

You can't keep a bad idea down: Dark history, death, and potential rebirth of eugenics

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Abstract

“Be careful what you wish for”: This adage guides both how this project came to life, and how the topic covered in this review continues to unfold. What began as talks between two friends on shared interests in military history led to a 4-year discussion about how our science curriculum does little to introduce our students to societal and ethical impacts of the science they are taught. What emerged was a curricular idea centered on how “good intentions” of some were developed and twisted by others to result in disastrous consequences of state-sanctioned eugenics. In this article, we take the reader (as we did our students) through the long and soiled history of eugenic thought, from its genesis to the present. Though our focus is on European and American eugenics, we will show how the interfaces and interactions between science and society have evolved over time but have remained ever constant. Four critical ‘case studies’ will also be employed here for deep, thoughtful exploration on a particular eugenic issue. The goal of the review, as it is with our course, is not to paint humanity with a single evil brush. Instead, our ambition is to introduce our students/readers to the potential for harm through the misapplication and misappropriation of science and scientific technology, and to provide them with the tools to ask the appropriate questions of their scientists, physicians, and politicians.

KEY WORDS

CRISPR, eugenics, medical genetics, prejudice, racism

1 | INTRODUCTION

Let us begin with two quotes:

“The demand that it should be made impossible for defective people to continue to propagate defective offspring is a demand that is based on most reasonable grounds, and its proper fulfillment is the most humane task that mankind has to face. Unhappy and undeserved suffering in millions of cases will be spared, with the result that there will be a

gradual improvement in national health.” – A.H. (written in 1924)

“The unnatural and increasingly rapid growth of the Feeble-Minded and Insane classes, coupled as it is with a steady restriction among all the thrifty, energetic and superior stocks, constitutes a national and race danger which it is impossible to exaggerate...I feel that the source from which the stream of madness is fed should be cut off and sealed up before another year has passed.” – W.C. (written in 1910)

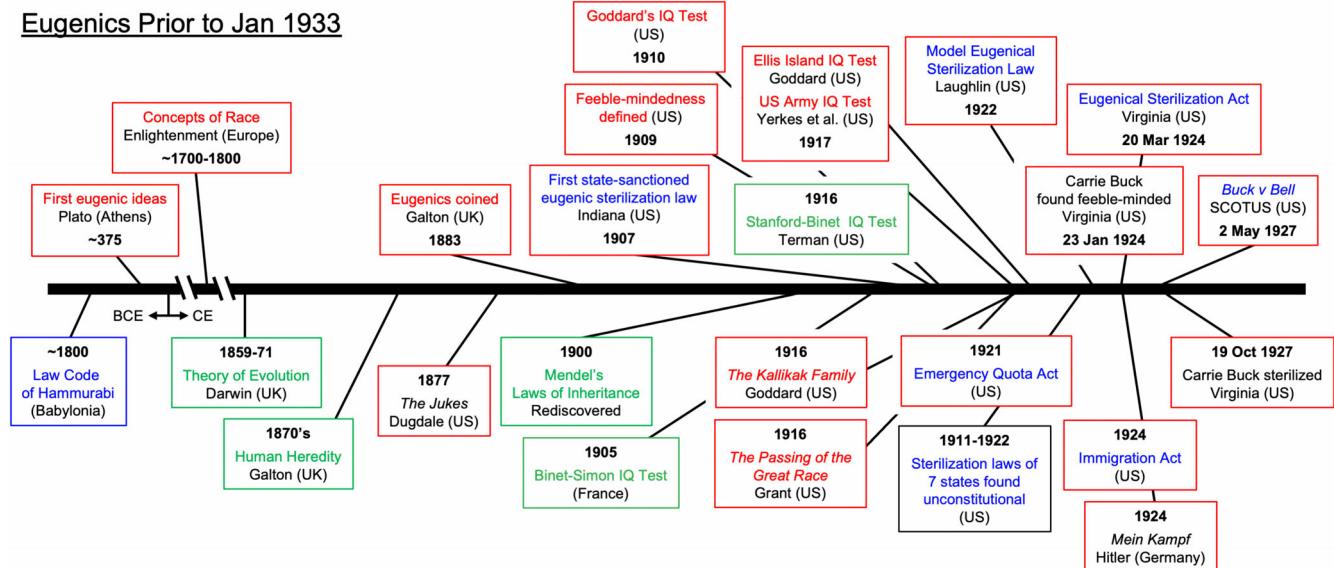


FIGURE 1 Timeline of eugenics prior to the arrival of the Nazi state in January 1933. Each of the depicted items is discussed in the text as an important event, writing, piece of science, or action that contributed to the “classic eugenics” timeline prior to the rise of the Nazi state. Blue text refers to laws or legal events/issues; Red text refers to overtly or specifically eugenic writings, events, or science issues/actions; Red boxes surround both overtly eugenic items, as well as those laws, writings, events, or actions that had eugenic impact that were not necessarily eugenic by intent; Green text and boxes refer to scientific events that influenced eugenic thought

The first quote is from Adolf Hitler (Figure 1; Hitler, 1939), and the second from Winston Churchill (Churchill, 1910). Though it seems almost trite to quote Hitler in an article about eugenics, it is a jarring juxtaposition to read the eugenic screed written from then British Home Secretary Churchill to Prime Minister H.H. Asquith. Hitler’s words in *Mein Kampf*, setting aside our historical knowledge of the genocidal outcomes of his embrace of eugenics, seem almost tame and reasoned in comparison to Churchill’s sanist, ableist, racist, and nationalist rhetoric.

How could Winston Churchill, a man generally held in high esteem for his leadership and defense of freedom and liberty in the face of genocidal fascism, hold beliefs fundamentally not all that different from Adolf Hitler? How did societal anxieties, fears, and ‘-isms’ (hereafter when we use -ism(s), we are referring to the broad assemblage of belief-based biases and prejudices that impact human interactions and society) feed eugenic ideas of the late 19th/early 20th century (all time period references are CE unless otherwise noted)? How did notions of ‘race’ that had hardened since the Enlightenment influence eugenic thought? What role did science and the scientific community play in eugenic beliefs and policies; those both democratic and totalitarian in tenor and application? And if we contextualize into the present: Has the 21st century embrace of assisted reproductive technology (ART), pre-implantation genetic diagnosis (PGD), prenatal genetic testing, and gene editing technologies (i.e., TALENs, ZFNs, and CRISPR) fed a resurgence of

eugenic thought? Can we use science to create a better humanity? If so, how? More importantly, should we?

We recently began teaching a course at the University of Missouri-Columbia called “Genetic Engineering: Miracle for Humanity or New Pathway to Eugenics?” as an opportunity for undergraduate students (both STEM and non-STEM) to engage with and reflect upon questions like these. In this article, we will give an overview of the ‘classic eugenic’ to ‘newgenic’ (Lyster, 2013; Wilson, 2018a, 2018b) continuum covered in our class; focusing on European and American eugenics. We examine how science was used to provide legitimacy and ‘respectability’ to various cultural and societal prejudices that drove eugenic ideas. We will also discuss how students were prompted to engage with these topics sitting at the interface between science and society that can challenge ethical and cultural mores.

2 | EUGENICS: GENESIS AND ORIGINS

2.1 | Anatomy of a term

The term ‘eugenics’ was first used by an Englishman, Francis Galton, in 1883 (Figure 1), taking it from the Greek word εὐγενής (*eugenēs*), meaning ‘noble’ or ‘well-born’ (Galton, 1883; Garver & Garver, 1991; Kerr & Shakespeare, 2002). Galton defined eugenics as

“...the science of improving stock, which is by no means confined to questions of judicious mating, but which, especially in the case of man, takes cognisance of all influences that tend in however remote a way to give more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had” (Galton, 1883).

If the reader finds this definition neither satisfying nor particularly clear, not to worry, Galton apparently did not either as it went through several revisions even in his hands. Two decades later Galton defined eugenics as

“the science which deals with all influences that improve the inborn qualities of a race; also with those that develop them to the utmost advantage” (Galton, 1904).

And finally in his memoires he pronounced eugenics

“the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally” (Galton, 1908).

While various socio-cultural factors influenced the definitions offered by Galton, and others, over time, and should not be discounted, we like Gillham's (2001) simple definition of late 19th/early 20th century eugenics (aka, 'classic eugenics') as "*the improvement of humanity through selective breeding.*" This definition is in fact only a slightly reworked version of one offered in 1911 by Charles Davenport, an American eugenicist and Carnegie Institution of Washington/Cold Spring Harbor Laboratory scientist (Davenport, 1911). As we will later see, even this clear and concise definition is probably not sufficient to define 'newgenics' of the 21st century (Agar, 1998; Brown, 2019; Efron & Lifshitz-Aviram, 2020; Epstein, 2003; Fox, 2007; Kerr & Shakespeare, 2002; Wilson, 2017, 2018a, 2018b; Winfield, 2012). Before turning to our discussion of 'classic eugenics,' let us examine the concept of race, its anatomical underpinnings, and its biological reification, as these are impossible to separate from the rise of 'classic eugenics' thought.

2.2 | The biologization of race

An accounting of eugenics, even a brief one as attempted here, would not be complete without briefly discussing the origins of the concepts of race. In this section, we will

attempt to give only an overview of this concept as a detailed analysis is well beyond the scope of this manuscript.

Throughout recorded history, humans have been driven by curiosity to learn more about our own anatomy. The oldest known description of trauma, referred to as the Edwin Smith papyrus, dates from the 16th century BCE (van Middendorp et al., 2010). The original translator, James Henry Breasted, speculated that the Egyptian physician Imhotep, of the 26th century BCE, may have been the original author (van Middendorp et al., 2010). Despite the questions surrounding its origin, the Edwin Smith papyrus contains the oldest reference to the human brain (Kandel et al., 2012). Moreover, the Edwin Smith papyrus categorizes the described injuries as treatable versus untreatable one of the earliest examples of military-like triage (van Middendorp et al., 2010). The renaissance genius of Leonardo da Vinci was also drawn to investigation of human anatomy. Leonardo began his detailed analysis of human anatomy prior to 1,489 resulting in some of the earliest details of human anatomy (Voller, 1956).

However, the quest for knowledge about the human body was not always considered a noble pursuit and has been utilized for less than noble purposes. In the 19th century, it was not considered illegal to possess and sell a human body and anatomists were always in need of bodies for dissection. This combination might have contributed to what has become known as the West Port Murders where William Hare and William Burke murdered 16 people to sell to the anatomist Robert Knox (Kean, 2021). The attempts to utilize anatomy as justification for racial classification were a less than noble utilization of anatomical knowledge. With the attempts to utilize biology to justify categorizing people, perhaps it is not all too surprising that anatomy became the scientific foundation for these attempts. We introduce the development of the fields of craniology and phrenology as modern attempts to biologize racial classifications.

The notion of categorizing humans into groups is hardly new, and by all accounts, racial categorizing was not central to Europeans until the Enlightenment (Figure 1; R. Robertson, 2021; Roth, 1992). In dynastic China, the classics of Confucianism formed the foundation for the categorization of people (Dikötter, 1992). Confucianism depicted classification more along cultural lines where barbarians were defined as those that do not follow 'Chinese ways' (Dikötter, 1992). However, this depiction was not consistent with other ancient texts such as the ZuoZhuan in which the following was often quoted:

“If he is not of our race, he is sure to have a different mind.” [“fei wo zulei, qi xin bi yi.”]

translation and original from Frank Dikötter (1992)

Furthermore, a notion that will develop in 18th century Europe, environmental determinism—or the notion that physical environment predisposes peoples and societies to particular developmental trajectories, might have been seen as early as the Tang dynasty (618–907 CE) of China (Dikötter, 1992). In fact, consistent with this notion, scholars have suggested that enslaved Africans were imported into China as early as the Tang dynasty (Xinglang, 1928).

Within western culture, some of the earliest examples of race classifications came from Christian interactions with Jews and Muslims (Hochman, 2019). In the 13th century, Canon 68 of the Fourth Lateran Council of 1215 set forth laws that segregated Jews and Muslims from Christians based on difference in dress ultimately ending in forced expulsion of Jews from England (Heng, 2018). However, Hochman argued that this was not an example of the racialization (the process through which racialized groups are formed) of Jews, as it was believed differences between Jews and Christians could be remedied by conversion of Jews to Christianity (Hochman, 2019). Thus, it would appear that the concept of race was linked to traits that could not be changed or were inherited. With this in mind, the first instance of racial classification came from 15th century Spain (Roth, 1992). During this period, resentment in 'old Christians' began to grow toward 'new Christians,' which consisted of converted Jews. The doctrine of "*limpieza de sangre*" (purity of blood) formed the first medieval example of true anti-Semitism (Roth, 1992). Under this doctrine:

"Jews and Jewish converts to Christianity constituted a race, as Jewish blood irreconcilably corrupted its possessor down to the fourth generation, despite intermarriage with old Christians" (Roth, 1992).

Thus, for the first time, biology was used as justification for opposition and classification of a group of people.

The notion of race became more prevalent with attempts to justify these classifications through science. The term race appeared in the writings of François Bernier in *New Divisions of Earth* in 1684 (see Stuurman, 2000), Carl Von Linnaeus in *Systematic Naturae* in 1735 (see Johoda, 2009), and Pierre Louis Moreau de Maupertuis in *Vénus Physique* in 1745 (see Douglas, 2005). However, their use was not similar to the modern notion of the term race or was used ambiguously (Douglas, 2005). For example, Bernier employed physiognomy to group men into four 'stocks' (Fortney, 1977).

George Louis Leclerc, Comte de Buffon was credited by some as introducing the term 'race' into the language of natural science (Fortney, 1977), though others contend Buffon's use of race was far from systematic or similar to modern usage (Douglas, 2005). Johann Friedrich Blumenbach gathered in one work all the theories and methods of systematization of mankind into races or varieties (Fortney, 1977). In *De Generis Humani Varietate Natura* (original, 1795), Blumenbach associated skull measurements with the five races of mankind thus launching the field of craniology (Blumenbach, 1865). Additionally, the first published data on the systematic comparison of skulls from different races was performed by Petrus Camper in 1794 (Branson, 2017). However, the work of William Frederic Edwards in 1829 was the first to contend that skull rather than skin color was the essential criteria for race (see Johoda, 2009). In 1842, Swedish scientist Anders Retzius introduced terms that would become associated with the scientific classification of skulls with race: dolichocephalic, brachycephalic, and the cephalic index (see Johoda, 2009).

While craniology paved the way for a systematic analysis of the skulls of different races, it was not widely read. The first publication on the volumetric analysis of skulls by Samuel Morton was priced at today's equivalent of \$500 (Branson, 2017). The field championed by Johann Gaspar Spurzheim, phrenology, was much more available through "...widely disseminated publications, itinerant practitioners and visual exhibitions" (Branson, 2017).

Spurzheim was a student and collaborator of Franz Joseph Gall, who is erroneously credited as having founded the field of phrenology. Gall attempted to use scientific exploration of skulls to provide insights into behavior and termed his analysis organology (Zola-Morgan, 1995). A growing disagreement between Gall and Spurzheim resulted in the breakup of the collaboration. Left on his own, Spurzheim modified many of Gall's original ideas into the field of phrenology (Zola-Morgan, 1995). However, common to both organology and phrenology was the localization of functions to different 'cortical organs' (Zola-Morgan, 1995).

"Gall based his theory on the idea that the brain is the organ of the mind, an organ composed of twenty-seven innate faculties. The power of a specific faculty depended on its size. Gall drew on earlier studies that suggested that the skull takes an outward shape from the shape and size of the brain" (Branson, 2017).

Spurzheim considered phrenology as a tool for predicting human behavior and was more concerned with

popularizing phrenology and with utilizing phrenology as the basis for social reform (Zola-Morgan, 1995). As part of this notion, phrenologists such as George Combe and Orson Fowler promoted the idea that 'cortical organs' could change size based upon use (Hamilton, 2008).

The ability to change one's 'cortical organs,' and thus one's behavior, based upon use painted a utopian picture of phrenology as a science of social change. Unfortunately, what was not considered in this picture was the Eurocentric notion of perfection (Hamilton, 2008). The shape of the skull, as seen in Petrus Camper's doctrine of facial angle, to the placement of cortical organs, by phrenologists, were all based upon a Eurocentric doctrine where Caucasians were considered ideal and deviation from ideal were markers of inferiority (Branson, 2017; Hamilton, 2008). This Eurocentric bias was clearly demonstrated in the phrenological analysis of African men, women, and children on the slave ship *Amistad* (Branson, 2017). Both George Combe and Lorenzo Fowler, Orson Fowler's brother, performed an analysis on the jailed Africans. It was particularly telling that the descriptions of the presumed leader of the Africans, Cinque, differed significantly from the other men. Combe's description stated:

"...Their heads present great varieties of form as well as of size. Several have small heads, even for Africans; some short and broad heads, with high foreheads but with very little longitudinal extent in the anterior lobe. Their leader Cinquez, or Jinquez, who killed the captain of the schooner, is a well-made man of 24 or 25 years of age. His head is long from the front to the back, and rises high above the ear, particularly in the regions of Self-Esteem, and Firmness...This size and form of brain indicate considerable mental power, decision, self-reliance, prompt perception, and readiness of action..." (George Combe, from Branson, 2017).

Combe's description was clearly meant to imply the superior nature of Cinque was due to his phrenological features being similar to those typically measured in Caucasians.

This is by no means an exhaustive detailing of the complex subject of race, but it should provide context for the biologization of race that was a common feature of late 19th century English progressive thought, just as Galton and others were proposing their eugenic ideas (see below).

3 | CLASSIC EUGENICS: LATE 19TH/EARLY 20TH CENTURY

3.1 | Beginnings

Who was Francis Galton and why did he birth the original eugenics movement? A polymath and highly accomplished statistician, Galton made many positive and significant contributions to science in his lifetime (Bulmer, 2003). In the late 1800's, motivated by his half-cousin Charles Darwin's emerging theories on evolution (Figure 1; C. Darwin, 1859, 1871), Galton began applying statistical methods to pedigrees to examine the basis of human heredity (Figure 1; Galton, 1872, 1875, 1877). His work, together with the rediscoveries of Mendel's laws of inheritance (Figure 1; Bateson, 1900), soon convinced Galton (and others as it turned out) that the best (and worst) of the human condition was inherited; one could be 'well-born' or 'pauperized' by genetics (Allen, 1986; Galton, 1883, 1901, 1904, 1908). It was then but a short leap to envision an improvement of humanity through selective breeding of the 'fittest' members of society ('positive eugenics'), while simultaneously restricting reproduction of the 'unfit' (Allen, 1986; Garver & Garver, 1991).

The timing of Galton's ideas could not have been better timed to shifts in society, especially in Western Europe and the United States. The world was just entering the Progressive Era and social energies were focused on addressing various problems arising from industrialization, urbanization, immigration, and political corruption (A. C. Kennedy, 2008; Leonard, 2005, 2016; Nichols & Unger, 2017; Okrent, 2019; D. B. Robertson, 2015). At the same time, there was growing belief and anxiety that while birth rates were declining within the middle and upper classes (i.e., the 'well-born'), the 'unfit' lower classes were reproducing without restraint (Kerr & Shakespeare, 2002; Kevles, 1985; Paul, 1995). Eugenics provided not only a scientific explanation for many of these issues plaguing society, but also potential solutions (Appleman, 2018; A. Cohen, 2016; Kerr & Shakespeare, 2002; Kevles, 1999; Leonard, 2005, 2016; Winfield, 2010, 2012). Galton nicely expressed the progressive faith that eugenics could not only save society but improve upon humanity:

"Its [eugenics] first object is to check the birth-rate of the Unfit, instead of allowing them to come into being, though doomed in large numbers to perish prematurely. The second object is the improvement of the race by furthering the productivity of the Fit by early

marriages and healthful rearing of their children. Natural Selection rests upon excessive production and wholesale destruction; Eugenics on bringing no more individuals into the world than can be properly cared for, and those only of the best stock” (Galton, 1908).

Though Galton is generally referred to as the 'father' of the 'classic eugenics' movement (Garver & Garver, 1991; Gillham, 2001; Kevles, 1985; Paul, 1995), ideas about human heredity and breeding were already floating around pre/early Victorian England before his work on heredity (Waller, 2001). Yet it was in ~375 BCE when the ancient Greek philosopher Plato envisioned the likely first utopian society developed along eugenic principles in *The Republic* (Figure 1; see Galton, 1998, 2005). After discussing breeding “birds...horses and other animals” for “the best of them,” Plato turns to Athenian citizenry:

“We must, if we are to be consistent, and if we're to have a real pedigree herd, mate the best of our men with the best of our women as often as possible, and the inferior men with the inferior women as seldom as possible, and bring up only the offspring of the best” (Plato, 1974).

This was not meant to occur by a random or self-directed process, but a top-down State-selected and sanctioned 'mating festival' (Plato, 1974). Surely this breeding program represented what we now recognize as 'positive' and 'negative' eugenics, long before Galton coined the term. And lest we think selective breeding was the sole component of Plato's eugenic program, pay attention to the last clause of the above quote: "...and bring up only the offspring of the best." In the very next section of *The Republic*, Plato described the State-sanctioned infanticide of inferior and defective children, thus ensuring the propagation of only the superior 'well-born' (Plato, 1974). While Plato's vision was never realized in his time, two millennia later the first tentative steps were taken in Britain and the United States, before finally being employed in its fullest genocidal sense by Nazi Germany in the early/mid portion of the 20th century.

Before we move on to the United States and Nazi Germany, let us return briefly to a question raised by the introductory quotes: How could it be that Winston Churchill held such strong eugenic feelings about others in British society? Quite simply, Churchill was a man of his times and environment (Gilbert, 2011). As we have now seen the first broad eugenic movement began in Great Britain in the late 19th century, within the progressive and privileged white middle/upper-class (Allen, 1986; A. Cohen, 2016; Garver & Garver, 1991; Kerr &

Shakespeare, 2002; Kevles, 1985; Leonard, 2016; Paul, 1995). Given Churchill's position within this very cultural milieu it would have been surprising had he not imbibed and reflected these ideas (Gilbert, 2011). That Churchill's rhetoric was couched in nationalism should also not surprise us as even Galton, who pushed eugenic ideas as a way to improve 'humanity' broadly, had a more provincial primary focus:

“To no nation is a high human breed more necessary than to our own [Britain], for we plant our stock all over the world and lay the foundation of the dispositions and capacities of future millions of the human race” (Galton, 1901).

This kind of nationalist 'racism' is a feature of eugenics we will often see.

3.2 | The ascension of eugenics in the United States

Most early eugenicists, despite the prejudices they brought to their beliefs (see below), held sincere, and even arguably 'noble,' aspirations for their programs of human improvement (see Allen, 1986; Comfort, 2012; Paul, 1995; Wilson, 2018b). This naïve optimism was expressed well by Charles Darwin's son Francis:

“But all would agree on some eugenic principles: That it is better to be healthy and vigorous than sickly and weak well-fitted for their part in life rather than the reverse, in fact good specimens of their kind whatever that kind may be...no one can doubt that the science of eugenics must become a great and beneficent force in the evolution of man” (F. Darwin, 1914).

On this last clause—oh how wrong he was!

'Classic eugenics' may have begun in Britain, but it was studied, taught, and practiced most zealously in the United States and Germany (Allen, 1983, 1986; Garver & Garver, 1991; Kerr & Shakespeare, 2002; Kevles, 1985; Paul, 1995). Arguably, the US was the leader in eugenic science at the peak of the movement in the early 1900s (Allen, 1983; Garver & Garver, 1991; Kevles, 1985; Paul, 1995). And as we will explore, while American eugenic 'solutions' were not taken to the extremes seen in Nazi Germany (see Caplan et al., 1999; Childers, 2017; Connelly, 1999; Friedlander, 1997; Haas, 2008; Hayes, 2017; Holtzman & Rothstein, 1992; Lewy, 1999; Lutz & Lutz, 1995; McMillan, 2014; Rosenhaft, 2011),

they were applied harshly in society through laws that determined who was 'fit' versus 'unfit,' based more on prejudice, various '-isms,' and Progressive Era ideas (social and economic) than sound science (Appleman, 2018; Baynton, 2016; Caplan et al., 1999; Chousou et al., 2019; Garver & Garver, 1991; Holtzman & Rothstein, 1992; Kerr & Shakespeare, 2002; Kevles, 1985; Leonard, 2016; Micklos & Carlson, 2000; Paul, 1995, 2016; Stolerman, 2017; Winfield, 2012).

Human pedigrees, so important in the development of Galton's eugenic ideas (Galton, 1872, 1875, 1877, 1883, 1901, 1904), were also being used around the same time in the United States to identify familial lineages functioning as 'cradles' of the socially 'unfit,' such as criminals, paupers, alcoholics, prostitutes, and various physical and mental defects (Appleman, 2018; Chousou et al., 2019; Garver & Garver, 1991; Kerr & Shakespeare, 2002; Kevles, 1985; Paul, 1995; Stolerman, 2017; Winfield, 2010). The first major pedigree study published in the US to gather eugenic attention was Richard Dugdale's *The Jukes: A Study in Crime, Pauperism, Disease, and Heredity* (1877). Though the Jukes family tree was riddled with social "deviants," Dugdale, a progressive social and prison reformer, concluded that the environment was more responsible for the Jukes 'problems' than heredity (Dugdale, 1877). Yet, for early eugenicists, Dugdale showed a pedigree laden with deviants and defectives, so they were willing to ignore societal influences and declared the Jukes genetically unfit, spurring on new pedigree studies in search of more support for their eugenic ideas about deficient human stock (Figure 1; Doll, 1917; Estabrook, 1916; Estabrook & Davenport, 1912; Goddard, 1916).

The most popularly influential of these subsequent pedigree studies, one that represented a lynchpin of eugenic science for the next quarter of a century, was Henry Goddard's *The Kallikak Family: A Study in the Heredity of Feeble-Mindedness* (Figure 1; Goddard, 1916). As a psychologist and director of the Vineland Training School for Feeble-Minded Girls and Boys in Vineland, New Jersey, Goddard's primary interest was in human intelligence and what became a focal point of American eugenics: 'feeble-mindedness.' As defined in a 1909 Report of the Committee on the Classification of Feeble-minded (Figure 1):

"The term feeble-minded is used generically to include all degrees of mental defect due to arrested or imperfect development as a result of which the person so effected is incapable of competing on equal terms with normal fellows or managing himself or his affairs with normal prudence" (Rogers, 1910).

In short, 'feeble-minded' was a catch-all term of the period for individuals thought to suffer from various purported mental deficiencies, as well as socially deviant behaviors (Kevles, 1985). Goddard's study of the pseudonymous 'Kallikak' family convinced him that 'feeble-mindedness' was a Mendelian trait, "*a condition of mind or brain which is transmitted as regularly and surely as color of hair or eyes*" (Goddard, 1920). Other pedigree studies, such as those by Charles Davenport and colleagues at the Eugenics Records Office in Cold Spring Harbor, came to similar conclusions (Estabrook, 1916; Estabrook & Davenport, 1912). While not everyone was equally convinced (see Allen, 2011; Paul, 2016), the eugenics community at large came to embrace 'feeble-mindedness' as an inherited trait that could be targeted by eugenic policy for elimination (Garver & Garver, 1991; Kevles, 1985; Mazumdar, 2002; Paul, 1995).

Goddard also provided the quantitative 'scientific' means for identifying and classifying the 'feeble-minded.' Prior to the 'Kallikak's' Goddard had been working with the Binet-Simon intelligence test (Figure 1; Binet & Simon, 1904) to assess and classify Vineland patients (see Zenderland, 2001). In 1910, Goddard advanced a new three-part scale on which to grade the 'feeble-minded' from lowest to highest intelligence, as follows: 'idiots' with their mental development not exceeding a normal child of 2 years of age by the Binet-Simon test; 'imbeciles' with a mental age of 3–7; and 'morons' with a mental age of 8–12 (Figure 1; Rogers, 1910). And it was Goddard's newly invented 'moron' class that changed the social and eugenic playing field, as "*morons are often normal looking with few or no obvious stigmata of degeneration*" (Goddard, 1920). Of course, Goddard's concern was that 'morons' would go undetected and would beget more 'feeble-minded' individuals (Goddard, 1920), yet his inclusion of this category in a psychiatric diagnosis allowed for much more leeway in deciding who was and was not 'feeble-minded' and thus potential for eugenic abuse (A. Cohen, 2016; Kevles, 1985; Paul, 1995).

Other psychologists soon picked up on Goddard's work, also adapting and modifying the Binet-Simon test (A. Cohen, 2016; Kevles, 1985). The most famous adaptation was the development of the I.Q. ('intelligence quotient') test by Stanford University's Lewis Terman (Figure 1; Terman, 1916). Once various intelligence tests were in hand eugenacists had a tool to identify the 'feeble-minded' among us. Based on testing performed on 'average' immigrants coming through Ellis Island over a period of 4 years (Figure 1), Goddard reported that 40% of new immigrants were 'feeble-minded' (Gelb, 1986; Goddard, 1917; Tucker, 1999). Using his Stanford-Binet I.Q. test, Terman found that more than 1% of California school children were likely 'feeble-minded,' declaring:

"the problem is not one that can be left to its own solution...the longer the menace is neglected, the more threatening it becomes" (Terman, 1917).

The largest intelligence testing study, of 1.75 million newly enlisted US soldiers, was done in 1917 (Figure 1) under the auspices of the newly established National Research Council (formed by the National Academy of Sciences). The research team, headed by then president of the American Psychological Association and Harvard professor, Robert Yerkes, and including Terman and Goddard, employed two tests: an 'alpha' test for English literate enlistees; and a 'beta' test (pictorial) for those not literate in English. According to the team, after controlling for literacy with the alpha/beta tests, a full 43.7% of all white enlistees could be classified as 'feeble-minded' (Bri-gham, 1923; Yerkes, 1919; Yoakum & Yerkes, 1920). It seemed clear: the 'feeble-minded' were a menace and threat to the American society (Baynton, 2016; A. Cohen, 2016; Kevles, 1985; Paul, 1995).

It was now that different pieces of science, eugenic ideology, progressive ideals, prejudices, and '-isms' of the period came fully together. As we have already seen, eugenacists believed 'feeble-mindedness' was an inherited trait (Garver & Garver, 1991; Kevles, 1985; Mazumdar, 2002; Paul, 1995). And though many 'disorders' were believed to be controlled by simple Mendelian genetics (Davenport, 1911; Davenport & Weeks, 1911; Rosanoff, 1912; Rosanoff & Orr, 1911), 'feeble-mindedness' was given particular attention as it was considered a root cause of several mental/behavioral disorders, including insanity and epilepsy (in the early 20th century, epilepsy was considered a mental illness rather than a neurological disorder; Reynolds & Trimble, 2009), as well as a whole pallet of social maladies (e.g., pauperism, criminality, alcoholism, narcotism, prostitution, and truancy; Davenport, 1911; Goddard, 1920; Kevles, 1985; Paul, 1995). As Terman wrote:

"...feeble-mindedness is one of the most important factors in delinquency, crime, alcoholism, pauperism, prostitution, and the spread of venereal diseases...Three fourths of the cases of feeble-mindedness are due to a single cause, heredity, and the one hopeful method of curtailing the increasing spawn of degeneracy is to provide additional care for our higher-grade defectives during the reproductive period..." (Terman, 1917).

And so it was that the 'feeble-minded,' epileptics, and other 'defectives' were shunted off to live in state institutions,

segregated from society at large and from each other; the intent being to provide care and prevent their unchecked reproduction (Appleman, 2018; A. Cohen, 2016; Kerr & Shakespeare, 2002; Kevles, 1985; Leonard, 2005; Paul, 1995)—*"We are sorry for you...but we deny you the right to parentage. You may live but you must not propagate"* (The Science of Breeding, 1911). Though it was felt that segregation of the 'feeble-minded' might reduce, or even eliminate, the breeding of more 'feeble-minded,' it would be costly to society, requiring time, personnel (doctors, nurses, staff), and considerable financial resources. As a leading biology textbook of the period put it:

"Hundreds of families such as those described above [referring to Goddard's 'Kallikak's'] exist today, spreading disease, immorality, and crime to all parts of this country. The cost to society of such families is very severe. Just as certain animals or plants become parasitic on other plants or animals, these families have become parasitic on society. They not only do harm to others by corrupting, stealing, or spreading disease, but they are actually protected and cared for by the state out of public money. Largely for them the poorhouse and the asylum exist. They take from society, but they give nothing in return. They are true parasites" (Hunter, 1914).

Fortunately, in this reform-minded era (Freeden, 1979; A. C. Kennedy, 2008; Leonard, 2005; Nichols & Unger, 2017; D. B. Robertson, 2015), eugenics offered a cheap, humane, and permanent solution: sterilization (Appleman, 2018; Bligh, 1965; Chousou et al., 2019; Freeden, 1979; Garver & Garver, 1991; Laughlin, 1922; Lombardo, 2003; Micklos & Carlson, 2000; Parker, 1915; Suuberg, 2020; Winfield, 2010).

3.3 | Eugenic sterilization in the United States

"...Sterilization of both males and females may be accomplished with so little initial and subsequent disturbance to the individual, excepting in so far as his reproductive capacity is concerned, that no one can object seriously to this method when legally and humanly employed...persons who are such radical defectives through heredity to be in the nature of public wards [feeble-minded, habitual criminals, blind, and deaf-mutes] should be rendered sterile..." – G.H. Parker (1915)

The US was the leading edge of eugenic sterilization in the early 20th century; by 1931 involuntary sterilization statutes had been codified in more than 30 of then 48 states (Appleman, 2018; Bligh, 1965; Chousou et al., 2019; Garver & Garver, 1991; Micklos & Carlson, 2000; Reilly, 2015; Sofair & Kaldjian, 2000; Suuberg, 2020; Willrich, 1998). Between 1907 and the late 1970s, 60,000–70,000 Americans had undergone legal, coerced sterilization (Appleman, 2018; Micklos & Carlson, 2000; Reilly, 2015; Sofair & Kaldjian, 2000; Suuberg, 2020). Only in Scandinavia (Denmark, Sweden, Norway, and Finland) and Nazi Germany were eugenic sterilizations carried out more enthusiastically, with ~100,000 sterilized in Scandinavia (Broberg & Roll-Hansen, 2005; Drouard, 1999; Kerr & Shakespeare, 2002) and 375,000–400,000 in the Third Reich (Bachrach, 2004; Mostert, 2002; M. Robertson et al., 2019; Sofair & Kaldjian, 2000; Teicher, 2019). Even in these latter cases the US was the model state from which sterilization laws were derived (Bachrach, 2004; Broberg & Roll-Hansen, 2005; Whitman, 2017), as we will later discuss relative to Nazi Germany's eugenic programs.

The first US state, and in fact first governmental body in the world (Reilly, 2015), to pass a eugenic sterilization law was Indiana in 1907 (Figure 1; Davenport, 1911; Garver & Garver, 1991; Laughlin, 1922; Micklos & Carlson, 2000; Sofair & Kaldjian, 2000; Willrich, 1998; Winfield, 2010). Consistent with its eugenic purpose, the preamble to the law read: “*Whereas, Heredity plays a most important part in the transmission of crime, idiocy and imbecility...*” (Indiana General Assembly, 1907). As Harry Laughlin, Assistant Director of the Eugenics Record Office in Cold Spring Harbor, noted in his summary of the law, it applied to “*...inmates of all State institutions who are deemed by a commission of three surgeons to be unimprovable, physically and mentally, and unfit for procreation...*” (Laughlin, 1922).

Between 1907 and 1918, 14 additional states (Washington, California, Connecticut, Nevada, Iowa, New Jersey, New York, North Dakota, Michigan, Kansas, Wisconsin, Nebraska, Oregon, and South Dakota) passed sterilization laws (Laughlin, 1922). However, because the US operates under a Common Law system where precedent based on judicial review of statutes relative to state and US constitutions determine enforceable laws (Ewald, 2001), it was not long before state sterilization laws found their ways to the courts. Eight of the first fifteen state laws were challenged in court between 1911 and 1922; Nevada's law was found to violate the 'cruel and unusual punishment' clause of the Nevada state constitution, while Iowa, New Jersey, New York, Michigan, Indiana, and Oregon were all found to violate the 14th Amendment of the US Constitution (Figure 1;

Laughlin, 1922). Only Washington's law was upheld in court (Laughlin, 1922). These court losses were a serious blow to the eugenics movement.

Institutional professionals and eugenics experts gathered the wagons and began to strategize on how to develop sound new laws that would withstand challenge in the courts. In 1922, Harry Laughlin produced a 'model eugenic sterilization law' based on all the past state statutes, eugenic science, and court challenges up to that point (Figure 1; Laughlin, 1922). Ideally, one of the new laws based on Laughlin's model law would make its way to the US Supreme Court, and if upheld there would establish national legal precedent (A. Cohen, 2016).

3.4 | Case study 1: *Buck v. bell*

We now turn to the first of four 'case studies' our students engaged in during the course; this one focused on Adam Cohen's *Imbeciles: The Supreme Court, American Eugenics, and the Sterilization of Carrie Buck* (A. Cohen, 2016). The central themes of the book revolve around eugenics, sterilization, racism, sexism (to a lesser extent), classism, and law in the 1920s as told through the people, places, legislation associated with Carrie Buck, and the events that engulf her. We believe the history of American eugenics simply cannot be adequately understood or appreciated for its moral and ethical weight without this story.

On January 23, 1924, a Commission of Feeble-mindedness pronounced then 17-year-old Carrie Buck 'feeble-minded or epileptic' (Figure 1) and committed her to the Virginia Colony for Epileptics and Feeble-Minded near Lynchburg, Virginia (A. Cohen, 2016). In late March of 1924, Virginia passed its Eugenic Sterilization Act (Figure 1; General Assembly of the State of Virginia, 1924; Strode, 1924), which had been based on Laughlin's 'model sterilization law' (A. Cohen, 2016; Laughlin, 1922; Micklos & Carlson, 2000; Suuberg, 2020). The law was drafted by former VA state senator and lawyer Aubrey Strode, in consultation with Laughlin, and two physicians, Dr. Joseph DeJarnette (superintendent of Western State Hospital in Staunton, Virginia) and Dr. Albert Priddy (superintendent of the Colony for Epileptics and Feeble-Minded). Even before their work was completed, the plan was to test the law in the courts and if possible get appeals all the way to the US Supreme Court where they hoped to get a positive ruling (A. Cohen, 2016). But for this to work, an ideal patient to be sterilized was needed, and Priddy had her at his Colony: Ms. Buck.

Carrie Buck was thought an 'ideal' patient to test the legality of the Virginia law for many reasons: (a) a judge and two physicians had found her 'feeble-minded' at the hearing which committed her; (b) Colony doctors had

confirmed her 'feeble-mindedness'; (c) her mother was a 'feeble-minded' patient at the Colony; (d) an additional eight members of the Buck and Harlow (Carrie's mother's maiden name) families were inmates at the Colony, and several other inmates of the same surnames were at other state institutions, providing a clear familial lineage of 'feeble-mindedness'; (e) at 17, she had given birth out of wedlock, a fact that at the time indicated her promiscuous and 'defective' nature (Carrie was in fact raped by a nephew of her then foster parents); (f) her baby was also considered 'feeble-minded'; and (g) because she was young her sterilization would allow her to be released early, precluding the need to be institutionalized for her entire reproductive lifetime (A. Cohen, 2016). Carrie's long, and unfortunately largely passive, legal journey started on September 10, 1924 with a Colony Special Board of Director's hearing that ruled in favor of Dr Priddy's request to sterilize her; it ended on May 2, 1927 when by an 8–1 decision the US Supreme Court ruled the Virginia law constitutional and allowed her sterilization to proceed (Figure 1; *Buck v. Bell*, 1927; A. Cohen, 2016; Lombardo, 2003). Carrie Buck was forcibly sterilized by salpingectomy (removal of the fallopian tubes) on October 19, 1927 (Figure 1; A. Cohen, 2016). Carrie's only child, her daughter Vivian, died at 8 years of age in the custody of Carrie's former foster parents on July 3, 1932, having never lived with her mother.

Carrie Buck's life was just the first of tens of thousands of American lives to be irreparably altered by state-sanctioned sterilization because of the US Supreme Court ruling on *Buck v. Bell*. Revered jurist and Supreme Court Justice Oliver Wendell Holmes Jr, in writing the majority ruling opinion captured perfectly the cruel and cold logic of the eugenic movement:

"It is better for all the world if, instead of waiting to execute degenerate offspring for crime or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind...Three generations of imbeciles are enough" (*Buck v. Bell*, 1927).

It is difficult to believe those deemed 'unfit,' 'inferior,' or 'defective' could be convinced by the state to voluntarily give up their biological drive to reproduce. Indeed, no broad program of 'cultural/social engineering' was possible in a civil society without the force of law, especially in a country like the United States where freedom and liberty are civil expectations. Though Mendelian and Darwinian ideas provided the scientific imprimatur for eugenic programs, it was the law that brought the science and prejudice together to allow those programs to be implemented in society (Willrich, 1998).

The prolog to the Law Code of Hammurabi (18th century BCE; Figure 1) states "...that the strong should not injure/oppress the weak" (Kent, 1903; Prince, 1904). A more just bedrock for a system of laws seems hard to imagine. While it is reasonable to expect that the US legal system would honor this precept, this is sadly not the case (Jenkins, 1905). As Cohen points out in *Imbeciles*: "American law is a great respecter of hierarchy – it operates most harshly on those at the bottom" (A. Cohen, 2016). While today no coercive, US state-sponsored eugenic or social sterilization programs operate, many of the statutes allowing such programs still exist, and *Buck v. Bell* remains the precedent law of the land (A. Cohen, 2016; Reilly, 2015; Suuberg, 2020).

After reading and discussing *Imbeciles*, the students are asked to reflect upon a number of questions, such as: Does morality influence law, and if so, how? How is it that Progressivism and eugenics became such close 'bedfellows?' How did human behavior and psychology impact the embrace of, and evangelicalism for, the eugenics movement? Is eugenics truly dead? Could it arise like a Phoenix in the era of designer medicine? Are there cultural/social programs or systems in the United States, past or present (other than eugenics), that have been/are driven by a prejudice or -ism and justified, at least in part, through biology/science? By engaging in these thought exercises, the students not only reflect upon what they have already learned about eugenics, but also begin to think about topics yet to be discussed.

4 | NAZI EUGENICS, RACIAL HYGIENE, AND THE HOLOCAUST: EARLY/MID 20TH CENTURY

In 1946, Primo Levi¹ wrote this of the Holocaust:

"Perhaps what happened cannot be comprehended, or rather shouldn't be [emphasis is the authors] comprehended, because to comprehend is almost to justify...But there is nothing rational about Nazi hatred: it's a hatred that is not in us; it's outside of man, a poisonous fruit arising from the deadly trunk of fascism, but outside and beyond fascism itself. We can't understand it; but we can and must understand its roots and be on our guard. If understanding is impossible, recognizing is necessary, because what has happened can happen again, consciences can again be seduced and obscured: even our own" – from If This Is a Man (Levi, 2015)

We would ask the reader, as we do our students, to take Levi at his word and accept that one cannot fully comprehend the horrors of the Holocaust. But can we attempt to appreciate how the Nazi state employed science as a justification to fulfill their murderous visions of a pure German *Volk* (people)? In this section, we will examine German and Nazi prejudice and '-isms,' and the role of science in Nazi ideology and social engineering.

4.1 | Ha-Shoah and the holocaust

Before we examine prejudice, '-isms,' Nazi science and eugenics, let us back up a bit. We started this section introduction with a quote about the Holocaust (Figure 2), but we never defined the Holocaust (see Lindquist, 2013). Is a definition even necessary in 2021? We believe so, especially if we hope to gain an appreciation for the role Nazi science played in the regimes race ideology. It is important to know *who* the victims of the Holocaust were, *why* they were chosen, and *how* Nazi science and medicine provided a patina of justification for their victimization.

Yad Vashem (The World Holocaust Remembrance Center in Jerusalem, Israel) defines the Holocaust simply as:

*"The systematic destruction of European Jewry at the hands of the Nazis during World War II."*²

Eugenics After Jan 1933

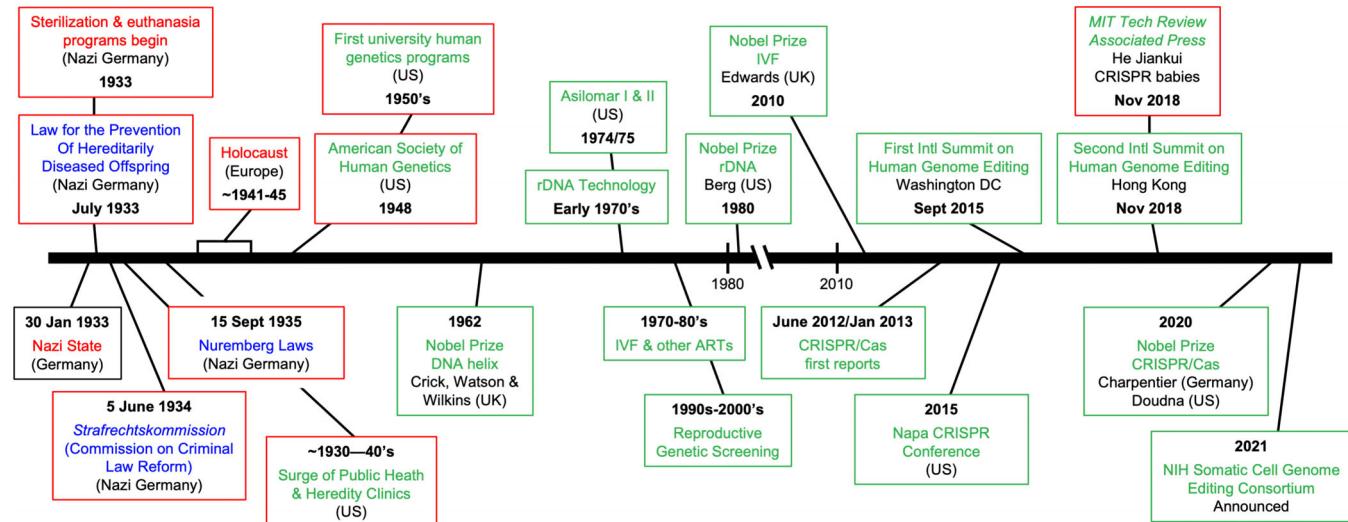


FIGURE 2 Timeline of eugenics after the rise of the Nazi state in January 1933. Each of the depicted items is discussed in the text as an important event, writing, piece of science, or action that contributed to the eugenics timeline after the rise of the Nazi state. Blue text refers to laws or legal events/issues; Red text refers to overtly or specifically eugenic writings, events, or science issues/actions; Red boxes surround both overtly eugenic items, as well as those laws, writings, events, or actions that had eugenic impact that were not necessarily eugenic by intent; Green text and boxes refer to scientific events that influenced eugenic thought

The United State Holocaust Memorial Museum (Washington, DC) defines the Holocaust more broadly as:

*"The systematic, state-sponsored persecution and murder of six million Jews by the Nazi regime and its allies and collaborators... While Jews were the priority target of Nazi racism, other groups within Germany were persecuted for racial reasons, including Roma (then commonly called 'Gypsies'), Afro-Germans, and people with mental or physical disabilities."*³

For our purposes, we will utilize the latter definition, not because it is correct, nor to minimize in any way the destruction of European Jewry, but because it encompasses an additional ~675,000 victims of Nazi race ideology as relates to our discussions of science, eugenics, and race laws. We will use the preferred Hebrew term *Ha-Shoah* (Michman, 2017) when referring to the six million European Jews murdered by the Nazis.

4.2 | Prejudice, race, and '-isms' in Nazi Germany

Human prejudice has been a subject for socio-psychological study for nearly a century (Fish & Syed, 2020; Fiske, 1998). A deep examination of the cognitive aspects of prejudice (Billig, 2002; Tajfel, 1969) is beyond the scope of this review,

yet we will briefly discuss a few of the commonly accepted ideas. First, prejudice is rarely an 'individual enterprise,' but rather arises through a variety of sociocultural and situational group identities (McFarland, 2010). Second, though not exclusively, these group identities broadly cluster into two major categories that predict a 'generalized pattern of prejudice' (Allport, 1954): authoritarianism and social dominance (Heylen & Pauwels, 2015; McFarland, 2010). Authoritarian individuals form group identity through common values of conformity, security, and traditionalism; individuals in social dominance groups have preferences for hierarchy and dominance over lower-status groups (Heylen & Pauwels, 2015; McFarland, 2010). There is considerable overlap between these groups. However, McFarland has found that individuals exhibiting high levels of empathy and principled moral reasoning have significantly reduced generalized prejudice (McFarland, 2010). So, the old adage that "you aren't born with prejudice, it's a learned behavior" seems generally valid. It is however important to understand that prejudice refers "*to preconceived, unsubstantiated opinions of persons based on perceived categorical differences*" (Fish & Syed, 2020) and as such it encompasses 'positive,' as well as 'negative' feelings ('positive prejudice' is a like of self-group, rather than hatred toward an out-group; because it is still part of prejudice with an outward negativity, 'positive prejudice' is not positive in a socio-cultural sense; Fish & Syed, 2020; Fiske, 1998).

Racism is just one expression of 'negative prejudice' (Baldwin, 2017). The concept of race dates as far back as the 13th century (see Heng, 2018), and as early as the late 18th century the seeds for modern day white supremacy were sown (Fish & Syed, 2020). French and German anthropologists, George Louis Leclerc, Comte de Buffon, and Johann Blumenbach, respectively, were among the first to propose that Caucasians were the original and superior human 'race' (Fish & Syed, 2020). In the United States, the idea of a superior 'Nordic' (also called Aryan) white race was brought into the public consciousness by Madison Grant's *The Passing of the Great Race* (Figure 1; A. Cohen, 2016; Grant, 1916). Adolf Hitler reportedly wrote a 'fan letter' to Grant remarking that *The Passing of the Great Race* was 'his bible' (A. Cohen, 2016). It was however a Frenchman, Count Arthur de Gobineau, who some 60 years before Grant, laid out the first roadmap for 'Aryan' supremacy that we'd now recognize as central to Nazi racism (de Gobineau, 1915; Rose et al., 1973; Stein, 1988; Weikart, 2013). While there is no evidence that Gobineau was an antisemite⁴ (Hayes, 2017), and a direct line from his writings to Nazi race ideology is not clear, numerous threads connected the two (Fortier, 1967). Moreover, his ideas were well represented by the likes of Richard Wagner, Houston Stewart Chamberlain, Hans Günther, Alfred

Rosenberg (Chapoutot, 2015; Fortier, 1967; Holborn, 1964; Stone, 2016); fellow travelers with Hitler in a common vile swamp of prejudice (Friedlander, 1997). Of course, a biological concept of race is now largely without adherents in the academy (Smedley & Smedley, 2005), though it still finds shelter in the lay public (Brueckner et al., 2005; Epstein Jayaratne et al., 2006).

Underlying all the prejudice-based '-isms' of Nazi Germany was a profound belief in, and propagation of, 'Aryan' superiority as embodied in the German Volk (Friedlander, 1997; Hayes, 2017; Holborn, 1964; McMillan, 2014; Rose et al., 1973; Stein, 1988; Stone, 2016; Weikart, 2013). The most invasive and destructive expression of this ideology, as illustrated by the appalling toll of *Ha-Shoah*, was antisemitism. Sadly, antisemitic beliefs were not unique nor limited to Nazi Germany, and endure to this day (Lipstadt, 2019; Moffit, 2019). As Friedlander has pointed out, what made Nazi antisemitism distinctive was its 'redemptive' quality:

"Redemptive anti-Semitism was born from the fear of racial degeneration...The main cause of degeneration was the penetration of the Jews into the German body politic, into German society, and into the German bloodstream, Germanhood and the Aryan world were on the path to perdition if the struggle against the Jews was not joined; this was a struggle to the death. Redemption would only come as liberation from the Jews - as their expulsion, possibly their annihilation" (Friedlander, 1997).

A classic eugenics argument easily follows from ideas of 'us against them' and differences arising (inherited) in 'the blood.'

Nazi prejudice was not however limited to antisemitism. Other forms of racism (including racial xenophobia; Bock, 1983; Connelly, 1999; Haas, 2008; Lewy, 1999; Lutz & Lutz, 1995; Rosenhaft, 2011), as well as sexism (Bock, 1983), homophobia (Boden, 2011), ableism, and sanism (Kessler, 2007; Mostert, 2002; M. Robertson et al., 2019; Sofair & Kaldjian, 2000; Teicher, 2019), were all part of the early Nazi ideology that gave rise to the Holocaust. Allport, though not referencing Nazi Germany in particular, captured the essence of Nazi ideology well when he wrote:

"One of the facts of which we are most certain is that people who reject one out-group will tend to reject other out-groups. If a person is anti-Jewish, he is likely to be anti-Catholic, anti-Negro [Allport's term], anti any out-group" (Allport, 1954).

4.3 | Genetics and eugenics: Justifying and implementing Nazi prejudices and '-isms'

The common thread tying all the pieces of Nazi prejudice and ideology, and eventually race-based policies, was the belief in 'Aryan' supremacy that was taught, imbibed, and internalized as a biological 'reality' (Arnold, 2006; R. J. Evans, 2005; Gellately, 2020; Hayes, 2017; McMillan, 2014; Rose et al., 1973; Stein, 1988; Weikart, 2013). The sheer depth and irrationality of the Nazi prejudice begged for a scientific rationalization (Beyerchen, 1997), one German science and medicine was more than happy to provide (Berez & Weiss, 2004; M. M. Cohen, 2010; Gausemeier, 2010; Kessler, 2007; Rose et al., 1973; Stein, 1988; Weikart, 2013). With the aid of the scientific endorsement, it became almost second nature for average Germans to depersonalize (Tajfel, 1969) and dehumanize (Haslam, 2006; Steizinger, 2018) genetic 'enemies of the state' (Arendt, 1951; Childers, 2017). And with that, the road was paved to acceptable (or at least willfully ignored) forced sterilization (Mostert, 2002; M. Robertson et al., 2019; Sofair & Kaldjian, 2000; Teicher, 2019), and later euthanasia (Kessler, 2007; Mostert, 2002; M. Robertson et al., 2019), of the disabled and 'undesirable' in the early 1930s (Figure 2). The subsequent "evolution" (in mid-late 1930's to 1945) of Gypsy (Lewy, 1999; Lutz & Lutz, 1995; Rosenhaft, 2011), Afro-German (Haas, 2008; Rosenhaft, 2011), homosexual (Boden, 2011), Slav (Lewy, 1999), and Jewish (Childers, 2017; Friedlander, 1997; Hayes, 2017; McMillan, 2014) persecution now seemed like a foregone conclusion.

As we have already seen, the peak of the global eugenics movement occurred in the 1920s to early 1930s (Allen, 1983, 1986; Freedman, 1979; Garver & Garver, 1991; Micklos & Carlson, 2000; Stolerman, 2017), exactly when the Nazi Party was gaining power (Figures 1 and 2; Childers, 2017; R. J. Evans, 2005; Gellately, 2020). The coincidence of science and Nazism was a perfect storm to set the wheels of the Holocaust in motion. While science was used to provide the intellectual bedrock for Nazi race policies, scholars have not always agreed on how ideas of genetics and evolution were embraced and employed. For example, much of the literature on the scientific basis for Nazi race ideology focused on social Darwinism as the main driver (McMillan, 2014; Paul, 2003; Richards, 2013; Rose et al., 1973; Stein, 1988; Teicher, 2020a; Weikart, 1993, 2013; Weindling, 1998). Was Hitler a Darwinist, a social Darwinist, or neither? What about Nazi ideologues and state policy, were they steeped in social Darwinism? Though these questions are all still being debated, as we will see in our second Case Study at least

one scholar is refocusing the questions not on Darwin but Mendel, with racial genetics as the key factor (Teicher, 2020b).

4.4 | Case study 2: Social Mendelism in Nazi Germany

"[The Nazis] prided themselves on grounding their world-view in biological principles" – Amir Teicher (2020b).

In our second Case Study, we examine the contributions of Mendelian and Darwinian ideas in the development and implementation of Nazi eugenic policies. As already mentioned, Nazi eugenics has generally been considered the epitome of social Darwinism (McMillan, 2014; Paul, 2003; Richards, 2013; Rose et al., 1973; Stein, 1988; Teicher, 2020a; Weikart, 1993, 2013; Weindling, 1998). In *Social Mendelism: Genetics and the Politics of Race in Germany 1900–1948*, Professor Amir Teicher of Tel Aviv University presents the concept that misapplication of Mendel's laws contributed to the development of Nazi policy, without discounting a role for social Darwinism (Teicher, 2020b). Inclusion of *Social Mendelism* in the course curriculum provides students a contextual means to explore the dangers associated with misapplication of scientific theory.

The Augustinian monk Gregor Johann Mendel first presented his findings on plant hybridization on February 8 and March 8, 1865, at meetings of the Brünn Natural History Society, and published them the following year (Mendel, 1866). It is hard to imagine given the esteem in which Mendel is held today that, at the time, his results received little attention. However, around the time Mendel was lecturing on his findings, events were occurring in other fields that would have profound impacts on the application of Mendel's findings. In 1861, anthropologists met to formally standardize anthropological measurements (Teicher, 2020b). In 1869, genealogy established a national society that "...began laying the foundation for genealogical research and for popularizing its results among the German public" (Teicher, 2020b). Finally, the field of psychiatry in the late nineteenth century focused on defining and delineating the "diseases and disorders that subvert human mental capacities" (Teicher, 2020b). Psychiatry began to look at mental disorders as diseases of the brain and began to adhere to methods of natural sciences. Furthermore, psychiatry began to shift away from solely looking to cure individuals but to "familial and societal mental deterioration" (Teicher, 2020b).

In the late 19th century, Mendel's laws were 'rediscovered,' thanks to the work of Hugo de Vries, Carl

Correns, and Erich von Tschermark (Figure 1; Bateson, 1900; R. Moore, 2001). However, Mendel himself never summarized his findings as a list similar to the three laws bearing his name (Mendel, 1866). The current format of Mendel's laws represented ongoing work of scientists during the early 20th century (Teicher, 2020b). During this process, in 1903, Hugo de Vries developed the term “*to mendelize*” (*mendeln*) or to ‘*mendel out*’ (*herausmendeln*)” (Teicher, 2020b). While not universally accepted, this novel verb was utilized to explain the process of re-emergence of parental traits in the second generation after being concealed in the first generation (Teicher, 2020b). As evidence accumulated on the applicability of Mendelian laws to plants and animals, the inevitable occurred. In 1907, without a preponderance of supporting evidence, Wilhelm Haacke declared that Mendel's laws applied to humans (Teicher, 2020b). Both anthropology and psychiatry incorporated a Mendelian approach to their analyses, while genealogy rejected Mendelism (Teicher, 2020b).

William Frederic Edwards declared that skull rather than skin color was the essential criteria for race (W. F. Edwards, 1829; Johoda, 2009), and Anders Retzius introduced language and methods for the scientific classification of skulls with race: dolichocephalic, brachycephalic, and the cephalic index (see Johoda, 2009). The application of Mendelian laws to humans now provided scientific methodology to the racial classification that was rampant in the late 19th century. Inherent to Mendel's laws was the notion that some traits were inherited in a dominant manner. Following simple Mendelian logic, a dominant trait was expressed in three of four possible genotypes resulting from heterozygous crossings (e.g., crossing two F1s). The offspring of F1 interbreeding potentially included a homozygous recessive offspring, which was said to have “Mendel out” the recessive parents' genotype and phenotype (Mendel, 1866; Teicher, 2020b).

Coincident with the embrace and application of Mendel's laws was the rise in the notion of national purity (Teicher, 2020b). The collision of Mendelism with Nationalism resulted in tragic consequences. As Teicher notes, in 1926, the *Handbook of Sexology* declared that “*every man is a bastard*,” with ‘bastard’ in this case meaning every human was heterozygous for at least some of their traits (Teicher, 2020b). Also, inherent to Mendelism was the immutability of heritability factors, which ran counter to Lamarckian inheritance. Therefore, thrust upon populations striving for national purity was the notion that all people harbored dangerous recessive traits that were immutable and could ‘Mendel out’ with successive generations. It was under these circumstances that eugenic thinking began to offer a solution, and in 1907, well before the rise of National Socialism in Germany, the first eugenic sterilization law was passed in the US

state of Indiana (Indiana., 1907). While initiated in the United States, the eugenic approach would reach its zenith/nadir in Nazi Germany.

In *Social Mendelism*, Amir Teicher does a masterful job of documenting and delineating how the Nazis misused Mendelism as their scientific rationale for bigotry. Under the guise of protecting the German *Volk* from dangerous recessive traits, Nazi Germany initiated a propaganda campaign designed to educate Germans on the dangers of recessive traits, which was clearly illustrated in Karl Bareth and Alfred Vogel's textbook *Heredity Theory and Racial Science for Primary and Middle-School*:

“The Mischlinge [a Nazi legal definition of mixed Aryan/non-Aryan ancestry, most often mixes of Aryan and Jewish] deceive us through their outward appearance. Next to the visible [hereditary] dispositions they possess dispositions which are hidden from sight. These too are inherited. We distinguish genotype (Erbbild) from phenotype (Erscheinungsbild). Both are not the same. One must therefore never judge an organism by its phenotype. The most important is the genotype. One cannot see by the external features of an organism what hereditary dispositions are hidden in it” (Original quote from Bareth and Vogel, supplied by Teicher, 2020b).

Once Hitler came to power, a series of laws were passed that targeted those considered defective or outside the German *Volk*; starting with the 1933 “Law for the Prevention of Hereditarily Diseased Offspring” (Figure 2), and culminating in 1935 with the passing of the “Reich Citizenship Law” and “Law for Protection of German Blood and German Honor” (Teicher, 2020b). These latter laws collectively became known as the Nuremberg Laws⁵ (Figure 2) and were targeted mainly at Jews (Friedlander, 1997; Heideman, 2016–2017; Lowenstein, 1936; Rundle, 2009; Scales-Trent, 2001; Wiesen, 2017). As Nathan Stoltzfus has argued: “[t]he point [of the Nuremberg Laws]...was to identify and separate the Jews from other Germans” (Stoltzfus, 2011). Richard Heideman has gone further in rightly concluding that the Nuremberg Laws represented “state-sponsored, sanctioned and enforced hate, religious discrimination...and persecutions of Jews” (Heideman, 2016–2017). By defining Jews through inherited factors that could not be altered by conversion to Christianity, the Nazis anchored their laws to the Mendelian principle of recessive inheritance (Teicher, 2020b). The two racial Nuremberg Laws were critical steps in the evolution of the Holocaust (Arendt, 1951, 2006; Childers, 2017; Friedlander, 1997; Heideman, 2016–2017; Rundle, 2009; Wachsmann, 2015).

After reading and discussing *Social Mendelism*, students were again asked to respond to a number of questions, such as: Why does the author propose social Mendelism as the motivator and driver of Nazi Race ideology and policy, rather than social Darwinism (as proposed by other scholars)? Where did the basic assumption that complex traits are monogenic arise? Mendel's laws never addressed purity; he ascribed no value to the traits in question. So, what was the rationale for Nazi distortion of Mendelism to include value associated with a particular trait? The goal of engaging students in these thought exercises is to get them to reflect on the potential societal implications for the misapplications of scientific ideas by individuals or by nation states.

5 | THE NAZIS LOOKED WEST: AMERICAN-NAZI EUGENIC AND LEGAL AXIS

As introduced earlier, 'classic eugenics' was most zealously studied, taught, and practiced in the United States and Nazi Germany (Allen, 1983, 1986; Garver & Garver, 1991; Kerr & Shakespeare, 2002; Kevles, 1985; Paul, 1995). We have already looked at some of the history, science, and societal impacts of the eugenics movement in these two states, how sterilization laws were used in service of eugenic ideas in the US, and how prejudice and various '-isms' drove Nazi ideology. In our undergraduate class, we next asked students to delve into three broad topic areas that can be difficult and emotional to discuss, but ones we felt are critical to understanding eugenics, as well as the society in which we currently live: (a) US and Nazi race laws, and how genetic and biological ideas influenced such laws; (b) how the two countries utilized the law in eugenic policy and practice; and (c) how US race law informed Nazi eugenic legal statutes. Though an in-depth discussion of each of these topics is beyond the scope of this review, we will provide a brief overview of these topics and how we engage students with them using our third Case Study.

On the importance of Nazi race law to the Holocaust, Australian legal scholar Kristen Rundle wrote:

"[L]aw effectively led us directly to Auschwitz...without the usefulness of the law as a means of identifying and defining Jews for the purpose of their persecution, it is extremely improbable, if not impossible, that the Nazis would have been capable of executing their extermination policy in the systematic

manner, and to the level, that they did" (Rundle, 2009).

Nearly 10 years before Nazi Party racist ideology was to influence German law, Adolf Hitler wrote in *Mein Kampf*:

"At present [cir. 1924-25] there exists one State which manifests at least some modest attempts that show a better appreciation of how things ought to be done in this matter [re. immigration, citizenship, and anti-miscegenation laws]. It is not, however, in our model German Republic but in the U.S.A. that efforts are made to conform at least partly to the counsels of commonsense. By refusing immigrants to enter these if they are in a bad state of health, and by excluding certain races from the right to become nationalized as citizens, they have begun to introduce principles similar to those ones which we wish to ground the People's State" (Hitler, 1939).

It seems clear that, even before their seizure of power, Hitler and Nazi legal scholars saw America as the world leader in establishment and application of racial law (Ezzell, 2002; Hitler, 1939; Horst Grill & Jenkins, 1992; Krieger, 1934; Scales-Trent, 2001; Sofair & Kaldjian, 2000; Stoltzfus, 2011; Wiesen, 2017). Not so obvious, was how central (if at all) US legal statutes were to the development of Nazi race law.

The US Constitutional system of laws was one founded upon Enlightenment ideas and classic liberalism⁶ (Berman, 1992; Cook-Martin & FitzGerald, 2010). While liberalism emphasized equality and individual rights (Conway, 1995), the same liberalism resulted in an uncomfortable paradigm: the political plurality inherent in the liberal system can allow racialized policies to take hold (Cook-Martin & FitzGerald, 2010; Cottrol, 2001). In contrast to 'collateral' racism of the liberal American system,⁷ Nazi law was structured to purposely reflect the racial ideology of the state (Caestecker & Fraser, 2008; Cottrol, 2001; Dickman, 1943; Ezzell, 2002; Lowenstein, 1936; Washington, 2011–2012; Wiesen, 2017). Of Nazi law, William Dickman wrote in the midst of the Second World War:

"Three main ideas characterize the doctrines of Nazi Civil Law: I. The anti-democratic principle of absolute submission to leadership [Führerprinzip], II. The anti-individualistic principle that 'common interest supersedes

private interest,’ and III. The racial concept” (Dickman, 1943).

When the Nazis came to power in 1933, they immediately began dismantling and replacing the relatively liberal Continental legal system established by the short-lived Weimar Republic (Arendt, 195; Lowenstein, 1936; Rundle, 2009; Scheuerman, 1996; Washington, 2011–2012). The new legal system, a “genuine Germanic law” grounded in racial ideology supported by eugenic ‘science’ (Lowenstein, 1936), aimed to marginalize and remove the undesired racial components of society, especially the Jews (Caestecker & Fraser, 2008; Cottrol, 2001; Dickman, 1943; Ezzell, 2002; Lowenstein, 1936; Washington, 2011–2012; Wiesen, 2017). As Daniel and Sterphone wrote:

“[Nazi] notions of racial defilement, contamination, and impurity [all eugenics ideas] combined conspiracy theories of an international Jewry striving for global domination [re. Protocols of the Elders of Zion (see Bytwerk, 2015; Hasian, 1997)] by undermining Germany from within its national borders” (Daniel & Sterphone, 2019).

As the ‘Jewish Question’ was a central tenet of Nazi ideology (Childers, 2017; Friedlander, 1997; Gellately, 2020; Hayes, 2017; Kershaw, 2008; Kroslák, 2015; Range, 2020; Wiesen, 2017), solutions to this ‘question’ were inherently provided by Nazi laws.

From the time Hitler became Chancellor of Germany (January 30, 1933; Figure 2) to the start of the Second World War (September 1, 1939), the Nazis passed more than 400 decrees, regulations, and legal amendments that eroded the rights and liberties of Jews and other non-Aryans (R. J. Miller, 2020). While each of these could be argued to be racial in character by virtue of who they target, not all were explicitly eugenic in character (R. J. Miller, 2020). Yet nearly all these statutes contributed in some manner to the eugenic slide from segregation to genocide in Nazi Germany. But did US race law impact this process, and if so, how? Bernard Fischer has noted that:

“When questioned [after the war] about laws preventing Jewish and ‘Aryan’ intermarriage, the Nazis pointed to laws in the United States restricting marriages between blacks and whites. When questioned about expelling all Jewish physicians from German medical societies, the Nazis pointed to the American Medical Association’s refusal in 1939 to admit African-American physicians” (Fischer, 2012).

But were such comments honest revelations of influence, or merely *post-hoc* justifications?

5.1 | Case study 3: Hitler’s American model

Our third Case study was focused on the question: What role, if any, did US laws and prejudices play in the development and implementation of Nazi race laws? Students read Yale law professor James Q. Whitman’s *Hitler’s American Model: The United States and the Making of Nazi Race Law* (Whitman, 2017) as a means to tackle this question. Whitman articulated a thorough and compelling case for a straight-line, if not direct connection, between US and Nazi race law (Whitman, 2017). This conclusion has not however been the conventional wisdom. As Whitman notes in his introduction:

“[S]cholars have insisted on what most of us must think of as the obvious truth: There was of course no direct American influence on Nazi race law, or at least no meaningful influence. Whatever similarities there may have been, the Nazis were authors of their own monstrous work; certainly America had nothing to teach Hitler” (Whitman, 2017).

Whitman’s thesis rested on three overlapping bins of evidence: (a) plentiful examples of US race law prior to the rise of the Nazi state; (b) extensive German (Weimar and Nazi era) scholarship examining US race law; and (c) the verbatim transcript of a 1934 meeting where Nazi legal minds deliberated what would become the Nuremberg Laws (Figure 2; Whitman, 2017). While US laws and scholarship of those laws provided only circumstantial evidence that the Nazis were influenced by US race law, it was the 1934 Nuremberg Law discussion that provides the smoking gun, so let us begin there.

On June 5, 1934, a group of leading Nazi lawyers and physicians making up the *Strafrechtskommission* (Commission on Criminal Law Reform) gathered to discuss plans for new racial laws to define and remove Jews from most aspects of German society (Figure 2; Whitman, 2017). These deliberations yielded the 1935 “Reich Citizenship Law” and “Law for Protection of German Blood and German Honor,” or Nuremberg Laws (Figure 2), so called because they were first unveiled at the annual Nazi Party rally, or *Reichsparteitag*, in Nuremberg (Friedlander, 1997; Heideman, 2016–2017; Lowenstein, 1936; Rundle, 2009; Scales-Trent, 2001; Wiesen, 2017). Justice Minister Franz Gürtner, who chaired the committee, declared at the start of the

meeting that it was “*naturally very attractive to look around in the world to see how this problem [establishment of race law] has been attacked by other Völker*” (Whitman, 2017). The US being the only example to exploit, Gürtner then read a memo prepared by his ministry on American race law which set the subsequent tone of the meeting (Whitman, 2017). The discussion and debate of US race policy was wide and ranging (Whitman, 2017), and included: immigration laws, such as the Emergency Quota Act of 1921 and the Immigration Act of 1924 (Figure 1) that used race tables and ‘national origin’ quotas to set boundaries of policy (Getz, 1995; Lee, 2006; Leonard, 2016; Ngai, 2007; Silber, 1997); the system of *de jure* and *de facto* second-class citizenship for blacks, Chinese and others (Carbado, 2005); ‘Jim Crow’ laws and statutes that segregated African-Americans from white society (F. L. Edwards & Thomson, 2010; Harris, 2000; McKanders, 2010; Wiesen, 2017; Woodward, 1955); and the numerous anti-miscegenation laws that sought to prevent and criminalize inter-racial sexual contact and marriage (Cruz & Berson, 2001; Hickman, 1997; Pascoe, 1996; Weinberger, 1956–1957; Woods, 1999).

The moderate conservatives in the group, including Gürtner, argued that the American ‘model’ was not precise enough in terms of defining race and racial inferiors. Karl Klee, Presiding Criminal Court Judge and Professor of Criminal Law at Berlin University, and one of the hard-liners, argued:

“American race legislation too [just like German popular attitudes] certainly does not base itself on the idea of [mere] racial difference, but, to the extent their legislation is aimed against Negroes and others, absolutely certainly on the idea of the inferiority of the other race, in the face of which the purity of the American race must be protected” (Whitman, 2017).

Fellow hard-liner Roland Freisler, then State Secretary attached to the Ministry of Justice and later President of the infamous Nazi Peoples Court (Ortner, 2018), argued that the Americans had a “*political construction of race*” that was ideological rather than scientific as the Germans were seeking to develop (Whitman, 2017). Somewhat tritely, but not inaccurately, Freisler further argued that though the Americans did not always clearly delineate the races, that did not deter them from enforcing their criminal race laws (Whitman, 2017). Though a few US states did apply the “one drop [of non-Caucasian blood]” rule for defining who was black (Cruz & Berson, 2001; Hickman, 1997; Lombardo, 1987–1988; Pascoe, 1996;

Sherman, 1988), not all did, and the moderate Nazis felt (ironically) the ‘one drop’ rule was too harsh for Nazi policy (Whitman, 2017). The moderates’ objections to US definitions of race won the day as the eventual Nuremberg Laws used a complicated and frequently revised familial calculus to determine who was a Jew and subject to the new laws (Ezzell, 2002; Krošlák, 2015; Rundle, 2009). Interestingly, the definitions of who was Jewish outlined in the First Implementing Regulation (the first of many addenda) of the Reich Citizenship Law followed a similar calculus applied by an Oregon anti-miscegenation law for the definition of blacks and Native Americans (Ezzell, 2002).

There was also some objection by Gürtner and other moderates that since US law did not apply directly to Jews, it was not applicable in Germany (Whitman, 2017). However, the eventual Nuremberg Laws were not envisioned as a system of segregation or apartheid, but rather to establish racial citizenship, sex, and marriage laws. Though US citizenship, immigration, and anti-miscegenation laws did not specifically target Jews, they were considered the ‘cutting edge’ of race-based laws in the world at the time. As such, even the moderate Nazis could not ignore the legal precedent America had set which could in fact be applied more ‘scientifically and precisely’ in Germany. As Whitman notes, the Nazis would have passed race laws and committed crimes against humanity in the absence of US race laws, but it is important to ask: “*how did it come to pass that America produced laws that seemed intriguing and attractive to the Nazis*” (Whitman, 2017)? It was by examining the breadth and nuance of US race law and policy that Nazis found common ground with the US, and why Whitman believed there was a direct line between US and Nazi race law (Whitman, 2017). A recent study by Robert Miller of Arizona State University corroborated Whitman’s conclusions and extended them by showing that the Nazis paid close attention not only to anti-black, but also anti-Native American legislation (R. J. Miller, 2020). Hitler’s and Nazi fascination with Native Americans, ‘Manifest Destiny,’ and the frontier American west also helped shaped *Lebensraum* policy, Germany’s genocidal conquest of eastern territories (R. J. Miller, 2020; Westermann, 2016).

Before we leave this Case Study, it is worth noting that most US race law debated by the *Strafrechtskommission* in 1934 outlived the Nazi regime and its American-inspired laws. ‘Jim Crow’ laws were not found unconstitutional and nullified until 1954 with the US Supreme Court ruling in *Brown v Board of Education* (*Brown v Board*, 1954). The restrictive quota system constraining US immigration was in place until the passage of the Immigration and Naturalization Act (aka, the

Celler Act) in 1965 (Cook-Martin & FitzGerald, 2010; Hirschman, 2005; Lee, 2006; Ludmerer, 1972; Okrent, 2019). And it was only in 1967 with the Supreme Court ruling in *Loving v Virginia* that anti-miscegenation laws were outlawed (Cruz & Berson, 2001; Hickman, 1997; R. Kennedy, 1997; Lombardo, 1987–1988; *Loving v Virginia*, 1967; Sealing, 2000; Sherman, 1988). It took until 2015 with the *Obergefell v Hodges* ruling on gay marriage for the Supreme Court to reaffirm that the right to marry (whom you wish) was a civil right afforded under the 'equal protection clause' of the 14th Amendment (Yoshino, 2015). Though laws may change, some 'biological' attitudes on which such racist laws rest, like the one-drop rule, persist, and influence American society to this day (Alba, 2016; Hollinger, 2005; Khanna, 2010; Speali., 2012; Witzig, 2014).

6 | THE MORE THINGS CHANGE, THE MORE EUGENICS STAYS THE SAME: NEW EUGENICS IN THE LATE 20TH/EARLY 21ST CENTURY

As we have seen 'classic eugenics' experienced its zenith, or maybe more appropriately its nadir, with the Holocaust and other Nazi atrocities in the 1930–1940s. In the wake of the Second World War, the victorious liberal democratic nations of the world (most notably the US and Britain), despite their complicity in giving rise to the scientific and legal systems that formed the Nazi eugenic programs, rightfully rejected the blatant -ism-based eugenic practices of Nazi Germany and questioned the unscientific basis of 'classic eugenics' (Epstein, 2003; Kevles, 1985; Mazumdar, 2002; Ranisch, 2019). Though the 'reform eugenics' of the 1940s–1970s which replaced 'classic eugenics' also reduced its dependence on coercive policies, its core ideology remained the same: the overall goal of 'human improvement' (Epstein, 2003; Kerr & Shakespeare, 2002; Kevles, 1985; Mazumdar, 2002; Ranisch, 2019). Still, eugenic ideas must have been relegated to the fringes of scientific culture, isolated to crackpots and loons in the late 20th/early 21st centuries, right? Think again. Here is what James Watson, co-discoverer of the DNA helix and co-recipient of the 1962 Nobel Prize in Physiology or Medicine (Figure 2), wrote in 1995:

"Our growing ability to unscramble human genetic destinies will increasingly have an impact on how humans view themselves and justify their behavior toward others. Our children will more be seen not as expressions of God's will, but as results of the uncontrollable throw of genetic dice that do not always give

us the results we want. At the same time, we will increasingly have the power, through prenatal diagnosis, to spot the good throws and to consider discarding through abortion the bad ones...But diabolical as Hitler was, and I don't want to minimize the evil he perpetuated using false genetic arguments, we should not be held in hostage to his awful past. For the genetic dice will continue to inflict cruel fates on all too many individuals and their families who do not deserve this damnation. Decency demands that someone must rescue them from genetic hells. If we don't play God, who will?" (Watson, 1995)

And here is what Robert Edwards, developer and pioneer of in vitro fertilization and recipient of the 2010 Nobel Prize in Physiology or Medicine (Figure 2), said in 1974 and 1999:

"...any [scientific] method of potential value in raising human standards should be considered, and [human reproductive] cloning might contribute towards this end by providing pools of talent [1974]... Soon it will be a sin of parents to have a child that carries the heavy burden of genetic disease. We are entering a world where we have to consider the quality of our children [1999]." (Obasogie, 2013)

These statements of renowned scientists are disturbing echoes of the past:

"Through educational means the State must teach individuals that illness is not a disgrace but an unfortunate accident which has to be pitied, yet that it is a crime and a disgrace to make this affliction all the worse by passing on disease and defects to innocent creatures, out of mere egotism." – Adolf Hitler in *Mein Kampf* (Hitler, 1939)

None of this is meant to impugn the scientific contributions of Watson, Edwards, or other modern-day scientific trailblazers who may hold eugenic-like beliefs. Rather these quotes are given (contrasted with that of Adolf Hitler, our common eugenic boogeyman) to provide a warning that eugenic ideas continue to persist even after all humanity has experienced in its name. It is also worth acknowledging that the slippery-slope from the first clause of Hitler's statement showing compassion for the genetically diseased and disabled (which was written nearly a decade before he came to power), to state-

sponsored sterilization in order to prevent more 'defectives' from entering society (Mostert, 2002; M. Robertson et al., 2019; Sofair & Kaldjian, 2000; Teicher, 2019), to euthanasia of the already living diseased and disabled (Kessler, 2007; Mostert, 2002; M. Robertson et al., 2019), to wholesale genocide (Boden, 2011; Childers, 2017; Connally, 1999; Friedlander, 1997; Haas, 2008; Hayes, 2017; Lewy, 1999; Lutz & Lutz, 1995; McMillan, 2014; Rosenhaft, 2011) is anything but theoretical (Figure 2).

6.1 | The rise of medical genetics

In *The Science of Human Perfection: How Genes Became the Heart of American Medicine*, Johns Hopkins University science historian Nathaniel Comfort writes:

"The eugenic origins of human genetics are sequestered in the past, separated from modern medical human genetics by the historical firewall of World War II...in this book I treat human improvement and the relief of suffering as two goals of all eugenics – and all medical genetics" (Comfort, 2012).

The parity of eugenic and medical genetic visions Comfort proposes is likely to cause some discomfort (no pun intended) in our readers, as it should. But as we have already attempted to show, the path from past to present, *vis-à-vis* eugenic science, is twisted and complicated but largely unbroken.

The shadow cast by Nazi eugenic policies was long indeed. In post-war America, only the most rabid eugenacists espoused publicly their early 20th century beliefs (Agar, 2019; Brown, 2019; Comfort, 2012; Epstein, 2003; Garver & Garver, 1994; Kevles, 1999; Mazumdar, 2002; Micklos & Carlson, 2000; Wilson, 2017; Winfield, 2012). The Galtonian idealism of human improvement that was core to all eugenic belief did not however simply evaporate once the Holocaust was known to the world. No, it acquired new connotations and labels: First, this idealism found expression in public health and heredity clinics in the 1930–1940s (Figure 2; Comfort, 2012; Dice, 1952; Resta, 1997). Out of these arose the first medical programs in "human genetics" at universities such as Ohio State, Wake Forest, Michigan, Minnesota, Johns Hopkins, Washington, and Wisconsin (Figure 2; Comfort, 2012). These new academic research and clinical programs gave credibility to, and drove the growth of, the emergent field of medical genetics (Comfort, 2012; Dunn, 1962; McKusick, 1975). The Dice (1952), Dunn (1962), and McKusick (1975) articles cited above

each represented a "presidential address" to the American Society of Human Genetics (Figure 2; which evolved out of the leadership of the early heredity clinics and human genetics programs; Comfort, 2012). In their reading, one will get not just the history of the field but see how the lines of eugenics and medical genetics got more and more blurred with time. As Comfort has said:

"The promises of genetic medicine are [author emphasis] the promises of eugenics... eugenics was the means by which genetics went medical...Eugenics is the lifeblood of medical genetics, the very reason genetics appealed to physicians...As long as their primary objective remained the reduction of individual suffering, physicians could become enthusiastic supporters of long-standing eugenic goals such as reducing the burden on society of the unfit" (Comfort, 2012).

The early medical genetics of the 1940–1950s has, of course, changed with technology and knowledge advancements, but, as a core of American medicine, it is still with us today. Label it how you'd like: medical genetics, human genetics, preventative genetic medicine, genetic public health—it all boils down to 'medical eugenics' (Comfort, 2012).

"Cover one eye when looking at the heredity clinics and you think you are looking at an old-fashioned eugenics office. Cover the other, and you see something very like a medical genetics clinic of the 'modern' period. Stereoscopically, the images blend, gaining texture and depth. Their founders saw them as the next logical step in the medicalization of negative eugenics" (Comfort, 2012).

6.2 | Reproductive technology, genetic testing, and 'medical eugenics'

Technological advances in human genetics and reproduction during the latter part of the 20th century, together with the fruits of the human genome project (Collins & McKusick, 2001; Collins et al., 2003; L. Roberts, 2001; Watson, 1990) in the first decade of the 21st, led to yet another reshaping of the eugenics landscape. Gone was the Progressive era appetite for collectivism (Freeden, 1979; Leonard, 2005, 2016; Okrent, 2019; Stolerman, 2017) or the atomic age socialism of Hermann Muller's eugenics (Comfort, 2012); 21st century 'new eugenics' (Agar, 1998; Allen, 2001; Brown, 2019;

Comfort, 2012; Efron & Lifshitz-Aviram, 2020; Epstein, 2003; Friedmann, 2019; Garver & Garver, 1994; MacKellar, 2017, 2020; Quintyn, 2020; Ranisch, 2019; Wilson, 2017, 2018b) is instead

"guided by the principles of individual gain rather than social progress...Genetic determinism today means looking out for one's own hereditary interests, the gene pool be damned" (Comfort, 2012).

The development of assisted reproductive technologies (ART), such as in vitro fertilization (IVF; Bavister, 2002; R. G. Edwards, 2007; Kamel, 2013; Löwy, 2020), along with various means of genetic testing (e.g., carrier, pre-conception, IVF-linked preimplantation, prenatal, and newborn) (Bombard et al., 2010; Brezina & Kutteh, 2015; Hashiloni-Dolev et al., 2019; Heijligers et al., 2018; Lazarin & Haque, 2016; Nazareth et al., 2015; Parikh et al., 2018; J. S. Roberts & Ostergren, 2013; T. Zhang et al., 2019), transformed the field of medical genetics (Figure 2). Once limited in reach and impact (Comfort, 2012), the techniques of medical genetics can now be offered and practiced in a patient-centric fashion relatively cheaply and on a mass scale (Agar, 1998, 2019; Allen, 2001; Garver & Garver, 1994; Hashiloni-Dolev et al., 2019; Kerr & Shakespeare, 2002; Wilson, 2017, 2018b). Medical genetic technologies are marketed to the public as: part of family planning and function; a means to detect, minimize (via available therapies/treatments), or prevent (via embryo selection or abortion) disease; and to provide reproductive choice (Begović, 2019; Bombard et al., 2010; Brezina & Kutteh, 2015; Brinsden, 2009; Genoff Garzon et al., 2018; Löwy, 2020; Zuckerman et al., 2017). In the US health care system another unspoken, yet no less real, factor motivates marketing of these technologies as well: profit (Comfort, 2012; Fox, 2007; Garland-Thomson, 2020; Kevles, 2016; King, 1999; Kitcher, 1996; Singer, 2003). When each of these factors is thrown in a blender with the history of eugenics, we end up with an opaque ethical slurry that beggar's easy definition.

So, what is 21st century medical genetics? Is it 'medical eugenics,' as Comfort has labeled it (Comfort, 2012)? Some scholars argue that medical genetics is not eugenics at all since its goals are individual- and/or family-oriented and pursued freely, rather than being coerced as part of a social-genetic engineering program of an authoritarian state (Cowan, 2009a, 2009b; Emmerich & Gordijn, 2019; Epstein, 2003). Others argue that neither utopian social engineering nor coercion are prerequisite for a eugenic program, and that only a goal of 'genetic improvement of humanity,' which is also central to the

medical genetic mission, is necessary (Agar, 1998, 2019; Allen, 2001; Brown, 2019; Efron & Lifshitz-Aviram, 2020; Fox, 2007; Garland-Thomson, 2020; Kevles, 2016; King, 1999; Kitcher, 1996; MacKellar, 2017, 2020; Peters, 2019; Wilson, 2017, 2018a, 2018b). These scholars are indeed willing to attach the label of 'eugenics' to modern medical genetics. While none join Comfort in using 'medical eugenics' as a label, they use a variety of other labels: 'new eugenics/newgenics' (Allen, 2001; Brown, 2019; MacKellar, 2017, 2020; Wilson, 2017, 2018a, 2018b); 'liberal eugenics' (Agar, 1998, 2019); '*laissez faire* eugenics' (Kitcher, 1996); 'velvet eugenics' (maybe because "it's kitschy but still feels good") (Garland-Thomson, 2020); the non-eugenic-termed, but quite descriptive 'conditional parentage' (Efron & Lifshitz-Aviram, 2020); and our personal favorites 'free-market eugenics' or 'consumer eugenics' (King, 1999; Peters, 2019). Still other scholars, though recognizing the potential parallels between medical genetics and eugenics, prefer to avoid labeling with a historically-loaded term like 'eugenics.' Instead, this group argues for label-free and open debate of the ethics, policies, and practice of medical genetics (Begović, 2019; Friedmann, 2019; Gabel & Moreno, 2019; Löwy, 2020; Powell, 2015; Ranisch, 2019). Though we agree that open debate and discussion about all aspects of medical genetics is a must, as we are about to see, recent developments suggest that it would be imprudent to throw eugenic concepts out of the discussions at this point.

6.3 | Case study 4: Editing humanity

The ability to detect genetic disease is just the first step in a successful medical genetics approach; being able to effectively treat a discovered disease and relieve potential suffering is the therapeutic goal. The ultimate objective, however, is elimination of disease—one that shares a history with eugenics. Over the past decade advances in gene editing technology put 'cures' for genetic diseases within reach, through repair of disease-causing alleles in patients (i.e., somatic cell genome/gene editing, or SCGE), or even removal of such alleles from the human gene pool (i.e., germline genome/gene editing, or GGE; Ashmore-Harris & Fruhwirth, 2020; Delhove et al., 2020; Knott & Doudna, 2018; MacKellar, 2017, 2020; Powell, 2015; Ranisch, 2019; van Dijke et al., 2018; Wolf et al., 2019). It is to these new advances, and the prospects of their 'free-market' or 'consumer eugenic' uses (and potential abuses), we now turn our attention in our fourth and final Case Study. The book *Editing Humanity: The CRISPR Revolution and the New Era of Genome Editing* by Kevin Davies (Davies, 2020), executive editor

of *The CRISPR Journal* and founding editor of *Nature Genetics*, serves as the focal point of our discussions on these topics.

Four central themes run through *Editing Humanity* that we wish students to engage with: (a) the development of gene editing technology, especially the CRISPR (clustered regularly interspaced short palindromic repeats)/Cas (CRISPR-associated) system; (b) initial discussions within the scientific community about how and when to utilize CRISPR/Cas technology; (c) the November 2018 revelation that twin girls born in China had been germline-edited with CRISPR/Cas; and (d) the fallout from this reckless and unethical experiment (Davies, 2020). Let us begin with CRISPR/Cas gene editing system.

The seismic shift in gene editing that resulted from the development of the CRISPR/Cas system prompted Fyodor Urnov, professor of genetics, genomics and development at the University of California-Berkeley, to label the 'era of genome editing' as either B.C. ('before CRISPR') or 'A.C.' ('after CRISPR'; Urnov, 2018). Though the exact date probably only really matters for the ongoing patent disputes (Churi & Taylor, 2020; J. Cohen, 2019-a; Davies, 2020; Greely, 2021; Sherkow, 2018), most generally agree that the A.C. period began either in June 2012 or January 2013 (Figure 2; Bak et al., 2018; Doudna & Charpentier, 2014; Tröder & Zevnik, 2021; Urnov, 2018). The first report that the CRISPR/Cas system could be used as a genome editing tool was published in *Science* in June of 2012 (Jinek et al., 2012); while three independent reports were published in January of 2013, two in *Science* and the one in *eLife*, demonstrating the utility of CRISPR/Cas as an efficient RNA-guided gene editing system in human cells (Cong et al., 2013; Jinek et al., 2013; Mali et al., 2013). Ironically, CRISPR/Cas was studied quite intensively for 25 years 'B.C.', but these earlier studies were focused on the native biological function of CRISPR/Cas as a prokaryotic adaptive immune system, not as a gene editing system (see Doudna & Charpentier, 2014). It is also important to note that CRISPR/Cas is not the only gene editing system that has been developed. It was preceded by several others, including homing meganucleases, ZFNs (zinc-finger nucleases), and TALENs (transcription-activation-like effector nucleases; Bogdanove & Voytas, 2011; Carroll, 2008; Christian et al., 2010; Joung & Sander, 2013; J. C. Miller et al., 2007, 2011; Pâques & Duchateau, 2007; Porteus & Baltimore, 2003; Reyon et al., 2012; Sanjana et al., 2012; Stoddard, 2005, 2014; Urnov et al., 2010; F. Zhang et al., 2011). However, none of these earlier gene editing platforms are as cheap, simple, or flexible to use as CRISPR/Cas (Bak et al., 2018; Tröder & Zevnik, 2021), thus the general validity of the

Urnov 'B.C./A.C.' timeline (Urnov, 2018). Davies sums up well the democratizing impact of the CRISPR/Cas advance:

"CRISPR is one of those once-in-a-generation breakthroughs that changes the way science is conducted almost overnight...Earlier methods for gene editing was conceived in the early 2000's...In 2011, the year before CRISPR burst into the scientific mainstream, the journal Nature Methods anointed genome editing its 'Method of the Year.' ZFNs and another platform called TALENs have their admirers, but were too fussy and expensive to break out the way CRISPR has...CRISPR takes the premise of other forms of genome editing and (in the parlance of Spinal Tap) turns it up to 11." (Davies, 2020)

This effuse assessment of CRISPR/Cas is not merely poetic license of an author who was close to the drama. In 2020, Jennifer Doudna (professor of biochemistry, biophysics, and structural biology at the University of California-Berkeley) and Emmanuelle Charpentier (professor and Managing Director of the Max Planck Unit for the Science of Pathogens, Berlin) were awarded the Nobel Prize in Chemistry for their path-setting work on CRISPR/Cas (Figure 2). It is not however the technology per se that makes CRISPR/Cas so revolutionary, but rather its potential application for medical genetics. Robert Sinsheimer, biophysicist and an intellectual father of the Human Genome Project (Davies, 2020; Sinsheimer & Cook-Deegan, 2013), said this about advances in biology in 1969: "*The application of knowledge requires technology, but the impact of knowledge can precede its application*" (Sinsheimer, 1969). This observation is no less true of the gene editing era, especially A.C. With an established field of medical genetics, and now the technical tools to edit disease-causing alleles *ex vivo* or *in vivo*, will we put the cart in front of the horse? Will the desire to 'cure' be so great that we proceed without due caution and appropriate ethical concern? In the same 1969 article, Sinsheimer also waxed rather eugenically about what he saw as man's genetic near future:

"Today there is much talk about the possibility of human genetic modification - of designed genetic change, specifically of mankind. A new eugenics has arisen, based upon the dramatic increase in our understanding of the biochemistry of heredity and our comprehension of the craft and means of evolution. I think this possibility, which we now glimpse

only in fragmented outline, is potentially one of the most important concepts to arise in the history of mankind. I can think of none with greater long-range implications for the future of our species. Indeed this concept marks a turning point in the whole evolution of life. For the first time in all time a living creature understands its origin and can undertake to design its future...I know there are those who find this concept and this prospect repugnant - who fear, with reason, that we may unleash forces beyond human scale and who recoil from this responsibility. I would suggest to them that they do not see our present situation whole. They are not among the losers in that chromosomal lottery that so firmly channels our human destinies...We are among those who were favored in the chromosomal lottery, and, in the nature of things, it will be our very conscious choice whether as a species we will continue to accept the innumerable, individual tragedies inherent in the outcome of this mindless, age-old throw of dice, or instead will shoulder the responsibility for intelligent genetic intervention...We can be the agent of transition to a wholly new path of evolution. This is a cosmic event" (Sinsheimer, 1969).

Sinsheimer's words fit this moment in the 'A.C.' age of gene editing quite presciently. If you are feeling uncomfortable, that is good. Even if our ethics do not save us from following the white-coated rabbit down the eugenic hole,⁸ maybe our discomfort and fear will.

But before we despair, let us examine a time half a century ago when another ethical crisis arose in molecular genetics and what science did to meet it. In the early 1970s, Stanford University was the center of the molecular biology universe and out of her hallowed halls arose recombinant DNA (rDNA) technology (Figure 2; D. E. Berg et al., 1974; Chang & Cohen, 1974; S. N. Cohen et al., 1972, 1973; Jackson et al., 1972; Lobban & Kaiser, 1973; Mertz & Davis, 1972; Morrow et al., 1974). For the first time pieces of DNA could be mixed and matched, and whole new genes created; it was a first molecular step toward the gene editing revolution (P. Berg & Mertz, 2010; Urnov, 2018). But from the beginning those making the discoveries were also sounding alarms of caution; most notable among them was biochemist, and eventual (1980) Nobel Prize in Chemistry recipient (for rDNA), Paul Berg (Figure 2; Friedberg, 2014; Greely, 2021). Beginning with discussions at a Gordon Research Conference on Nucleic Acids in June of 1973 and culminating with the two famous (in molecular

biology circles and bioethics circles anyhow) Asilomar Conferences on Recombinant DNA molecules (Figure 2), the molecular biology community in conjunction with the National Academy of Sciences, National Institute of Medicine (now National Academy of Medicine), and National Institutes of Health (NIH) discussed, debated, prepared, and published reports on how regulation and oversite of this nascent field would occur (P. Berg, 2008; P. Berg et al., 1974, 1975; Comfort, 2012; Greely, 2021; Singer & Soll, 1973). Initially a call was made for a voluntary moratorium on certain kinds of rDNA work (P. Berg et al., 1974), during which time a set of quite thoughtful and thorough guidelines for regulation of rDNA were developed (P. Berg et al., 1975). To this day, these guidelines are overseen and enforced by the Recombinant DNA Advisory Committee at NIH and local Institutional Biosafety Committees at each college/university or public institution participating in rDNA research. While the Asilomar Conferences and their resulting regulations were not always perfect, they have served as a model for community oversight to allow ethical and safe practice of the rDNA science to continue and progress.

In January of 2015, Jennifer Doudna, operating very much in the spirit and historical reverence of the Asilomar Conferences, organized the first conference to discuss CRISPR/Cas technology. Held in Napa Valley (Figure 2), the gathering of 14 attendees included two of the organizers of the 1975 Asilomar II Conference, Paul Berg and David Baltimore (Davies, 2020; Greely, 2021). A report from the conference published in *Science* articulated four basic recommendations: (a) to strongly discourage any attempts at GGE in humans; (b) to encourage transparent research to evaluate the efficiency and specificity of CRISPR/Cas gene editing; (c) to create forums for scientists and bioethicists to provide information about potential application, ethics, and legal implications of CRISPR/Cas gene editing; and (d) to convene a globally representative group of all stakeholders (including the public) to discuss CRISPR/Cas gene editing, and where appropriate, make recommendations (Baltimore et al., 2015). Another group in the field, including Urnov, who were not part of the Napa conference, shortly thereafter called for a voluntary moratorium on human GGE (Lanphier et al., 2015).

Not everyone felt the Asilomar approach to CRISPR/Cas gene editing was sufficient to deal with a topic so wide-reaching and evolutionarily consequential. Harvard bioethicist Sheila Jasanoff and colleagues wrote:

"CRISPR-Cas9 offers, at first sight, a technological turn that seems too good for humankind to refuse. It is a quick, cheap, and surprisingly precise way to get at nature's

genetic mistakes and make sure that the accidentally afflicted will get a fair deal, with medical interventions specifically tailored to their conditions. Not surprisingly, these are exhilarating prospects for science and they bring promises of salvation to patients suffering from incurable conditions. But excitement should not overwhelm society's need to deliberate well on intervening into some of nature's most basic functions. That deliberation, in our view, demands a more sophisticated model than 'Asilomar-in-memory,' a flawed and simplistic approach to evaluating alternative technological futures in a global society" (Jasanoff et al., 2015).

Sadly, not long after the call for restraint the first reported use of CRISPR/Cas to edit a human embryo was published (Liang et al., 2015). Though non-viable tripronuclear embryos were used in these experiments, and thus the changes made were not germline heritable, a 'redline' had been crossed and it was clear that simple appeals to collegial restraint were not enough (Davies, 2020). It would seem the bioethicists had already seen the rabbit hole.

But staying true to the more conservative approaches of academia the scientific community continued on the Asilomar-style path for discussion and debate on CRISPR/Cas oversite and regulation. As occurred with rDNA discussions four decades earlier, the National Academies next got involved; in this case calling for a Human Genome Editing Initiative and an international conference to start broader dialog (Greely, 2021). The First International Summit on Human Genome Editing occurred in September of 2015 in Washington, DC (Figure 2; Davies, 2020; Greely, 2021). The recommendations coming out of the conference were quite similar to those articulated in Napa, not surprisingly as there was considerable overlap in participants and leadership (Greely, 2021).

The Second International Summit on Human Genome Editing was held in Hong Kong in late November 2018 (Figure 2). One day before the summit began an investigative reporter with *MIT Technology Review*, Antonio Regalado, broke a story that changed not only the tenor of the summit, but the entire future of the gene editing discussion: "EXCLUSIVE: Chinese scientists are creating CRISPR babies" (Figure 2; Davies, 2020; Greely, 2021; Regalado, 2018). A second news article by Marilynn Marchione, chief medical correspondent for the Associated Press, released just hours after Regalado's, provided a critical revelation that sent the story into a fever pitch: the CRISPR/Cas gene-edited

babies, twin girls, had already been born (Figure 2; Davies, 2020; Greely, 2021; Marchione, 2018). At this moment in 2018, it indeed appeared that humanity was one critical step closer to being enticed down the eugenic rabbit hole.

The scientist who took it upon himself to cross the "redline" of heritable human GGE the community had hoped to delay until thoughtful and appropriate guardrails, regulations, and oversite were in place, was He Jiankui (Davies, 2020; Greely, 2021). He earned his PhD degree in bioengineering at Rice University and was a postdoctoral researcher at Stanford before taking a faculty position at Southern University of Science and Technology in Shenzhen, China in 2012 (Davies, 2020). He's "experiment" (in quotes here to reflect the Promethean-like quality of what He did) was never published and we may never know the entire story given the lack of transparency in the Chinese system. However, we did learn some important facts from He's presentation at the summit (Davies, 2020), and from subsequently released Chinese government 'perspectives' from his criminal trial for 'unauthorized practice of medicine' (Greely, 2021). Let us first examine the 'experiment' itself.

The main goal of the 'experiment' was to generate children engineered to be resistant to HIV infection. This would be accomplished by editing both alleles of the normal wild-type *CCR5* gene to mutant alleles called *CCR5Δ32*. The wild-type *CCR5* gene encodes a plasma membrane receptor which can function with CD4 as a co-receptor for HIV infection of T cells (Browning et al., 1997; Choe et al., 1996; Fauci, 1996; J. P. Moore, 1997), while *CCR5Δ32* contains a 32 base deletion which renders the encoded *CCR5* non-functional as an HIV receptor (Y. Huang et al., 1996; Martinson et al., 1997; Samson et al., 1996). The *CCR5Δ32* allele is found naturally in human populations, being most abundant in people of northern European descent, and very few HIV⁺ individuals carry two *CCR5Δ32* alleles (Davies, 2020). In 2009, it was reported in the *New England Journal of Medicine* that an HIV-positive patient, who received a hematopoietic stem cell transplant from a *CCR5Δ35/CCR5Δ35* donor for treatment of acute myeloid leukemia, had remained HIV free for 20 months following the transplant in the absence of antiretroviral therapy (Hütter et al., 2009). From a purely theoretical standpoint He's 'experiment' seemed to have merit; but this was where merit ended.

From He's presentation at the summit, it was clear that neither CRISPR/Cas-engineered embryo contained the *CCR5Δ32* mutation; both contained novel variants of *CCR5* with unknown impact on function, with one embryo having only one allele altered (the other was still wild-type in sequence; Davies, 2020; Greely, 2021).

Davies, who was in the room as He presented his results, wrote:

"Instead of precisely excising the 32 letters of genetic code, it was if the editor [He] had shut his eyes and slashed at the page with a red pen, hoping to erase the right words" (Davies, 2020).

To make things worse, it appeared that the twins were likely to be mosaic for *CCR5* (e.g., different cells having different complements of mutant and wild-type alleles; Davies, 2020; Greely, 2021). Thus, any potential protective benefit of the editing was hugely problematic as few, if any, target T cells might even carry the mutant *CCR5* allele (never mind that it would not even be the desired *CCR5Δ32* allele). The misedit and mosaicism problems He encountered, along with potential "off target" edits which were not addressed, were already well-documented issues with CRISPR/Cas editing (Cho et al., 2014; Fogarty et al., 2017; Fu et al., 2013; Hsu et al., 2013; Tang et al., 2017); including for *CCR5* edits in nonviable human embryos (Kang et al., 2016). Each of these potential problems with CRISPR/Cas use were all cited by the community as reasons for not proceeding with human GGE (Baltimore et al., 2015; Bosley et al., 2015; Lanphier et al., 2015). Yet He forged ahead, the promise of fame and fortune (He also co-founded two biotechnology companies (Davies, 2020) and was in discussions about opening clinics in China that could serve as hubs for 'medical tourism' (Greely, 2021)) too great to ignore for such trivialities as clinical safety.

Surely however, He approached his 'experiment' in otherwise ethical ways? Short answer: Nope. In his recent book about the He saga, *CRISPR People: The Science and Ethics of Editing People*, Stanford law professor Henry T. Greely sums up nicely the ethical morass:

"The experiment was criminally reckless as well as grossly premature, and deeply unethical...[the experiment] has at least five major problems: a terrible risk/benefit ratio; very questionable consent; inappropriate approval process; complete opacity; and, finally, the violation of what came as close as possible in the world of science to an international consensus against germline genome editing" (Greely, 2021).

The condemnation He received from the scientific and ethics community has been extensive and largely uniform (Al-Balas et al., 2020; Botkin, 2020; Charo, 2019;

J. Cohen, 2019b; Davies, 2019; Doudna, 2020; Dyer, 2018; Dzau et al., 2018; Lander et al., 2019; Musunuru, 2019; Rosenbaum, 2019; Wolinetz & Collins, 2019), though a few like Harvard professor of genetics George Church have defended He's "experiment." In the Marchione AP article, Church was quoted as saying: "*I think this [the attempt to GGE HIV resistance] is justifiable*" (Marchione, 2018). In a subsequent interview with *Science* reporter Jon Cohen, Church said:

"...it [the condemnation of He] seems like a bullying situation to me. The most serious thing I've heard is that he didn't do the paperwork right. He wouldn't be the first person who got the paperwork wrong. It's just that the stakes are higher. If it had gone south and someone had been damaged, maybe there would be some point...I was hoping he did everything right. You don't have that many shots on goal. He's not doing it the way I'd do it, but I'm hoping it doesn't work out badly. As long as these are normal, healthy kids it's going to be fine for the field and the family..." (J. Cohen, 2018).

When asked by Cohen if he would have taken part in the He 'experiment,' Church responded:

"Probably not. But I probably wouldn't have put the sequence of the 1918 flu virus or smallpox virus in the public domain. This is a slightly lower risk than putting potent pathogenic sequences in the public domain" (J. Cohen, 2018).

This rather chilly comment from Church reminds us of the immortal words of Mr. Spock in *Star Trek III: The Search for Spock* (1984): "*Logic clearly dictates that the needs of the many outweigh the needs of the few.*" To which we would respond: "...or the CRISPR twins."

At this point in our course—after immersing themselves in 'classic eugenics,' American and Nazi eugenics of the early/mid 20th century and their commonalities (scientific, prejudice/ism, and legal), 'reform eugenics' and the establishment of medical genetics/medical eugenics,' and potential rise of 'new eugenics' with advances in reproductive technologies, genetic testing, and gene editing—students were asked to consider, and then develop arguments either 'affirming' or 'disavowing' the following statement: *As a potential parent it is my right to utilize all modern gene editing technology to ensure that my child carries only the traits his/her parents desire.* How would you argue?

7 | CONCLUSIONS

Eugenics is both historical and current; it has been utopian and idealist, as well as prejudicial, ugly and genocidal. 'Classic eugenics,' once the darling of 'well-born,' well-to-do, high society types, has transformed into the specter of 'free-market eugenics' represented by medical genetics and the potential of CRISPR/Cas-based gene editing writ large for the consumer masses. Inherent in this new 'free-market eugenics' is the freedom of individual choice to pursue human betterment. Despite the general lack of coercive methods in modern western medicine, the slippery-slope from ideas of human improvement to a new era of eugenics is not theoretical, we have seen it play out before, as the >6.5 million dead in the Holocaust attests. The initial shock and fear of He's 'CRISPR babies' was short-lived and though human GGE is still not currently accepted practice, it is only a matter of time; the details of technical delivery, safety, ethics, access and equity, oversite and regulation, as well as other issues are currently being discussed, debated, and decided (Adashi & Cohen, 2020a, 2020b; Adashi et al., 2020; Arguedas-Ramírez, 2020; Baylis et al., 2020; Charo, 2019; Davies, 2019; J. H. Evans, 2021; Friedmann, 2019; Gabel & Moreno, 2019; Greely, 2019; Hildebrandt & Marron, 2018; Howell et al., 2020; Isa et al., 2020; Jasanoff & Hurlbut, 2018; Jasanoff et al., 2019; Locke, 2020; Marchant, 2021; Peters, 2019; Ranisch, 2019; Townsend, 2020; Turocy et al., 2021; Wolf et al., 2019). Will we continue to pursue the Asilomar-style discussions and debates, even expanded to include a broader assemblage of stakeholders (i.e., representatives of all of humanity!)? Or will we embrace other approaches? Might we use, as geopolitical and US foreign relations expert Jamie Metzl has suggested, the 1960's development of the Non-Proliferation Treaty to meet the existential crises of a potential nuclear apocalypse as a model (Metzl, 2019)? Only time will tell.

Though there are still serious concerns about the safety of CRISPR/Cas gene editing—be it on—target mis-edits, off-target edits, mosaicism (Cho et al., 2014; Fogarty et al., 2017; Fu et al., 2013; Hsu et al., 2013; Tang et al., 2017), recently described chromothripsis ("chromosome shredding"; Leibowitz et al., 2021; Urnov, 2021a), or the existence of human immunity to Cas proteins, such as Cas9 (Charlesworth et al., 2019; Crudele & Chamberlain, 2018; Ferdosi et al., 2019; Gough & Gersbach, 2020; Li et al., 2020; Mehta & Merkel, 2020; Simhadri et al., 2018; Wagner et al., 2019; Wignakumar & Fairchild, 2019)—medical genetics marches on with several clinical trials and applications of CRISPR/Cas-based SCGE therapies already ongoing (Doudna, 2020; Foss et al., 2019; Khalaf et al., 2020; Lu

et al., 2020; Stadtmauer et al., 2020; Urnov, 2021b; Yan & Li, 2020). The NIH recently announced a "Somatic Cell Genome Editing Consortium" to further facilitate such therapeutics (Figure 2; Saha et al., 2021). And even if CRISPR/Cas gene editing is slow to come to fruition, the Covid-19 pandemic has created new opportunities, as CRISPR/Cas-based SARS-CoV-2 detection and diagnostic tools have been developed and brought to market (Broughton et al., 2020; Hou et al., 2020; Z. Huang et al., 2020; Ooi et al., 2021).

Though global public understanding, perceptions, and opinions on gene editing are far from clear (Howell et al., 2020), where surveys have been done the views are generally positive toward 'medically-relevant' uses of human gene editing; with SCGE being seen more favorably than GGE (Delhove et al., 2020). In Britain, where 'classic eugenics' began, even the idea of using transnational 'medical tourism' to obtain gene editing services one might not get in the UK is seen positively by two-thirds of 521 surveyed (Kaur, 2020). It would thus appear that CRISPR the Cheshire cat is guiding us deeper into the rabbit hole, to where is the question: eugenic madness or genetic paradise?

In our class, we want students to see the breadth of science and its interfaces with society—the good, the bad, and the ugly. Yet we also want them to walk away with some hope for the future. Much like Pandora's box of Greek mythology, advances in science, once revealed cannot be forgotten (once out of the box they cannot be put back in)—just think about nuclear fission and the development of the atomic bomb. However, it is worth remembering that Pandora closed her box soon enough to trap 'hope.' Though, as stated by The Architect in *The Matrix Reloaded* (2003):

"Hope, is the quintessential human delusion, simultaneously the source of your greatest strength, and your greatest weakness."

With all due respect to The Architect, Hope is the goal of our class and this article—Hope for each of us to better anticipate potential societal impacts of scientific advancements, before they happen, so maybe some of the evils escaping the box can be minimized or prevented.

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AUTHOR CONTRIBUTIONS

Mannie Liscum: Conceptualization (equal); writing – original draft (equal); writing – review and editing (equal). **Michael Leonard Garcia:** Conceptualization (equal); writing – original draft (equal); writing – review and editing (equal).

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ENDNOTES

¹ Primo Levi (1919–1987) was a Jewish-Italian chemist who survived captivity and enslaved-labor in Auschwitz III-Monowitz. Monowitz was a sub-camp of the Auschwitz complex where German chemical giant IG Farben (IG Farbenindustrie AG) and the SS co-operated in a venture to make synthetic rubber and fuel. Though not directly connected to Levi, the Jewish-German chemist Fritz Haber completed much of his 1918 Nobel awarded research at BASF with Carl Bosch (who was awarded a Nobel in 1931 for high pressure chemistry). Bosch was a founding member and first CEO of IG Farben, when it formed from six preexisting German chemical concerns (including BASF) in 1925. Haber served on the board of supervisors of IG Farben from 1926 until 1933 when he was forced to resign because of Nazi antisemitic policies. Bosch was Chairman of Board of Directors of IG Farben from 1935 until his death in 1940. Auschwitz III was built in 1941–1942. Diarmuid Jeffreys has written a fascinating account of the IG Farben-Nazi compact and exploitation of science and victims of the Holocaust (Jeffreys, 2008).

² https://www.yadvashem.org/odot_pdf/Microsoft%20Word%20-%20206419.pdf

³ <https://encyclopedia.ushmm.org/content/en/article/introduction-to-the-holocaust>

⁴ In May of 2016, the International Holocaust Remembrance Alliance adopted a standard definition of antisemitism as: “*a certain perception of Jews, which may be expressed as hatred toward Jews. Rhetorical and physical manifestations of antisemitism are directed toward Jewish or non-Jewish individuals and/or their property, toward Jewish community institutions and religious facilities*” (Lipstadt, 2019).

⁵ The US Holocaust Memorial Museum describes the Nuremberg Laws thus: “*The laws excluded German Jews from Reich citizenship and prohibited them from marrying or having sexual relations with persons of ‘German or related blood.’ Ancillary ordinances to the laws disenfranchised Jews and deprived them of most political rights. The Nuremberg Laws, as they became known, did not define a “Jew” as someone with particular religious beliefs. Instead, anyone who had three or four Jewish grandparents was defined as a Jew, regardless of whether that individual identified himself or herself as a Jew or belonged to the Jewish religious community. Many Germans who had not practiced Judaism for years found themselves caught in the grip of Nazi terror. Even people with Jewish grandparents who had converted to Christianity were defined as Jews*”

(<https://encyclopedia.ushmm.org/content/en/article/the-nuremberg-race-laws>).

⁶ Here ‘liberal/liberalism’ does not refer to the American political left, but rather the Enlightenment ideals of equality and individual rights that have shaped most democratic countries, including the US (Conway, 1995).

⁷ The term ‘collateral’ is used here to reflect that the US legal system’s endemic racism is derived not from the liberal political system *per se*, but from racist attitudes of voices within the pluralistic society established by its liberality. The term is not used to excuse, or minimize, the oft systemic racism in the US legal system.

⁸ Maybe we should consider a re-visioning of Carroll’s (1865) classic as *Humanity in Eugenicland*?

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