceptual challenges from the arts, humanities, and social sciences, in the main, the fields of science, technology, and engineering have remained uncritical, focusing efforts on so-called innovative technofixes: techno-scientific and engineering-based approaches to Anthropocenic survival. Haraway (2017) argues that the Extended Evolutionary Synthesis requires the entanglement of the arts and sciences through human and nonhuman ecologies, histories, technologies, and affects. In the last half century contemporary research has

written a fascinating multispecies symbiotic history of the bumptious succession of life on earth, one that fosters new collective imaginaries around what might yet still be possible. I argue that science education needs a transnational and transknowledge extended synthesis (or *EcoEvoEdu*), one that encourages critical examination of the impact of globalization, nationalism, and capitalism on science education and works to imagine how science education can be reformed, reimagined, and reconfigured to contribute to the radical actualization of a just, equitable, and sustainable world. Wells' knew—as can be seen in his increasingly prophetic voice around the future uses and abuses of science and technology, and the importance of education for the future of mankind—that the Anthropocene era is an era of worlds at war with nothing less than the future of the planet at stake.

By the end of his career—having lived through two world wars and witnessed the dropping of atomic bombs on Hiroshima and Nagasaki—Wells grew less optimistic about the future and science's role in it. In *Mind at the End of Its Tether* (1945, p. 18), Wells' last published book, he put forth a bleak vision of the future, explaining that: "A series of events has forced upon the intelligent observer the realization that the human story has already come to an end and that *Homo sapiens*, as he has been pleased to call himself, is in his present form played out." Wells (1945, p. 1) expands on these logics:

> If his thinking has been sound, then this world is at the end of its tether. The end of everything we call life is close at hand and cannot be evaded. … [W]e are confronted with strange convincing realities so overwhelming that, were he indeed one of those logical consistent creatures we incline to claim we are, he would think day and night in a passion of concentration, dismay and mental struggle upon the ultimate disaster that confronts our species.

Upon reviewing *Mind at the End of Its Tether*, many critics claimed that, at 78 years old, it was Wells' mind that had become untethered from reality, as they were unable to comprehend the narrative of global catastrophe via human techno-scientific and politico-capitalist progress—*we know better now*. Wells was able to see that our (Western Euro-centric) mental agencies (i.e., science) had become *untethered* from cosmic processes, and there was no going back. Following many queer, feminist, posthuman, and decolonial scholars who view the Anthropocene as signaling the end of a particular Western Euro-centric colonial and capitalistic world, I believe the task at hand requires the radical actualization of another world. So, as we stand on the precipice of worlds at war, the question of what science education will become is still yet to be determined.

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