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DNA WITHOUT WARRANT: DECODING PRIVACY,
PROBABLE CAUSE AND PERSONHOOD

*By Ken Strutin**

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"History is a fragment of biology—the human moment in the pageant of species."¹

An arrest is not a medical procedure and probable cause is not consent, and yet for purposes of genetic sampling they have become so. The Constitution considers people to be information containers with rights. And for the most part, the confiscation of a person's genome in the stationhouse is a search. But the Supreme Court seems to parse constitutional privacy between data that originates from within (biologics) and data stored without (technology). Relying on the history of identification metrics, the necessity of stationhouse identification and the rationale of custodial control, the Court has lowered the threshold of biological privacy at arrest. In contrast to the low esteem in which privacy interests in the human genome seem to be held, there is a societal, even global, consensus building over the protection of privacy in digital data, such as the right to be forgotten.² Today, the right to privacy in ourselves and in our machines are at loggerheads due in large part to the Supreme Court's perceptions of privacy, probable cause and personhood.

When the Constitution was written, information was captured with the shutter speed of a painter's eye.³ Today, as much privacy as might have

¹ Will & Ariel Durant, *THE STORY OF CIVILIZATION: PART VIII, THE AGE OF LOUIS XIV* 365 (1963). Even as a subset of biology, history has been marked by the endless struggle over the custody of human life—covering the spectrum from slavery, trafficking, servitude and imprisonment to absolute freedom of body and mind. Compare WALK FREE FOUND., *THE GLOBAL SLAVERY INDEX* (2014), with *TOWARDS A WORLDWIDE INDEX OF HUMAN FREEDOM* (Fred McMahon, ed., Fraser Inst. 2012). And in the Information Age, this struggle includes custodial surveillance through genetic sampling, electronic tracking and digital monitoring. See generally William P. Ruger & Jason Sorens, *Freedom in the 50 States: An Index of Personal and Economic Freedom*, GEORGE MASON UNIV. MERCATUS CTR., <http://freedominthe50states.org/> (last visited Feb. 2, 2015) (including references to DNA test-on-arrest laws throughout).

² See Factsheet on the "Right to be Forgotten" Ruling (C-131/12), European Commission (2014) available at http://ec.europa.eu/justice/data_protection/files/factsheets/factsheet_data_protection_en.pdf; Kate Murphy, *We Want Privacy, but Can't Stop Sharing*, N.Y. TIMES, Oct. 4, 2014, at SR4.

³ There is a famous unfinished painting depicting a meeting between American and British representatives at the close of the Revolutionary War entitled "The American Peace Commissioners," with only the outlines of the British. "Benjamin West's painting of the preliminary peace negotiations was unfinished because the British Commissioners, who were to be on the right, refused to pose." See Robert G. Athearn, *THE AMERICAN HERITAGE NEW ILLUSTRATED HISTORY OF THE UNITED STATES, VOLUME 3, THE REVOLUTION* 257 (Am. Heritage ed. 1963). This suggests the fantastically slow pace at which information was captured in the era when the Constitution was written. It would be unimaginable today to take a picture with a piece missing. Indeed, the modern digital photographer can take in information beyond the visual-cognitive threshold. Still, it is worth noting that as far as we have come technologically, criminal justice keeps one foot in the past where human perception holds sway. See, e.g., Elizabeth Williams & Sue Russell, *THE ILLUSTRATED COURTROOM: 50 YEARS OF COURT ART*, (2014) (courtroom

been protected by the Fourth Amendment can be gleaned from a momentary cheek swab.⁴ Perhaps the induction of medical science and information technology into law enforcement came too fast too soon, before the law had a chance to catch its breath.⁵ Of late, genetic identification of arrestees has again pitted the logic of law against the understanding of science, a language spoken by the legal profession with a phrase book.⁶ But personhood is permanently diminished when the factory seal on biological privacy is broken, hence the wisdom behind the warrant requirement. Indeed, warrants are natural pauses in the swift track of forensic investigation, but the Supreme Court's decision in *Maryland v. King*⁷ has removed that speed bump and lowered the bar of personhood.

Like DNA, the Fourth Amendment contains a blueprint for human privacy.⁸ The authors of the Constitution made plain that the security of the "people" is manifested by a right against "unreasonable searches and seizures" of their "persons" (body), "houses" (personal space), "papers" (memories, thoughts and transactions), and "effects" (things).⁹ Overall, the Fourth Amendment, the Bill of Rights and the Civil War Amendments formed a

artistry); J. David Goodman, *Fighting Crime with Pencil and Paper*, N.Y. TIMES, Aug. 18, 2013, at A14 (sketch artistry).

⁴ While DNA is the ultimate storage container it has not yet received protections equivalent to electronic information. See generally Mauricio Castillo, *From Hard Drives to Flash Drives to DNA Drives*, 35 AM. J. NEURORADIOLOGY 1 (Apr. 4, 2013); George M. Church et al., *Next-Generation Digital Information Storage in DNA*, 337 SCIENCE 1628 (Sept. 2012); Ken Strutin, *DNA and the Double Helix of Constitutional Rights*, 252 N.Y. L.J. 5 (2014) ("DNA is the most compact and enduring of information media. And technology now permits a life's tale to be written into the fabric of life. As the present and future host of inestimable personal information, human DNA at a minimum ought to be entitled to the full range of constitutional protections afforded inorganic data formats." (footnote omitted)).

⁵ See Adam Lamparello & Charles MacLean, *Riley v. California: The New Katz or Chimel?*, 21 RICH. J.L. & TECH. 1, 19 (2014), <http://jolt.richmond.edu/v21i1/article1.pdf> ("In the law enforcement and government surveillance context, technological advances have made it possible to store an individual's DNA in a national database, and have made it nearly impossible for that same individual to send an email, download a YouTube video, or transmit a text message without knowing that the government might be watching—without having the slightest degree of suspicion of criminal behavior.").

⁶ See generally AM. PROSECUTORS RESEARCH INST., *FORENSIC DNA FUNDAMENTALS FOR THE PROSECUTOR: BE NOT AFRAID* (2003); David H. Kaye & George Sensabaugh, *Reference Guide on DNA Identification Evidence*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 129-210 (3rd ed. 2011); NAT'L INST. OF HEALTH, *GENETICS HOME REFERENCE HANDBOOK, CHAPTER 1: CELLS AND DNA* (2014); NAT'L INST. OF JUST., *DNA FOR THE DEFENSE BAR* (2012).

⁷ 133 S. Ct. 1958 (2013).

⁸ See U.S. CONST. amend. IV ("The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.")

⁹ *Id.*

Vitruvian Man of privacy and personhood within the squared circle of constitutionality.¹⁰

Arrestee gene capture is the latest piece in the identification-investigation puzzle that already includes faces and bodies (mugshots, showups and lineups), eyes (color, retina and iris scans), fingertips (fingerprints), body measurements and markings (height, weight, tattoos, palm prints, footprints), exemplars (handwriting, voice), biologics (blood, urine, saliva, and hair) and names (aliases). Around the corner, information gathering at arrest might include the modern digital wallet, compromising everything from passwords to social media, personal electronic devices and data sources.¹¹ In the name of privacy, people are seeking security measures, including biometric and behavioral encryption, which will further complicate constitutional analysis.¹² But as for biologics, a person's DNA is not self-evidence of identification, it is one end of an evidentiary link that can only be meaningful once connected to an existing databanked sample or one obtained from crime scene evidence.¹³

When the state tinkers with human biology, it tinkers with privacy. There is a continuum of DNA information that compromises identity and extends into the entirety of an individual's life. Genetic science is forcing law to come to terms with a deeper definition of personhood.¹⁴ Indeed, DNA sampling has the potential of making anyone a suspect for life and their genetic code consciousness of guilt. And the new linkage created between DNA extraction and probable cause is a long way from the laws that approved sam-

¹⁰ See generally Ken Strutin, *DNA, Privacy and Personhood: The Crime of Being Alive*, 250 N.Y. L.J. 5 (2013) ("The Bill of Rights is instinct with privacy, the Civil War Amendments with personhood.").

¹¹ See generally Adam M. Gershowitz, *Password Protected? Can a Password Save Your Cell Phone From a Search Incident to Arrest?*, 96 IOWA L. REV. 1125 (2011).

¹² See, e.g., Nicole Perlroth, *Finding the Unique in You to Build a Better Password*, N.Y. TIMES, Dec. 23, 2011.

¹³ See, e.g., *Mario W. v. Kaipio*, 265 P.3d 389, 408 (Ariz. Ct. App. 2011), *vacated*, 281 P.3d 476 (Ariz. 2012) (Norris, J., dissenting in part, concurring in result) ("Further, by itself, DNA provides no identifying information; a DNA sample is only useful when it can be compared to a prior DNA sample obtained from the same person. If the arrestee's DNA is not in a DNA database, there can be no comparison and thus no verification of identity."); PRESIDENT'S DNA INITIATIVE, IDENTIFYING VICTIMS USING DNA: A GUIDE FOR FAMILIES 2 (2005) ("To identify the remains of a victim, DNA from remains found at the disaster or accident site must be matched to DNA known to be from the victim or the victim's relatives. Thus, it is necessary to collect DNA samples from family members and from personal items or prior medical specimens from the victim.").

¹⁴ The cells of the body are replaced at different rates over one's lifetime. However, the seemingly permanent fixtures in the human schematics are DNA and some parts of the brain. See Nicholas Wade, *Your Body Is Younger Than You Think*, N.Y. TIMES, Aug. 2, 2005, at F1, <http://www.nytimes.com/2005/08/02/science/02cell.html?pagewanted=all&r=0> ("Most molecules in a cell are constantly being replaced but the DNA is not."). The metrics of a person, which remain that person throughout their time on earth whether revealed by scientific discovery or altered by innovation, will require new definitions of identity, privacy and personhood.

pling upon proof of guilt beyond a reasonable doubt. Formerly, it was crime scene evidence, post-conviction sampling or investigative collection through a warrant or court order, but now the arrest for any crime so classified is sufficient to collect and create the genetic rap sheet of an accused.¹⁵

Conflating a warrantless identification procedure with DNA matching, the Supreme Court in *Maryland v. King* removed a layer of privacy from constitutional scrutiny and opened the door to unchecked genetic investigation. DNA as evidence of identity and guilt has received a presumption of infallibility that shuts down critical inquiry at the pretrial stage.¹⁶ So much confidence has been invested in DNA's reputation that it has become the Fogelman by which all other forensics are measured and the tide that raises all the boats.¹⁷ Indeed, a prosecution can rest on DNA evidence alone.¹⁸ Thus, assailing DNA evidence for any reason reverberates through all forensics.

The Supreme Court succeeded in creating an amalgam of identification and investigation to justify biological sampling without individualized suspicion. At the same time, their reasoning reveals the law's discomfit with science already demonstrated by the Court's recent decisions in *Cavazos v. Smith*, grappling with advances in medical science that undermined shaken baby syndrome (SBS),¹⁹ and *Association for Molecular Pathology v. Myriad Genetics* in which their understanding of the "fine details of molecular

¹⁵ See *DNA Sample Collection from Arrestees*, NAT'L INST. FOR JUST. (Dec. 7, 2012), <http://www.nij.gov/topics/forensics/evidence/dna/pages/collection-from-arrestees.aspx>. As of June 2012, twenty-eight states have enacted test-on-arrest laws; all fifty states have laws requiring DNA sampling for convicted offenders; and federal laws cover both scenarios. *Id.*

¹⁶ See *infra* Part II.

¹⁷ See NAT'L RESEARCH COUNCIL, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD 7 (2009) ("With the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source."). See generally Brandon Garrett & Peter Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 VA. L. REV. 1 (2009); *Wrongful Convictions Involving Unvalidated or Improper Forensic Science that Were Later Overturned through DNA Testing*, INNOCENCE PROJECT, http://www.innocenceproject.org/docs/DNA_Exonerations_Forensic_Science.pdf (last updated Feb. 1, 2009).

¹⁸ See generally Ken Strutin, *Limitations of Forensics as Standalone Evidence of Guilt*, 243 N.Y. L.J. 5 (2010).

¹⁹ *Cavazos v. Smith*, 132 S. Ct. 2 (2011) (reversing grant of habeas petition because Ninth Circuit improperly substituted its judgment of expert evidence on cause of infant's death for that of the trial jurors); *id.* at 10 (Ginsburg, J., dissenting) (pointing out that since Shirley Ree Smith's 1997 conviction based on shaken baby evidence [SBS], "[d]oubt has increased in the medical community 'over whether infants can be fatally injured through shaking alone.'"). Five months after the Supreme Court's decision, Gov. Brown commuted her sentence. See Carol J. Williams, *Brown Commutes Sentence of Woman Convicted of Killing Grandson*, L.A. TIMES, Apr. 7, 2012, <http://articles.latimes.com/2012/apr/07/local/la-me-shaken-baby-clemency-20120407>.

biology" in a DNA patent claim were openly questioned by Justice Scalia.²⁰ Thus, the Supreme Court's comprehension of DNA questions in general will filter down to criminal forensics and Fourth Amendment analysis.

DNA science expands the frontiers of information about individuals, their families, their travels and their humanity, and potentially reveals new areas of behavior patterns and physical appearance.²¹ Using DNA in law enforcement pushes beyond the limits of privacy through surreptitious evidence gathering, test-on-arrest sampling, dragnets and mass databanking.²² Lastly, DNA jurisprudence exposes the dissonance in the Court's understanding of science and society, biology and personhood.

From the scientific heights of genetic analysis to the mundane forensic tasks of collecting and filing biological evidence, DNA proof has become the modern workhorse of criminal investigations. While fingerprints can be compared to themselves, DNA databanks are connective tissue that touches everything human and private. Today, genetic information is being used to establish identity (arrested, missing, or deceased), familial relationships (paternity or immigration), crime scene involvement (location, participation) and public health risks.²³ In the criminal arena, DNA sampling, whether for identification or investigation, casts a pall over all proceedings from stationhouse booking to setting bail, negotiating a plea, trying a case, imposing a sentence and ultimately challenging a conviction.²⁴

²⁰ Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2120 (2013).

²¹ See, e.g., Gautam Naik, *To Sketch a Thief: Genes Draw Likeness of Suspect*, WALL ST. J., Mar. 27, 2009, at A9, <http://online.wsj.com/articles/SB123810863649052551> (describing research into techniques such as forensic Phenotyping that might reveal physical traits); Eleonore Pauwels, *Leave Me Your DNA...and I'll 3D-Print Your Face*, GUARDIAN, June 1, 2013, <http://www.theguardian.com/commentisfree/2013/jun/01/dna-art-recreate-faces>.

²² For a collection of "research on the law and science of genetic evidence at the pre-conviction stage," see Ken Strutin, *DNA Evidence: Brave New World, Same Old Problems*, LAW LIBRARY RESOURCE XCHANGE (Oct. 14, 2013), <http://www.llrx.com/features/dnaevidence.htm>.

²³ See generally SARA HUSTON KATSANIS, INST. FOR HOMELAND SEC. SOL'NS, HUMAN DNA IDENTITY TESTING POLICY REPORT 5 (2013) available at http://sites.duke.edu/ihss/files/2012/03/DNA-Policy-24Jan13_psg-sk.pdf (highlighting significant privacy and forensic practice issues; "The U.S. government has instituted policies and regulations for use of DNA in missing persons identification, military, immigration, border security, human trafficking, and intercountry adoption. . . . As U.S. authorities consider approaches to incorporating DNA profiling into migration procedures, they must tackle the concerns for (1) retention of specimens; (2) use of stored specimens; (3) security and access to specimens; (4) security and access to DNA profiles; and (5) cross-border searching and exchange of profiles.").

²⁴ See Daniel Gaudet, *Waiting for John Doe: The Practical and Constitutional Implications of DNA Indictments*, 18 SUFFOLK J. TRIAL & APP. ADV. 106, 106 (2013); Katharine C. Lester, *Affects of Apprendi v. New Jersey on the Use of DNA Evidence at Sentencing—Can DNA Alone Convict of Unadjudicated Prior Acts?*, 17 WASH. & LEE J. CIVIL RTS. & SOC. JUST. 267, 269 (2010).

Databanking of arrestee genetics will have to be carefully examined in light of concerns over equal protection and racial overrepresentation.²⁵ The very existence of DNA databases with millions of profiles weighs on law enforcement and re-enforces stereotypes perpetuated by samples from predominantly minority races and people living in high crime areas.²⁶ Indeed, DNA databases will eventually mirror arrestee populations. Currently, up to four percent of United States citizens could potentially be added to CODIS and local databases.²⁷ Of course, the maintenance and expungement of records in cases where the arrests do not result in convictions will pose challenges for DNA sampling as they do now for stop and frisk data.²⁸ The speedy development of portable micro-analytics will eventually lead to DNA field tests as easy and common as breath tests are now.²⁹ And the tea leaves of profiling will reveal connections from identification to gender to family to ancestry to behavioral profiling; and further to third party witnesses, alternate suspects, near matches (suspect relatives) and genetically identical siblings. Indeed, DNA information is never viewed in isolation but associated with other database searches that in toto are revealing a new identification mosaic.³⁰

²⁵ See *Uniform Crime Report: Crime in the United States, 2013*, FBI (Fall 2013), <http://www.fbi.gov/abo-ut-us/cjis/ucr/crime-in-the-u.s./2013/crime-in-the-u.s.-2013/persons-arrested/persons-arrested> ("In 2013, 68.9 percent of all persons arrested were white, 28.3 percent were black, and the remaining 2.9 percent were of other races.").

²⁶ See Jonathan Kahn, *Race, Genes, and Justice: A Call to Reform the Presentation of Forensic DNA Evidence in Criminal Trials*, 74 *BROOK. L. REV.* 325, 325 (2009); Karen H. Rothenberg & Alice Wang, *Scarlet Gene: Behavioral Genetics, Criminal Law, and Racial and Ethnic Stigma*, 69 *LAW & CONTEMP. PROBS.* 343, 344 (2006).

²⁷ This is based on 11.3 million arrests nationally out of a total population of 316 million people. See *Uniform Crime Report*, *supra* note 25 ("Nationwide, law enforcement made an estimated 11,302,102 arrests in 2013."); *U.S. and World Population Clock*, U.S. CENSUS BUREAU, <http://www.census.gov/popclock/> (last visited Nov. 10, 2014) ("The United States population on July 4, 2013 was: 316,148,990").

²⁸ See *e.g.*, *Lino v. City of New York*, 101 A.D.3d 552, 556 (N.Y. App. Div. 2012) (finding arrestees had standing to challenge NYPD for failure to seal their records upon dismissal and retention of their information in "stop and frisk database" for possible "future investigations.").

²⁹ See, *e.g.*, Eric Nicholson, *Fort Worth Cops Collected "Voluntary" Blood, Saliva Samples During Lunchtime Roadblock*, *DALLAS OBSERVER* (Nov. 20 2013, 8:30 AM) http://blogs.dallasobserver.com/unfairpark/2013/11/fort_worth_roadblock_saliva_blood.php; Ray Locker & Kendall Breitman, *Rapid DNA Test Could Transform Crime Fight; Aims to Analyze Samples While Suspects Are Still Held*, *USA TODAY*, Jan. 28, 2014, at 1A, available at <https://advance.lexis.com/api/permalink/530abd08-6ff7-4279-b491-d7bcd99f2b2f?context=1000516> (discussing new test under development that might analyze DNA samples in 90 minutes.).

³⁰ See generally David Gray & Danielle Citron, *The Right to Quantitative Privacy*, 98 *MINN. L. REV.* 62 (2013) (discussing technology-centered approach to privacy rights); Christina Farr, *Can You Trust Facebook With Your Genetic Code?*, *VENTURE BEAT* (Oct. 7, 2013, 7:30 AM) <http://venturebeat.com/2013/10/07/can-you-trust-facebook-with-your-genetic-code/> (discussing the current atmosphere of self-publishing and life-logging that has already led people to post their genomic data on Facebook with reckless abandon.).

In Part I, this article explores the challenges to privacy, personhood and probable cause raised by DNA collection as identification sanctioned in *Maryland v. King*. Part II considers the presumed infallibility of DNA testing that undergirds the Supreme Court's embracement of genetic identification. Lastly, in Part III, this article will try to decipher the Court's Fourth Amendment logic in denying privacy to the information in human cells but embracing them in cell phones in *Riley v. California*.³¹

I. *MARYLAND V. KING*: A CONSTITUTIONAL IDENTITY CRISIS

The legal landscape before the Supreme Court took up *Maryland v. King* represented a mixed bag of federal and state interpretations of genetic privacy at the pre-conviction stage.³² Thus, the Court's decision to hear the Maryland case was born from a conflict over privacy, science and criminal procedure.³³ Justice Roberts granted a stay of the Maryland judgment to resolve the division of authority and mindful of the global impact of DNA databanking:

The split implicates an important feature of day-to-day law enforcement practice in approximately half the States and the Federal Government. . . . Because the DNA samples Maryland collects may otherwise be eligible for the FBI's national DNA database, the decision renders the database less effective for other States and the Federal Government.³⁴

Implicit in this decision is the reality that the trials of tomorrow will be litigated in the databases being created today.

A. The Majority

The identification at the center of *Maryland v. King* had two starting points and as it turned out two purposes. In 2003, an unknown man entered

³¹ 134 S. Ct. 2473 (2014).

³² See generally NAT'L INST. FOR JUST., DNA FOR THE DEFENSE BAR, *supra* note 6; JULIE E. SAMUELS ET AL., URBAN INST., COLLECTING DNA AT ARREST: POLICIES, PRACTICES, AND IMPLICATIONS, FINAL TECHNICAL REPORT (May 2013); *DNA Collection Upon Arrest*, NAT'L CLEARINGHOUSE FOR SCIENCE, TECH. & L. (May 2011), <http://www.ncstl.org/resources/DNACollectionUponArrest> (last visited Feb. 2, 2015); *DNA Sample Collection from Arrestees*, *supra* note 15; *State Laws Pertaining to Surreptitious DNA Testing*, GENETICS & PUBLIC POLICY CTR., http://www.dnapolicy.org/resources/State_Law_summaries_final_all_states.pdf (last updated Jan. 21, 2009).

³³ See generally David H. Kaye, *On the "Considered Analysis" of Collecting DNA Before Conviction*, 60 UCLA L. REV. DISCOURSE. 104 (2013) (arguing for a "fully considered analysis" of *Maryland v. King* by the Supreme Court).

³⁴ *Maryland v. King*, 133 S.Ct. 1, 2–3 (2012).

a Maryland woman's home armed with a gun and raped her.³⁵ No one was apprehended based on the description.³⁶ However, the unknown offender's DNA had been harvested.³⁷ In 2009, Alonzo King was arrested for felony assault, menacing people with a shotgun.³⁸ Due to the seriousness of the offense, he qualified for DNA sampling under the Maryland DNA Collection Act, i.e., a buccal swab performed during booking.³⁹ This genetic information was later connected to the unknown sample from the 2003 rape.⁴⁰ Mr. King was then charged with the rape offense and convicted at trial.⁴¹ The Maryland appeals court overturned the conviction because the DNA sample was the product of an unlawful search and seizure under the Fourth Amendment.⁴²

According to the timeline, Mr. King was arrested for assault on July 13, 2009, his DNA sample was posted to the state database and a match made to the 2003 evidence on August 4, 2009, three weeks later.⁴³ This first sample led to an indictment on the rape charge; another buccal swab was acquired with a search warrant for trial.⁴⁴ The defendant's Fourth Amendment challenge to the state's DNA Collection Act was denied by the trial judge.⁴⁵ Following his conviction, Mr. King was sentenced to life in prison without the possibility of parole.⁴⁶ Relying on decisions from other jurisdictions invalidating arrestee sampling, the state appeals court declared that the applicable sections of the Collection Act were unconstitutional.⁴⁷ In essence, the defendant's expectation of privacy exceeded Maryland's interest in using his

³⁵ *Maryland v. King*, 133 S.Ct. 1958, 1965 (2013).

³⁶ *Id.*

³⁷ *Id.*

³⁸ *Id.* The 2009 assault case was disposed of through an Alford plea to second-degree assault—a misdemeanor—while the first-degree assault charge was *nolle prosequi*. The defendant was sentenced to four years of incarceration, all but one suspended. *State v. King*, No. 22K09000428 (Md. Cir. Ct., Wicomico Cnty., Sept. 16, 2009), <http://casesearch.courts.state.md.us/inquiry/inquiryDetail.jjs?caseId=22K09000428&loc=48&detailLoc=K>.

³⁹ *King*, 133 S. Ct. 1958, 1965–66 (2013).

⁴⁰ *Id.* at 1966. When the 2009 arrest sample red flagged the 2003 case, a search warrant was obtained for another DNA profile for the new trial. *Id.* In practice, the genetic identification for a qualifying arrest that produced a profile and a match became probable cause for a search warrant in the cold case.

⁴¹ *Id.*

⁴² *Id.* at 1965–66.

⁴³ *Id.* at 1966.

⁴⁴ *Id.*; see George L. Blum, Annotation, *Sufficiency of Search Warrant for DNA Sample*, 93 A.L.R. 6th 275 (2014).

⁴⁵ *King*, 133 S.Ct. at 1966.

⁴⁶ *Id.*

⁴⁷ *Id.*

DNA to identify him.⁴⁸ And due to the conflict of authority on this issue across the country, the Supreme Court granted certiorari.⁴⁹

Justice Kennedy writing for the majority, began with high praise for forensic DNA testing:

The advent of DNA technology is one of the most significant scientific advancements of our era. The full potential for use of genetic markers in medicine and science is still being explored, but the utility of DNA identification in the criminal justice system is already undisputed. Since the first use of forensic DNA analysis to catch a rapist and murderer in England in 1986, (citation omitted), law enforcement, the defense bar, and the courts have acknowledged DNA testing's "unparalleled ability both to exonerate the wrongly convicted and to identify the guilty."⁵⁰

Then the discussion turned to a historical and contemporary understanding of nuclear DNA analysis, and the all-important coding and noncoding distinctions.⁵¹ According to the Court the noncoding section or junk DNA was unrevealing but useful for identification purposes.⁵² Again, Justice Kennedy emphasized the ability of DNA analysis to provide matches with "near certainty".⁵³

The Court then delved into the procedural requirements and protections under state law.⁵⁴ The Maryland Act limited arrestee sampling to violent crimes and burglary.⁵⁵ Unacknowledged by the Court was the potential for mission creep from statutes, which today are confined to violent offenses or felonies but will soon spread to minor crimes not to mention unregulated precinct databanking of unconvicted suspects, victims and others.⁵⁶ This is

⁴⁸ *Id.*; see *King v. State*, 42 A.3d 549, 555–56 (Md. 2012) ("We hold that § 2-504(a)(3) of the Maryland DNA Collection Act, which allows DNA collection from persons arrested, but not yet convicted, for crimes of violence and burglary, is unconstitutional, under the Fourth Amendment totality of the circumstances balancing test, as applied to the relevant facts of this case because King's expectation of privacy is greater than the State's purported interest in using King's DNA to identify him for purposes of his 10 April 2009 arrest on the assault charges.").

⁴⁹ *King*, 133 S. Ct. at 1966.

⁵⁰ *Id.*

⁵¹ *Id.* at 1966–67.

⁵² *Id.* at 1967.

⁵³ *Id.* (citing *Dist. Attorney's Office for the Third Judicial Dist. v. Osborne*, 557 U.S. 52, 62 (2009) (refusing to recognize a freestanding right to post-conviction DNA testing on Constitutional grounds)).

⁵⁴ Maryland's statute is not a national model, there are significant variations in coverage and safeguards among the states that allow for arrestee DNA testing. See generally Brian Clark Stuart, *Dethroning King: Why the Warrantless DNA Testing of Arrestees Should Be Prohibited Under State Constitutions*, 83 Miss. L.J. 1111, 1116 n.38 (2014) (containing an Appendix with a survey of DNA test-on-arrest laws).

⁵⁵ *King*, 133 S. Ct. at 1967.

⁵⁶ See Joseph Goldstein, *Police Agencies Are Assembling Records of DNA*, N.Y. TIMES, June 13, 2013, at A1 ("These local databases operate under their own rules, providing the police much more leeway

exceedingly important in light of the continuing parallel collection of digital data by law enforcement.⁵⁷

According to the Maryland statute, the DNA sample could not be processed or uploaded to any database until after arraignment, unless consented to.⁵⁸ This was an important step where a judicial officer had the opportunity to determine the existence of probable cause for the arrest and the fate of the DNA sample.⁵⁹ Moreover, the law limited information gathering to identification only.⁶⁰ Indeed, this was one of the embargos that carried a criminal sanction if violated: "A person may not willfully test a DNA sample for information that does not relate to the identification of individuals as specified in this subtitle."⁶¹ It also prohibited familial database searches for criminal investigation.⁶² These are important qualifiers for understanding the purposes of arrestee sampling and profiling.

The Court observed that the officers had met the statutory requirements when taking the sample, which put aside any objections on technical

than state and federal regulations. And the police sometimes collect samples from far more than those convicted of or arrested for serious offenses — in some cases, innocent victims of crimes who do not necessarily realize their DNA will be saved for future searches."); *see also* United States v. Davis, 690 F.3d 226 (4th Cir. 2012), cert. den., Davis v. United States, 134 S. Ct. 52 (2013) (addressing victim-offender DNA sample retention); Jeffrey Hess, *All Things Considered, Miss. Turns to Cord Blood to Track Down Statutory Rapists*, NPR (June 3, 2013), <http://www.npr.org/blogs/health/2013/06/03/188423215/miss-turns-to-cord-blood-to-track-down-statutory-rapists>. *See generally* Candice Roman-Santos, *Concerns Associated with Expanding DNA Databases*, 2 HASTINGS SCI. & TECH. L.J., 267, 295–98 (2011) (discussing "function creep").

⁵⁷ *See* discussion *infra* Part III; *cf.* G.W. Schulz, *Virginia Police Have Been Secretively Stockpiling Private Phone Records*, WIRED (Oct. 20, 2014, 6:30 AM), <http://www.wired.com/2014/10/virginia-police-secretively-stockpiling-private-phone-records/> ("In the case of the Virginia database, it's unclear whether content from seized cellphones—such as text messages—is included in the database or if it just contains so-called metadata describing the phone numbers called, the calls received and their date and duration.").

⁵⁸ *King*, 133 S. Ct. at 1967; *see* MD. CODE ANN., PUB. SAFETY § 2-504(d)(1) (West 2009). In a sense, test-on-arrest statutes borrow an individual's privacy unless or until it bears fruit as probable cause for a new arrest in a cold case or as factor in granting bail or some other law enforcement purpose. *See, e.g.*, 18 U.S.C. § 3142(b), (c)(1)(A) (2012) (codifying the authority to collect DNA sample from arrestees as condition of release pursuant to DNA Analysis Backlog Elimination Act of 2000, 42 U.S.C. § 14135a(3)). *Compare* United States v. Pool, 621 F.3d 1213 (9th Cir. 2010), *reh'g en banc*, 646 F.3d 659 (2011), *vacated as moot*, 659 F.3d 761 (2011) (holding the federal statute requiring DNA as condition of release was a valid identification method outweighing defendant's privacy interest under Fourth Amendment), *with* United States v. Scott, 450 F.3d 863, 863, 874 (9th Cir. 2006) ("Nevada's decision to test Scott for drugs without probable cause [as condition of release] does not pass constitutional muster under any of the three [Fourth Amendment] approaches: consent, special needs or totality of the circumstances.").

⁵⁹ 133 S. Ct. at 1967. If no probable cause is found the sample should be destroyed. *See* § 2-504(d)(2)(i).

⁶⁰ 133 S. Ct. at 1967; *see* § 2-505(b)(1) ("Only DNA records that directly relate to the identification of individuals shall be collected and stored.").

⁶¹ 133 S. Ct. at 1967; *see* § 2-512(c).

⁶² 133 S. Ct. at 1967; *see* § 2-506(d).

grounds.⁶³ The police took a buccal swab from inside King's cheek, which the Court termed as minimally invasive and harmless.⁶⁴ The majority's focus on the slightness of the physical intrusion is seemingly at odds with their interdictions in cases where technology measured human heat signatures and recorded movements over time via Global-Positioning-System (GPS).⁶⁵ Pain free should not equal privacy free. In light of the overwhelming quantity of personal data that technology can reveal, the invasiveness test might no longer be efficacious as the line for reasonableness.⁶⁶

Justice Kennedy further explained that the collection and storage of DNA profiles was superintended and standardized by the Federal Bureau of Investigation through the Combined DNA Index System (CODIS).⁶⁷ The CODIS is the warehouse and database for all fifty states' collection activities, which includes samples taken from arrestees, convicts and crime

⁶³ 133 S. Ct. at 1967. The actual obtention of genetic material, adherence to the statute, forensic protocols, laboratory practices, and the risks of cross-contamination and human error and biases are among the less superlative aspects of DNA testing. *See, e.g.*, Mark Hansen, *Crime Labs Under the Microscope After a String of Shoddy, Suspect and Fraudulent Results*, ABA J., Sept. 1, 2013, available at http://www.abajournal.com/magazine/article/crime_labs_under_the_microscope_after_a_string_of_shoddy_suspect_and_fraud/ (discussing New York City medical examiner's office reviewing over 800 rape cases covering a 10-year period due to concerns that "DNA evidence may have been mishandled by a lab technician who resigned in 2011 after an internal review uncovered problems with her work. . . . The review [about half done] uncovered 19 cases in which DNA evidence was commingled with DNA evidence from other cases."); Rocco LaDuca, *DNA Not Always the Magic Bullet in Crime Investigations*, UTICA OBSERVER-DISPATCH, Nov. 24, 2012, <http://www.uticaod.com/article/20121125/News/311259960> ("A lot of people think that if you get a DNA hit that, 'Bingo, you got the person,' but it doesn't work that way, Oneida County [New York] District Attorney Scott McNamara said. What law enforcement needs to be cognizant of is that there are many innocent explanations for things to be where they are, and as we get better and better at being able to find DNA, we also have to keep in mind that there is an innocent way for DNA to be left behind."); Osagie K. Obasogie, *High-Tech, High-Risk Forensics*, N.Y. TIMES, July 24, 2013, at A27, available at http://www.nytimes.com/2013/07/25/opinion/high-tech-high-risk-forensics.html?ref=opinion&_r=0 (stating innocent man's DNA found on murder victim's body was accidentally transferred).

⁶⁴ 133 S. Ct. at 1967–68. They did not consider the scenarios when force must be used because someone refused to surrender their genetic material. Contrariwise, in those states without test-on-arrest laws, samples might be extorted as leverage in a plea bargain or a condition of bail. *See, e.g.*, Elizabeth Jones & Wallace Wade, *"Spit and Acquit": Legal and Practical Ramifications of the DA's DNA Gathering Program*, ORANGE COUNTY LAW, Sept. 2009, at 18 ("The newest bargaining chip being offered by the Orange County District Attorney is the reduction of charges, or an outright dismissal, in exchange for an oral DNA swab ("buccal swab").").

⁶⁵ *See* *United States v. Jones*, 132 S. Ct. 945 (2012) (finding that four week GPS surveillance of defendant's vehicle violated Fourth Amendment); *Kyllo v. United States*, 533 U.S. 27, 40 (2001) (holding that surveillance by thermal imaging technology "not in general public use" to reveal heat signatures in private home violated Fourth Amendment). *See generally* Ken Strutin, *Mosaic Theory: A New Perspective for Human Privacy*, 250 N.Y. L.J. 5, 7 (2013) ("Thus, every kind of superinformation search, such as GPS monitoring or DNA databanking, yields a mosaic, a sui generis type of surveillance that is materially different from earlier practices. And the information thus gathered, such as the thousands of pages of data in *Jones*, can be archived, mined and shared.").

⁶⁶ *See* discussion *infra* Part III.

⁶⁷ *Maryland v. King*, 133 S. Ct. 1958, 1968 (2013).

scenes.⁶⁸ They rely on a 13 loci matching from noncoding DNA segments, which they claim makes for "extreme accuracy" in comparing samples for identification.⁶⁹ Considering that twenty-eight states have test-on-arrest laws, the Court expected that its holding apropos Maryland's law would have national repercussions.⁷⁰

Concededly, a buccal swab was a search under the Fourth Amendment.⁷¹ And the reasonableness of a body search was linked to its intrusiveness, which in this case was negligible.⁷² According to the majority, the Fourth Amendment was a bulwark against unmerited or improper intrusions, not all intrusions.⁷³ The reasonableness standard demanded a predicate of some "individualized suspicion".⁷⁴ Thus, warrantless searches gain validity as state interests become paramount and public interests decline; where the person is on notice; and when there is little discretion in the act of acquisition, such as during a booking procedure.⁷⁵ Under these discretionless circumstances, reasonableness governed Fourth Amendment analysis, not individualized suspicion.⁷⁶ In *King*, DNA sampling did not involve judgments by the processing officers, forestalling any competing interests, and left little for a magistrate to review.⁷⁷ Holding a suspect in custody after a valid arrest based on probable cause met this threshold. In this DNA scenario, privacy interests and law enforcement interests had to be weighed against each other to assess the reasonableness of taking buccal swabs from arrestees.⁷⁸

The Maryland Act expressed the state's interest in processing and identifying persons and property taken into custody by the police.⁷⁹ Probable cause for arrest laid the foundation for detention and booking, which encompassed a search of the person incident to the arrest and stationhouse processing.⁸⁰ Custom and precedent acknowledged the constitutional seal of

⁶⁸ *Id.* See generally *Frequently Asked Questions (FAQs) on the CODIS Program and the National DNA Index System (FBI)*, FBI, <http://www.fbi.gov/about-us/lab/biometric-analysis/codis/codis-and-ndis-fact-sheet> (last visited Jan. 29, 2015).

⁶⁹ 133 S. Ct. at 1968.

⁷⁰ *Id.* ("At issue is a standard, expanding technology already in widespread use throughout the Nation.").

⁷¹ *Id.* at 1968–69.

⁷² *Id.* at 1969.

⁷³ *Id.*

⁷⁴ *King*, 133 S.Ct. at 1969.

⁷⁵ *Id.* at 1969–70.

⁷⁶ *Id.* at 1970.

⁷⁷ *Id.*

⁷⁸ *Id.*

⁷⁹ *King*, 133 S.Ct. at 1970.

⁸⁰ *Id.* at 1970–71.

approval on searches connected with arrest and processing absent individualized suspicion.⁸¹ Thus, probable cause and administrative process cast a long shadow.⁸² Notably, this logic applied to human beings, not their technology.⁸³

For the majority the central concern was harvesting information that confirmed identity.⁸⁴ After all, due process depended on arresting and trying the correct suspect in order to assign personal guilt and responsibility. Thus, Justice Kennedy elaborated on the forms and finitude of identification in the stationhouse:

An individual's identity is more than just his name or Social Security number, and the government's interest in identification goes beyond ensuring that the proper name is typed on the indictment. Identity has never been considered limited to the name on the arrestee's birth certificate. In fact, a name is of little value compared to the real interest in identification at stake when an individual is brought into custody.⁸⁵

To which he added concerns over arrestees who might try to hide their name or change their appearance to avoid prosecution.⁸⁶

Lastly, he assailed the quality of criminal histories generated by the state, which might not provide correct or complete details.⁸⁷ Indeed, DNA sampling was essential to close this information gap. In other words, a person was more than their name; they were every contact with the justice system, every crime they have been accused of, and every conviction registered by the state.⁸⁸ And as the *King* decision will demonstrate, people are also identified by every uncharged offense to which they might be forensically linked. Indeed, the majority makes the point that identifying information

⁸¹ *Id.* at 1971.

⁸² *Id.* ("When probable cause exists to remove an individual from the normal channels of society and hold him in legal custody, DNA identification plays a critical role in serving those interests.")

⁸³ *See infra* Part III.

⁸⁴ *King*, 133 S. Ct. at 1970.

⁸⁵ *Id.* at 1971.

⁸⁶ *Id.* Impersonation, identity theft, as well as paternity and custody, directly implicate identification as an element of the offense. However, DNA identification is a different breed of metric from routine booking procedures, such as fingerprinting, due to their linkage to other unrelated facts like familial connections and inherent data like genetic diseases or features or predispositions.

⁸⁷ *Id.*

⁸⁸ *Id.* Expressing a philosophy reminiscent of the "broken windows" theory of crime prevention, Justice Kennedy focused on the value of knowing the potentiality of arrestees for serious crimes: "It is a common occurrence that '[p]eople detained for minor offenses can turn out to be the most devious and dangerous criminals. Hours after the Oklahoma City bombing, Timothy McVeigh was stopped by a state trooper who noticed he was driving without a license plate. Police stopped serial killer Joel Rifkin for the same reason. One of the terrorists involved in the September 11 attacks was stopped and ticketed for speeding just two days before hijacking Flight 93.'" (quoting *Florence v. Bd. of Chosen Freeholders*, 132 S.Ct. 1510, 1520 (2012)). *Id.* But is this a "common occurrence"?

has traditionally been collected for purposes of comparison, e.g., mugshot with wanted posters or eyewitness descriptions, and of course, the fingerprint database that put side by side arrestees and unsolved cases.⁸⁹ Once more, the Court views DNA profiling in line with customary methods like fingerprinting, differing only in degree.⁹⁰

The pinnacle of police investigation is identifying, locating, and apprehending an exclusive suspect who best fits the facts. To that end, the methods of identification or confirmation follow a history that has led them into the age of databases and biologics. Still, the amount of information garnered for this purpose had a natural ceiling, which technology has breached. The Court equated DNA loci with the whorls and swirls of fingerprints, exalting DNA as "irrefutable identification" judged against the now downgraded fingerprint.⁹¹ Still, Justice Kennedy characterized it as just one more tool: "DNA is another metric of identification used to connect the arrestee with his or her public persona, as reflected in records of his or her actions that are available to the police."⁹² But a CODIS profile is more akin to someone's Facebook page or cell phone than to a mugshot.⁹³ For the Court "complete identity" entailed extraneous details from unsolved cases and uncharged crimes.⁹⁴

Despite the overbroad definition of identity that encompassed uncharged and unsolved crimes, the Court drew upon additional justifications for eliciting an arrestee's genetic profile, such as jail security. The sheriff was entitled to know the "type of person" in their custody to promote smooth administration of pretrial detainees.⁹⁵ This rationale opened the floodgates of

⁸⁹ *King*, 133 S.Ct. at 1971–72. The advent of facial recognition databases might raise the photographic and sketch artist comparisons to a new constitutional level as well. See J. David Goodman, *Fighting Crime With Pencil and Paper*, N.Y. TIMES, Aug. 19, 2013, at A14 ("In a technology-obsessed department actively pursuing futuristic tools — like a scanner to detect hidden guns or robust facial recognition software — the sketches still hold sway for the simple reason that, despite their seeming imprecision, detectives still use them to catch suspects.").

⁹⁰ *King*, 133 S.Ct. at 1972 ("In this respect the only difference between DNA analysis and the accepted use of fingerprint databases is the unparalleled accuracy DNA provides.").

⁹¹ *Id.*

⁹² *Id.*

⁹³ See *id.*; see also Ken Strutin, *Social Media and the Vanishing Points of Ethical and Constitutional Boundaries*, 31 PACE L. REV. 228, 228 (2011); Ken Strutin, *Big Data, Little Privacy: Tracking the Usual Suspects*, LLRX.COM (July 21, 2013), <http://www.llrx.com/features/dataprivacy.htm>; *infra* Part III; see, e.g., James C. McKinley Jr., *Facebook Lawsuit Over Search Warrants Can Proceed, a Court in Manhattan Rules*, N.Y. TIMES, Sept. 26, 2014, at A24 (discussing Facebook's challenge to search warrants issued for the contents of pages belonging to 381 users as part of a fraud investigation).

⁹⁴ *King*, 133 S.Ct. at 1972 ("Finding occurrences of the arrestee's CODIS profile in outstanding cases is consistent with this common practice. It uses a different form of identification than a name or fingerprint, but its function is the same.").

⁹⁵ *Id.*

behavioral profiling beyond the patina of identity, e.g., uncharged, unsolved crimes; history of violent behavior or "mental disorder"; and possibly reinvestigation (reexamining the accuracy of the initial identification).⁹⁶ Then of course, the chief purpose of detention was to assure that the defendant would appear at trial.⁹⁷ Thus, risk of flight became a facet of identification, which would be allayed by a CODIS search for compelling reasons to flee.⁹⁸ Finally, anticipating the arraignment, the Court considered danger to the community in setting bail or terms of release.⁹⁹ Indeed, this last criterion broached predictive policing and preventive detention.¹⁰⁰ The crime prevention aspect that the Court described goes well beyond bail criteria and deep into warrantless investigation.¹⁰¹

The majority cited several crime prevention studies to bolster their point.

In considering laws to require collecting DNA from arrestees, government agencies around the Nation found evidence of numerous cases in which felony arrestees would have been identified as violent through DNA identification matching them to previous crimes but who later committed additional crimes because such identification was not used to detain them.¹⁰²

Still, danger to the community is not necessarily a bail criterion in all jurisdictions.¹⁰³ And the Court's approach bypasses traditional investigative policing that required individualized suspicion and probable cause. But here, Justice Kennedy was not distinguishing between guilt and innocence, rather

⁹⁶ *Id.* ("Knowledge of identity may inform an officer that a suspect is wanted for another offense, or has a record of violence or mental disorder. On the other hand, knowing identity may help clear a suspect and allow the police to concentrate their efforts elsewhere. Identity may prove particularly important in [certain cases, such as] where the police are investigating what appears to be a domestic assault." (quoting *Hiibel v. Sixth Judicial Dist. Court*, 542 U.S. 177, 186 (2004)). Might not this rationale open the door to retrieving medical or psychiatric records?)

⁹⁷ *King*, 133 S.Ct. at 1972–73.

⁹⁸ *Id.* at 1973 ("A person who is arrested for one offense but knows that he has yet to answer for some past crime may be more inclined to flee the instant charges, lest continued contact with the criminal justice system expose one or more other serious offenses."). This sounds like a predicate for consciousness of guilt based solely on a person's privacy interest in their genome.

⁹⁹ *Id.* at 1973; see *United States v. Salerno*, 481 U.S. 739, 749 (1987). (stating concerns raised by the Court are not universal, many states do not consider dangerousness or practice preventive detention); Ken Strutin, *Pretrial Detention, Bail and Due Process*, LLRX.COM (July 2, 2011), <http://www.llrx.com/features/pretrialdetention.htm>.

¹⁰⁰ *King*, S.Ct. 133 at 1972. "Knowing that the defendant is wanted for a previous violent crime based on DNA identification is especially probative of the court's consideration of 'the danger of the defendant to the alleged victim, another person, or the community.'" *Id.* at 1973 (citations omitted).

¹⁰¹ See *id.* at 1974.

¹⁰² *Id.* at 1973.

¹⁰³ The concerns raised by the Supreme Court are not universal, many states do not consider dangerousness or practice preventive detention. See generally Ken Strutin, *Pretrial Detention, Bail and Due Process*, LLRX (July 2, 2011), <http://www.llrx.com/features/pretrialdetention.htm>. *Bail - The Purposes of the Bail or Pretrial Release Decision*, JRANK, <http://law.jrank.org/pages/556/Bail-purposes-bail-or-pretrial-release-decision.html> (last visited Feb. 2, 2015).

the focus was on tagging an arrestee as violent, i.e., behavioral profiling. Conceptually, this approach is not very different from extracting propensity for violence information from genetics.¹⁰⁴

All of the above was an extra-constitutional method for creating an enhanced rap sheet and preparing the groundwork for prosecuting matched cold cases. Not only would this impact bail and revocation decisions, it would potentially encompass pretextual arrests, charge inflation to obtain samples, and plea bargaining by leveraging CODIS linked cases.¹⁰⁵ Notwithstanding, Justice Kennedy added one last rationale for sampling: it might liberate the wrongfully convicted in other cases.¹⁰⁶

Justice Kennedy went on to rationalize genetic sampling as identification through a review of accepted police methods sanctioned by history, such as photography (mugshots) and Bertillon body measurements.¹⁰⁷ The over inclusion of DNA science as forensic technology is leading to a foreshortening of privacy.¹⁰⁸ The Court's point was that a suspect's name alone was insufficient; detailed information was needed to reclaim escapees and produce important background data about criminal activities and personal histories. For the most part, these techniques entered the mainstream of criminalistics without constitutional scrutiny for the most part. Nineteenth Century thinking about identification and control of suspects was in lockstep with Nineteenth Century technology. Indeed, the fingerprint entered criminal proce-

¹⁰⁴ *King*, 133 S. Ct. at 1973; see also Paul S. Appelbaum, *The Double Helix Takes the Witness Stand: Behavioral and Neuropsychiatric Genetics in Court*, 82 NEURON 946, 946 (2014); Patricia Cohen, *Genetic Basis for Crime: A New Look*, N.Y. TIMES, June 20, 2011, at C1, <http://www.nytimes.com/2011/06/20/arts/genetics-and-crime-at-institute-of-justice-conference.html>. See generally Jari Tiihonen et al., *Genetic Background of Extreme Violent Behavior*, MOLECULAR PSYCHIATRY (Oct. 28, 2014), <http://www.nature.com/mp/journal/vaop/ncurrent/full/mp2014130a.html>.

¹⁰⁵ *King*, 133 S.Ct. at 1974.

¹⁰⁶ *Id.*; see Adam Liptak, *Cited by a Justice, but Feeling Less Than Honored*, N.Y. TIMES, June 10, 2013, at A15, <http://www.nytimes.com/2013/06/11/us/cited-by-a-justice-but-feeling-less-than-honored.html> (discussing the misimpressions left by Justices Kennedy and Scalia in their interpretation of DNA sampling as applied to wrongful conviction and their implications for law enforcement).

¹⁰⁷ *King*, 133 S.Ct. at 1975.

¹⁰⁸ The milestones in the scientific study of the human genome were made well over a century ago—1869 discovery, 1944 role in heredity, 1953 morphology. See Ralf Dahm, *Friedrich Miescher and the Discovery of DNA*, 278 DEV. BIOL. 274, 274 (2005); J.D. Watson & F.H.C. Crick, *Structure for Deoxyribose Nucleic Acid*, 171 NATURE 737, 737 (1953); *DNA as the "Stuff of Genes": The Discovery of the Transforming Principle, 1940-1944*, NAT'L LIBRARY OF MED., <http://profiles.nlm.nih.gov/ps/retrieve/Narrative/CC/p-nid/157> (last visited Feb. 2, 2015); *Double Helix: Fifty Years of DNA*, NATURE, <http://www.nature.com/nature/dna50/index.html> (last visited Feb. 2, 2015). Its life as a crime fighting and identification tool began only a generation ago—1984 forensics, 2009 fabrication. See Dan Frumkin et al., *Authentication of Forensic DNA Samples*, 4 FORENSIC SCI. INT'L.: GENETICS 95, 95 (2009); Nick Zagorski, *Profile of Alec J. Jeffreys*, 103 PROC. NAT'L ACAD. SCI. U.S.A. 8918, 8919 (2006). And in that brief time it has become the unsurpassable forensic tool in the eyes of the courts.

ture without any constitutional fanfare.¹⁰⁹ It was viewed as another metric, a natural outgrowth of photography and Bertillon measurements.¹¹⁰

Common forensic investigative and matching techniques involving fingerprints, firearms, bitemarks, and arson, had earned their reputations before the onset of DNA exonerations and revision of standards.¹¹¹ In the face of recent challenges, courts have upheld these scientifically unvetted techniques based on history and custom, confidence in cross-examination, exaltation of precedent over principle, and the availability of experts for the defense.¹¹² Thus, in the name of finality, comity and precedent, one person's junk science has become another's gold standard.¹¹³

Unlike fingerprints, DNA was raised in a laboratory and nurtured by scientists and doctors unconcerned with the aims of criminal procedure. However, DNA forensics represented a shift in the analysis of evidence and assignment of guilt. In Justice Kennedy's view, it made other identification techniques obsolete: "DNA identification is an advanced technique superior to fingerprinting in many ways, so much so that to insist on fingerprints as the norm would make little sense to either the forensic expert or a layper-

¹⁰⁹ *King*, 133 S. Ct. at 1976. ("In the seminal case of *United States v. Kelly*, 55 F.2d 67 (2d Cir. 1932), Judge Augustus Hand wrote that routine fingerprinting did not violate the Fourth Amendment precisely because it fit within the accepted means of processing an arrestee into custody.").

¹¹⁰ See *United States v. Kelly*, 55 F.2d 67, 69 (2d Cir. 1932).

¹¹¹ See Sarah Lucy Cooper, *The Collision of Law and Science: American Court Responses to Developments in Forensic Science*, 33 PACE L. REV. 234, 236, 300 (2013). This article demonstrates the lack of consistency in the response by federal and state courts to the NAS Report (Strengthening Forensic Science in the United States: A Path Forward (National Academy of Sciences 2009)), thus revealing their struggles with science. In essence, judges and juries are making judgments of scientific truth. And the results are a body of decisions that reveal compromise and stutter steps in their approaches tounderstanding about revelatory scientific investigation of time-honored forensic techniques.

¹¹² *Id.* at 300–01. Another revelation from DNA exonerations is the reciprocal reinforcement of false confessions by unvetted forensics. Thus, bad science can compound bad investigations. It seems that adversarial science warps the justice system by perpetuating a narrative of guilt based on precedent, history, custom and necessity. The theory of the case and the findings of science travel different paths; it is when they are artificially synthesized that false and inaccurate outcomes are most likely. The factual scenario of a case ought to be constructed without investigative biases, political necessity pressures to close cases, and judicial imperatives to punish offenders.

¹¹³ *Id.* at 301. Prof. Cooper concluded her research with this important observation: "[L]aw must serve as a way of organizing societies by providing stability and predictability, whereas science is encouraged to embrace new ideas so that we can better understand the natural world. . . . Moreover, judges seem ill-equipped to recognize the distinctions between valid and invalid forensic science. Law remains ill-equipped to incorporate changes in these disciplines because law is beholden to finality and predictability." *Id.*

son."¹¹⁴ The virtues of DNA were its uniqueness and immutability, insusceptible to plastic surgery or fingerprint erasure.¹¹⁵

Meanwhile, the Supreme Court struggled with the efficacy of DNA profiling in terms of processing speed, as compared with the swiftness of fingerprint reports, and resolved in favor of its unquestioning acceptance.¹¹⁶ Basically, the majority adopted the fingerprint experience as the model for recognizing DNA testing.¹¹⁷ The fingerprint analogy does carry some weight in support of genetic identification due its database linkage. Still, this reasoning points towards the potential of identification plus, the inclusion of any database sources that might address legitimate government interests at the booking and custodial stages, e.g., social media and digital profiles; medical and psychiatric records.¹¹⁸ This is not a mere "extension" of existing identification techniques.¹¹⁹

On the other side of the scale the Court weighed Mr. King's expectation of privacy. First, there had to be a valid arrest;¹²⁰ then the reasonableness of the search had to be evaluated.¹²¹ The Court put weight on the point that once in custody the accused's expectation of privacy was diminished.¹²² A stationhouse booking was not a programmatic or special needs search, such as checkpoints or roadblocks, which required justification unrelated to criminal investigation.¹²³ Due to the reduced expectation of privacy of arrestees, no "special needs" had to be considered.¹²⁴ What is more, custodial

¹¹⁴ *Maryland v. King*, 133 S.Ct. 1958, 1976 (2013). Still, the middle ground of retina and iris scans were ignored. The Court immediately embraced the most advanced and revelatory identification technique, which might, in constitutional hindsight, have been excessive and unnecessary.

¹¹⁵ *Id.*

¹¹⁶ *See id.* at 1976–77 ("The question of how long it takes to process identifying information obtained from a valid search goes only to the efficacy of the search for its purpose of prompt identification, not the constitutionality of the search.").

¹¹⁷ *Id.* ("Just as fingerprinting was constitutional for generations prior to the introduction of IAFIS [Integrated Automated Fingerprint Identification System], DNA identification of arrestees is a permissible tool of law enforcement today.").

¹¹⁸ *Cf. id.* at 1977 ("By identifying not only who the arrestee is but also what other available records disclose about his past to show who he is, the police can ensure that they have the proper person under arrest and that they have made the necessary arrangements for his custody; and, just as important, they can also prevent suspicion against or prosecution of the innocent.").

¹¹⁹ *But see King*, 133 S.Ct. at 1977.

¹²⁰ *Id.* at 1977–78.

¹²¹ *Id.*

¹²² *Id.* at 1978 ("The expectations of privacy of an individual taken into police custody 'necessarily [are] of a diminished scope.'" (quoting *Bell v. Wolfish*, 441 U.S. 520, 557 (1979))).

¹²³ *King*, 133 S.Ct. at 1978.

¹²⁴ *Id.* ("The special needs cases, though in full accord with the result reached here, do not have a direct bearing on the issues presented in this case, because unlike the search of a citizen who has not been suspected of a wrong, a detainee has a reduced expectation of privacy.").

searches had limits, such as surgery to remove an incriminating bullet or rummaging through a suspect's home, essentially warrantless searches that exceeded *Chimel*.¹²⁵

In the Court's opinion, a buccal swab was brief, harmless and scarcely intrusive enough to raise an eyebrow.¹²⁶ Even so, Justice Kennedy did allow for the possibility of changes in science that might warrant privacy protections: "While science can always progress further, and those progressions may have Fourth Amendment consequences, alleles at the CODIS loci 'are not at present revealing information beyond identification.'" (citation omitted). The argument that the testing at issue in this case reveals any private medical information at all is open to dispute.¹²⁷ According to the majority, the non-coding or junk DNA was uninformative and current procedures did not analyze them for any other purpose than identification.¹²⁸ But again, Justice Kennedy left the door open for revisiting the issue should retention and repurposing become a problem: "If in the future police analyze samples to determine, for instance, an arrestee's predisposition for a particular disease or other hereditary factors not relevant to identity, that case would present additional privacy concerns not present here."¹²⁹ According to the Court, the Maryland statute included sufficient safeguards against information abuse by confining data gathering to identification purposes only.¹³⁰

¹²⁵ See *id.* at 1979; *infra* Part III (discussing *Chimel v. California*, 395 U.S. 752 (1969)).

¹²⁶ *King*, 133 S.Ct. at 1979 ("A brief intrusion of an arrestee's person is subject to the Fourth Amendment, but a swab of this nature does not increase the indignity already attendant to normal incidents of arrest.").

¹²⁷ *Id.*

¹²⁸ *Id.* ("This parallels a similar safeguard based on actual practice in the school drug-testing context, where the Court deemed it 'significant that the tests at issue here look only for drugs, and not for whether the student is, for example, epileptic, pregnant, or diabetic.'" (quoting *Vernonia Sch. Dist. 47J v. Acton*, 515 U.S. 646, 658 (1995))).

¹²⁹ *Id.* Compare *United States v. Kriesel*, 720 F.3d 1137, 1139, 1147 (9th Cir. 2013) (holding, with some trepidation, that government retention of DNA blood sample obtained as condition of supervised release, which had been completed, was justified by the need for maintaining accuracy and quality assurance of CODIS: "We nevertheless recognize that we are dealing with a rapidly changing world in which risks of undue intrusions on privacy are also changing. We have previously stressed that if scientific discoveries make clear that junk DNA reveals more about individuals than we have previously understood, we should reconsider the government's DNA collection programs." *Id.* at 1147.), with *State v. Benefield*, 153 Conn. App. 691, 696–98, 707–08 (Conn. App. Ct. 2014), app. den., *State v. Benefield*, 315 Conn. 913 (2015) (holding that Defendant's consent to buccal saliva swab in 1986 murder investigation was sufficient to permit DNA testing and matching in 2009: "In summary, the determinative fact in this case is that the defendant consented to 'a complete search' of his saliva samples without temporal limitation, and without restriction as to the kinds of tests to be performed." *Id.* at 707.).

¹³⁰ *King*, 133 S.Ct. at 1979–80 ("[T]he Act requires that '[o]nly DNA records that directly relate to the identification of individuals shall be collected and stored.' No purpose other than identification is per-

The majority used language and custom to reduce arrestee privacy expectations. "Identification" has thus become Supreme Court newspeak for behavioral profiling and investigation into cold cases. But there is nothing routine about taking someone's genome and creating a profile from it as the dissenters explained.

B. The Dissent

Writing for the dissent, Justice Scalia held forth on the right to genetic privacy for arrestees. Their opinion also demonstrated the internal debate about the limits of scientific knowledge being set by judicial decisions:

The Court's assertion that DNA is being taken, not to solve crimes, but to *identify* those in the State's custody, taxes the credulity of the credulous. And the Court's comparison of Maryland's DNA searches to other techniques, such as fingerprinting, can seem apt only to those who know no more than today's opinion has chosen to tell them about how those DNA searches actually work.¹³¹

Justice Scalia went on to recall the history of the dreaded general warrant--"warrants not grounded upon a sworn oath of a specific infraction by a particular individual, and thus not limited in scope and application."¹³² The states enacted the Fourth Amendment in response to these abuses.¹³³ More to the point, the small range of suspicionless or special needs searches was never meant to cover crime detection or routine law enforcement.¹³⁴ Thus, without a justification for a search beyond the discovery of wrongdoing, the majority's reasonableness inquiry failed.¹³⁵ For instance, a warrantless search of an arrestee's home, outside the *Chimel* line, would be unreasonable. While some courts have recognized that a second analytical search of

missible: 'A person may not willfully test a DNA sample for information that does not relate to the identification of individuals as specified in this subtitle.'" (second alteration in original) (citations omitted).

¹³¹ *Id.* at 1980 (Scalia, J., dissenting).

¹³² *Id.*

¹³³ *Id.* at 1981 ("As ratified, the Fourth Amendment's Warrant Clause forbids a warrant to 'issue' except 'upon probable cause,' and requires that it be 'particula[r]' (which is to say, *individualized*) to 'the place to be searched, and the persons or things to be seized.' And we have held that, even when a warrant is not constitutionally necessary, the Fourth Amendment's general prohibition of 'unreasonable' searches imports the same requirement of individualized suspicion." (citing *Chandler v. Miller*, 520 U.S. 305, 308 (1997)); see U.S. CONST. amend. IV ("The right of the people to be secure in their persons, houses, papers, and effects, against *unreasonable searches* and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and *particularly describing* the place to be searched, and the persons or things to be seized." (emphasis added)).

¹³⁴ *King*, 133 S. Ct. at 1981-82.

¹³⁵ See *id.*

biologics required a warrant,¹³⁶ the *King* majority found that intrusion upon a person's genetic code was not deserving of the same level of privacy protection.¹³⁷

Still, the point of the dissent was that a suspicionless search for crime detection was indefensible. Justice Scalia took the majority to task for their loose definition of identification that encompassed evidence of unsolved unrelated crimes.¹³⁸ And more critically, Justice Scalia noted that the majority did not elaborate on the "actual workings of the DNA search at issue here."¹³⁹ This is the crux of modern decision making on constitutional questions that involve science—wherein does a court's scientific competence come from, legal reasoning or scientific method, Blackstone or Bacon.

The Maryland statute and procedures delayed testing and processing beyond the point that King's name, fingerprints and other identifying information would have already been collected.¹⁴⁰ According to Justice Scalia, following the pattern and timeline set out by the Maryland Collection Act and the majority's interpretation, King's identity had not been completely confirmed by arraignment—calling into question the state legislature's wisdom and clarity of purpose in setting arraignment as the deadline for DNA profiling.¹⁴¹ In fact, it took months for the profile to be completed by CODIS.¹⁴²

¹³⁶ See Catherine W. Kimel, *DNA Profiles, Computer Searches, and the Fourth Amendment*, 62 DUKE L.J. 933, 968 (2013); see also discussion *infra* Part III; *c.f.* *United States v. Ganius*, 755 F.3d 125 (2d Cir. 2014) (holding that indefinite retention of personal computer files for future searches amounted to a "general warrant."). See generally Liz Campbell, *A Rights-Based Analysis of DNA Retention: "Non-Conviction" Databases and the Liberal State*, 12 CRIM. L. REV. 889 (2010) (discussing the human rights implications of DNA information harvesting without conviction).

¹³⁷ *King*, 133 S. Ct. at 1980; see Stephanie B. Noronha, Comment, *Maryland v. King: Sacrificing the Fourth Amendment to Build Up the DNA Database*, 73 MD. L. REV. 667, 687 (2014).

¹³⁸ *King*, 133 S.Ct. at 1982–83 ("If identifying someone means finding out what unsolved crimes he has committed, then identification is indistinguishable from the ordinary law-enforcement aims that have never been thought to justify a suspicionless search. Searching every lawfully stopped car, for example, might turn up information about unsolved crimes the driver had committed, but no one would say that such a search was aimed at "identifying" him, and no court would hold such a search lawful.").

¹³⁹ *Id.* at 1983.

¹⁴⁰ *Id.*

¹⁴¹ *Id.* "Does the Court really believe that Maryland did not know whom it was arraigning? . . . Why would Maryland resign itself to simply hoping that the bail decision will drag out long enough that the 'identification' can succeed before the arrestee is released?" *Id.* at 1983–84.

¹⁴² *King*, 133 S. Ct. at 1984. Mr. King was arrested and his DNA sampled on April 10, 2009. The sample was received by the state police forensic division on April 23rd. It was then mailed to the state laboratory on June 25th. The analysis report was issued on July 13th at which time it was uploaded to the state DNA database along with Mr. King's identifying information. At this point, Mr. King had been arraigned, bail set and discovery started. On August 4th, the DNA sample, without the identifying details, was sent to CODIS where it was matched to the 2003 crime evidence. *Id.*

In addition to the time lag, Justice Scalia chastened the majority's over-eager acceptance of identification DNA testing by pointing out its practical flaws. CODIS was comprised of two principal databases one devoted to known individuals, "Convict and Arrestee Collection," and the other to evidence from crime scenes, "Unsolved Crimes Collection."¹⁴³ In practice, only the submitting state laboratory knew the identification of the entries in the "Convict and Arrestee Collection," the FBI's database did not contain names or personal identifiers.¹⁴⁴ In an effort to solve cold cases, each week the genetic samples stored in the crime scene collection were matched up against the offender records.¹⁴⁵ In order for this to work, a database of knowns, the convicted/arrestee collection, had to be matched with a database of unknowns, unsolved crime scene evidence.¹⁴⁶ Justice Scalia realized that identification should be limited to the search of the known offender database, and not focused on the unknown unmatched evidence collection.¹⁴⁷ The majority's promise that the state procedure would exonerate the innocent was also less than hoped for.¹⁴⁸

In essence, Justice Scalia's argument against the majority's theory was that CODIS identified evidence, not people.¹⁴⁹ Thus, there were definitional and linkage problems with the majority's reasoning. Since the Maryland authorities needed to have identifying information about the defendant before submitting the sample, CODIS was asked to somehow provide what the state already possessed. Thus, arrestee genetic testing appeared to have been intended to identify evidence from other cases, not the person in custody, unless an expanded definition of identification as crime solving was accepted. The Collection Act's enabling section listed five reasons for gathering DNA evidence at the booking stage, none of which addressed identification of arrestees.¹⁵⁰ Rather its chief purpose for gathering data was "as part of an

¹⁴³ *Id.*

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*; see FBI LAB., NATIONAL DNA INDEX SYSTEM (NDIS) OPERATIONAL PROCEDURES MANUAL 41 (2013), available at <http://static.fbi.gov/docs/NDIS-Procedures-Manual-Final-1-31-2013-1.pdf> ("On a weekly basis, a search is run at NDIS to search new and modified DNA records against all records in accordance with the authorized searches described in the Table of NDIS Searchable Indexes in Section 5.1.").

¹⁴⁶ *King*, 133 S.Ct. at 1984 (Scalia, J., dissenting).

¹⁴⁷ *Id.* at 1984–85 (Scalia, J., dissenting).

¹⁴⁸ *Id.* at 1985 (Scalia, J., dissenting); see Liptak, *supra* note 106, at A15. "The FBI CODIS database includes DNA from *unsolved* crimes. I [Scalia, J.] know of no indication (and the Court cites none) that it also includes DNA from all—or even any—crimes whose perpetrators have already been convicted." *King*, 133 S.Ct. at 1984 n. 2 (Scalia, J., dissenting).

¹⁴⁹ *King*, 133 S.Ct. at 1985 ("King was not identified by his association with the sample; rather, the sample was identified by its association with King.").

¹⁵⁰ MD. CODE ANN., PUB. SAFETY § 2-505 (LexisNexis 2014); *id.*

official investigation into a crime."¹⁵¹ Citing the statements of public officials on this litigation, the dissenters concluded that the goals were to reduce crime rates and solve open cases.¹⁵²

Another practical hole in the identification argument was redundancy. If a DNA sample for King had already existed in the state database, there would have been no reason to obtain another sample.¹⁵³ In fact, the state's regulations required significant identification details about the person from whom a sample was taken, begging the question of the value of using DNA to identify someone who must already be known by other identifiers.¹⁵⁴ The dissent concluded that "if the Court's identification theory is not wrong, there is no such thing as error."¹⁵⁵

After deconstructing the majority's major premises, Justice Scalia attacked their analogies to 19th Century criminalistics that were not Fourth Amendment events, e.g., photographing arrestees (mug shots), Bertillon measurements, and fingerprints.¹⁵⁶ Fingerprints especially evolved to serve ends distinct from DNA profiling and in different ways: (1) fingerprints could be processed expeditiously, while the time lag for DNA was inefficient for identification; (2) the Integrated Automated Fingerprint Identification System (IAFIS) contained descriptive information, such as mugshots, physical characteristics and criminal histories, but CODIS did not include names or identifiers; and (3) latent prints from crime scenes were not regularly compared with known fingerprints, CODIS was designed to match up

¹⁵¹ § 2-505(a)(2); *King*, 133 S. Ct. at 1985.

¹⁵² *King*, 133 S. Ct. at 1984. The statute did allude to identifying "human remains" and "missing individuals." § 2-505(a)(3)–(4). And the law interdicted using DNA data for unauthorized reasons. § 2-505(b)(2).

¹⁵³ *King*, 133 S. Ct. at 1986 ("[I]f someone is arrested and law enforcement determines that 'a convicted offender Statewide DNA Data Base sample already exists' for that arrestee, 'the agency is not required to obtain a new sample.' But how could the State know if an arrestee has already had his DNA sample collected, if the point of the sample is to identify who he is?" (citation omitted)); accord *People v. Husband*, 954 N.Y.S.2d 856, 859 (N.Y. Crim. Ct. 2012) ("But once a person's unique genetic profile has been uploaded to the databank, that person's DNA becomes available for potential matching or exoneration, and, with respect to such person, the purposes of the Executive Law have been wholly fulfilled. No rational purpose is served by the addition of a second (or third or more) copy of the identical profile, already tested and analyzed, to the index.").

¹⁵⁴ *King*, 133 S. Ct. at 1986 ("Maryland's regulations further require that the 'individual collecting a sample . . . verify the identity of the individual from whom a sample is taken by name and, if applicable, State identification (SID) number.' (But how?) And after the sample is taken, it continues to be identified by the individual's name, fingerprints, etc.,—rather than (as the Court believes) being used to identify individuals." (citations omitted)).

¹⁵⁵ *Id.*

¹⁵⁶ *Id.* at 1986–87 ("The Court does not actually say whether it believes that taking a person's fingerprints is a Fourth Amendment search, and our cases provide no ready answer to that question." *Id.* at 1987.).

individual profiles with crimes scene evidence.¹⁵⁷ More significantly, fingerprints came in under Fourth Amendment radar, annealed to the justice system without constitutional or scientific scrutiny.¹⁵⁸

The majority predicted that rapid DNA testing was around the corner, taking the unusual step of relying on hindsight to constitutionalize the use of technology.¹⁵⁹ At the same time, the influx of arrestee samples would increase the burden and effectively slow down data processing and suspect profiling.¹⁶⁰ Despite the advances waiting in the wings, Justice Scalia made this sobering assessment:

And that is the main point, which the Court's discussion of the brave new world of instant DNA analysis should not obscure. The issue before us is not whether DNA can *some day* be used for identification; nor even whether it can *today* be used for identification; but whether it *was used for identification here*.¹⁶¹

Fingerprints are the de facto national standard of identification, unless and until DNA identification is fully developed to fill that role.¹⁶² Thus, the Fourth Amendment was not concerned with bootstrapping future innovations to justify yesterday's searches.

Finally, the dissent thundered against the conflation of identification and investigation: "Solving unsolved crimes is a noble objective, but it occupies a lower place in the American pantheon of noble objectives than the protection of our people from suspicionless law-enforcement searches. The Fourth

¹⁵⁷ *Id.* Another important distinction is that fingerprinting was born in the stationhouse, DNA in the laboratory. So it is that fingerprinting became a custom, and DNA a science.

¹⁵⁸ *Id.* at 1988.

¹⁵⁹ *King*, 133 S. Ct. at 1988 (Scalia, J., dissenting).

¹⁶⁰ *Id.* (citing statistics about the uptick in arrests from Robert Brame et al., *Cumulative Prevalence of Arrest From Ages 8 to 23 in a National Sample*, 129 PEDIATRIC 21 (2011)).

¹⁶¹ *Id.* at 1988–89.

¹⁶² *Id.* at 1989. Meanwhile, local jails and detention facilities have turned to retina and iris scans as the highest quality identification metric. See *Jails Hope Eye Scanners Can Provide Foolproof Identification System for Inmates*, N.Y. TIMES, Feb. 28, 2010, at A25 available at http://www.nytimes.com/2010/02/28/us/28eyes.html?_r=0 ("The F.B.I. has the fingerprints and criminal history of about 65 million people in its database. Sheriffs complain that fingerprint search results can take hours or even days, but results with an iris scan are nearly instant. . . . Scanning inmates is quick, too. A person simply looks into a camera, which uses infrared light to illuminate and map the iris. Each iris is unique and contains about six times more features than a fingerprint."). Eye scanners are an efficient tool for identifying arrestees, tracking escapees and monitoring releases, but not useful in crime scene investigation at least until matching procedures and databases are fully developed. See Aliya Sternstein, *Eye on Crime: The FBI is Building a Database of Iris Scans*, NEXTGOV (June 27, 2012), <http://www.nextgov.com/emerging-tech/2012/06/eye-crime-fbi-building-database-iris-scans/56481/> ("[I]ncreasingly, law enforcement agencies are spending state and federal funds on iris recognition technology at jails to monitor inmates. Some Missouri prisons are buying the same system the FBI acquired, partly so that they can eventually exchange iris images with federal law enforcement officials.").

Amendment must prevail."¹⁶³ Indeed, carrying *King's* logic to its conclusion, genetic identification would not be constitutionally barred from any kind of arrest.¹⁶⁴ Upon conviction for the 2009 assault Maryland had the right to King's DNA, so it was only the innocent who would be burdened by the majority's holding. "In other words, this Act manages to burden uniquely the sole group for whom the Fourth Amendment's protections ought to be most jealously guarded: people who are innocent of the State's accusations."¹⁶⁵ So the dissenters closed by intoning the hope that this decision will "some day be repudiated."¹⁶⁶ Before that day comes, it will depend on state courts applying their constitutions to be the guardians of genetic privacy.¹⁶⁷

C. The State

In the aftermath of the Supreme Court's decision, the Maryland appeals court confronted for the first time the legitimacy of arrestee sampling under their constitution. In the first state appeal, *King I*, the defendant relied solely on the Fourth Amendment.¹⁶⁸ After the Supreme Court moved the line on privacy, he resorted to Maryland's constitution for relief.¹⁶⁹ In *King II*, the Court of Appeals of Maryland again considered the constitutionality of the Maryland DNA Collection Act but this time under Article 26 of their state

¹⁶³ *King*, 133 S. Ct. at 1989.

¹⁶⁴ *Id.* at 1989 ("Make no mistake about it: As an entirely predictable consequence of today's decision, your DNA can be taken and entered into a national DNA database if you are ever arrested, rightly or wrongly, and for whatever reason.").

¹⁶⁵ *Id.*

¹⁶⁶ *Id.* at 1989–90 (contrasting *New York v. Belton*, 453 U.S. 454 (1981) with *Arizona v. Gant*, 556 U.S. 332 (2009) as an example of the Court's reversal on suspicionless automobile searches). Justice Scalia might also have pointed to changes that occur when science revisits forensics. See generally Caitlin M. Plummer and Imran J. Syed, "Shifted Science" and Post-Conviction Relief, 8 STAN. J. C.R. & C.L. 259 (2012); Marc Price Wolf, *Habeas Relief From Bad Science: Does Federal Habeas Corpus Provide Relief for Prisoners Possibly Convicted on Misunderstood Fire Science?*, 10 MINN. J.L. SCI. & TECH. 213 (2008).

¹⁶⁷ See *Brigham City v. Stuart*, 547 U.S. 398, 409 (2006) (Stevens, J., concurring) ("Federal interests are not offended when a single State elects to provide greater protection for its citizens than the Federal Constitution requires."). See generally William J. Brennan, Jr., *State Constitutions and the Protections of Individual Rights*, 90 HARV. L. REV. 489 (1977); NAT'L INST. FOR JUST., *supra* note 6, at 72–75.

¹⁶⁸ *King v. State*, 42 A.3d 549, 554 (Md. 2012) (*King I*) ("The thrust of King's argument was that the DNA Act could not survive scrutiny under the Fourth Amendment and therefore King's arrest was invalid.").

¹⁶⁹ *King v. State*, 76 A.3d 1035, 1040 (Md. 2013) (*King II*).

constitution.¹⁷⁰ However, the second trip up the appellate ladder did not turn out as hoped.

Judged by history and language, Maryland's Article 26 was in lockstep with the Fourth Amendment.¹⁷¹ And even if grounds existed for a distinct interpretation, it would not have supported an unprecedented exclusionary rule.¹⁷² Thus, King faced the double barrier of forging a state constitutional right and remedy.¹⁷³ The Court of Appeals deferred to the Supreme Court's decision interpreting a search and seizure law so similar to their own.¹⁷⁴ Predictably, they adhered to the high court's judgment and reasoning, skirting the issue of whether an exclusionary remedy existed under state law.¹⁷⁵

The next phase of King's arguments concerned the second DNA sample, which was obtained by warrant and court order based on the stationhouse sampling.¹⁷⁶ All claims of procedural error under the Maryland Act ultimately failed. The appeals court found that King had not satisfied the burden of going forward;¹⁷⁷ even if a statutory violation had been found, his remedies were confined to the statute, not an unacknowledged exclusionary rule.¹⁷⁸ Thus, the only argument based on a statutory prohibition would be against using DNA sampling for "information unrelated to identifica-

¹⁷⁰ *Id.* at 1039–40 (finding that Mr. King defaulted on the state constitutional issue by failing to raise it in the trial court). Nonetheless, the court exercised its discretionary powers to hear the challenge. *Id.* The outcome of this decision did raise concerns over preservation and the risks attendant to coupling federal and state constitutional claims together.

¹⁷¹ *Id.* at 1041 (quoting Article 26 of the Maryland Declaration of Rights: "That all warrants, without oath or affirmation, to search suspected places, or to seize any person or property, are grievous and oppressive; and all general warrants to search suspected places, or to apprehend suspected persons, without naming or describing the place, or the person in special, are illegal, and ought not to be granted.").

¹⁷² *Id.* at 1041–42.

¹⁷³ *Id.* at 1042.

¹⁷⁴ *King*, 76 A.3d at 1042. Chief Justice Bell authored the dissent, pointing out the inconsistency of the Maryland appeals court finding a Fourth Amendment violation in the first round, but discarding that reasoning under their comparable state constitutional provision, specifically stating that "[i]t is my belief that the conclusion this Court reached applying the Fourth Amendment is equally supported by application of Article 26 of the Maryland Declaration of Rights, which we determined, at that time, to be a moot argument. Accordingly, I would re-affirm our judgment on that State Law ground." *Id.* at 1048–1049 (Bell, C.J., dissenting).

¹⁷⁵ *Id.* at 1042.

¹⁷⁶ *Id.*

¹⁷⁷ *Id.* at 1043.

¹⁷⁸ *Id.* at 1045–46 ("Although some other circumstances may present an opportunity to find that a violation of the Act amounted to an unreasonable search in violation of the Fourth Amendment, this case is certainly not that one. The question is not whether the Act was violated, but whether the alleged statutory violation could amount to a Fourth Amendment violation in its own right. Were the Act's technical protocols for DNA collection violated, the collection would remain a reasonable search nonetheless. Therefore, the statutory violations alleged by King, assuming *arguendo* they occurred, do not alter the Supreme Court's holding in *King*. The initial collection of King's DNA—whether pursuant to the Act's technical requirements or not—was constitutional." *Id.* at 1047).

tion".¹⁷⁹ This would hinge on a definition of "identification" distinct from the Supreme Court's and ideally founded on state constitutional law.¹⁸⁰

For the time being, the Supreme Court has taken away the ability of states with Fourth Amendment mirroring provisions, like Maryland, to evolve their own state privacy interests. Thus, the future of genetic privacy before conviction will depend on the Supreme Court's willingness to revisit *Maryland v. King* in the light of sea changes in state laws and court decisions as well as revised understandings of DNA profiling.¹⁸¹

More than half the states have laws authorizing some form of DNA test-on-arrest with varying standards and procedures in terms of qualifying offenses, timing for taking a sample, conditions for destroying samples, and their use in court proceedings.¹⁸² In light of the Maryland's court's decision in *King II*, it is the state collection statute that will draw the line on information capture and establish the remedy for its abuse, unless the state's constitution is found to exceed the limits of Fourth Amendment interpretation.

The distinction between sampling (cheek swab) and profiling (database matching) should be the trip wire for investigative search warrants.¹⁸³ Gath-

¹⁷⁹ *King*, 76 A.3d at 1048.

¹⁸⁰ See Stuart, *supra* note 54, at 1139.

¹⁸¹ See *Maryland v. King*, 133 S. Ct. 1958, 1990 n.6 (2013) (Scalia, J., dissenting) (Justice Scalia pointed to a recent reversal in the Fourth Amendment context: "Compare, *New York v. Belton*, 453 U.S. 454 (1981) (suspicionless search of a car permitted upon arrest of the driver), with *Arizona v. Gant*, 556 U.S. 332 (2009) (on second thought, no).") Moreover, reversals in juvenile death penalty and life without parole sentencing based in part on scientific grounds offer additional sanguine examples of precedent reversals. See, e.g., *Miller v. Alabama*, 132 S. Ct. 2455, 2464 n.5 (2012) ("The evidence presented to us in these cases indicates that the science and social science supporting Roper's and Graham's conclusions have become even stronger."); *Graham v. Florida*, 130 S. Ct. 2011, 2026 (2010) ("No recent data provide reason to reconsider the Court's observations in Roper about the nature of juveniles. As petitioner's amici point out, developments in psychology and brain science continue to show fundamental differences between juvenile and adult minds."); *Roper v. Simmons*, 125 S. Ct. 1183, 1195 (2005) ("[A]s any parent knows and as the scientific and sociological studies respondent and his amici cite tend to confirm, '[a] lack of maturity and an underdeveloped sense of responsibility are found in youth more often than in adults and are more understandable among the young.'"); see also *Maryland v. King*, 133 S. Ct. 1958, 1989 (2013) (discussing Justice Scalia's suggestion for revising the Court's decision and references to other sources).

¹⁸² Stuart, *supra* note 54, at 1116. "The Appendix contains a brief survey of the arrestee DNA testing statutes of all fifty states, including whether a state has a statute, what crimes trigger the statute, whether juveniles are subjected to testing, and the expungement procedures." *Id.* at 1116 n.38.

¹⁸³ *Id.* at 1120–21; see *King*, 133 S.Ct. at 1966 (explaining that the detectives in the *King* case obtained a search warrant before a second extraction and profiling for the new case.). Information rich DNA sampling, like blood draws and computer searches, ought to necessitate a warrant to assure that they are used for their intended purposes. Indeed, the best bulwark against fishing expeditions in human biologics is constitutional particularity; see, e.g., *United States v. Ganius*, 755 F.3d 125, 141 (2d Cir. 2014) ("[T]he Government violated Ganius's Fourth Amendment rights by seizing and indefinitely retaining non-responsive computer records, and then searching them when it later developed probable cause. Ac-

ering a clump of cells might seem mildly intrusive and scarcely enough to dust up a constitutional storm; but it is their linkage through database analysis that peels away layers of privacy, the presumption of innocence, and probable cause. This is especially distressing in cases where the DNA match is the principal or sole evidence against the accused; when a DNA swab might very well be tantamount to conviction.¹⁸⁴ This de facto DNA rap sheet might inevitably lead to data abuse as with other forms of super-surveillance.¹⁸⁵ It will likely double the burden of defendants who must contest their new arrest charges at the same time as unrelated charges stemming from the DNA match.

II. TO ERR IS HUMAN

DNA's scientific reputation is almost akin to magic, but its forensic applications are subject to the faults and limitations of other proof. Every stage in the collection, profiling, databanking and analysis of DNA evidence can be subject to human error, mechanical error, computer error, statistical error, false positives and cognitive biases.¹⁸⁶ Thus, whether used for identification or investigation, its vaunted reputation should not blind judges to the realities and limitations of DNA proof.

cordingly, Ganas's personal records, seized in the execution of the November 2003 warrant and retained for two-and-a-half years, should have been suppressed."); *State v. Martines*, 331 P.3d 105, 111 (Wash. Ct. App. 2014), pet. rev. granted, *State v. Martines*, 339 P.3d 634 (Sup. Ct. Wash. 2014) ("Where the State has probable cause to suspect driving under the influence, the requirement to obtain a particularized warrant for blood testing will prevent the State from rummaging among the various items of information contained in a blood sample for evidence unrelated to drunk driving. For example, when a blood sample is obtained in the course of investigating driving under the influence, the State may not—without further warrant—use the sample to produce a DNA profile that can be added to government data banks."). See generally Kimel, *supra* note 136, at 970 ("Then, as with post-seizure computer searches, courts should require the government to obtain a search warrant - based on probable cause to believe that the DNA profile to be searched will produce evidence of the crime under investigation - before the government is allowed to search a DNA profile that it created.").

¹⁸⁴ See *King v. State*, 42 A.3d 549, 554 (Md. 2012) (referring to the 2003 rape case, the court in *King I* pointed out: "The DNA database 'hit' was the only evidence of probable cause supporting the indictment."). See generally Andrea Roth, *Safety in Numbers--Deciding When DNA Alone Is Enough to Convict*, 85 N.Y.U. L. REV. 1130 (2010); Strutin, *Limitations of Forensics as Standalone Evidence of Guilt*, *supra* note 18, at 5.

¹⁸⁵ See Stuart, *supra* note 54, at 1152. ("The officer may have arrested the wrong person. The officer may have made an invalid arrest. The majority's holding [in *Maryland v. King*] will expand DNA testing with officers more apt to arrest in those states that test all arrestees and prosecutors charging for more serious crimes in jurisdictions that test for only certain crimes. Even if the arrest is completely legitimate, the arrestee deserves the constitutional protection against search and seizure. Because the arrestee has not yet been proven guilty, there is no diminished privacy interest.").

¹⁸⁶ See generally Tania Simoncelli & Barry Steinhardt, *California's Proposition 69: A Dangerous Precedent for Criminal DNA Databases*, 33 J.L. MED. & ETHICS 279, 286–87 (2005).

In *Association for Molecular Pathology v. Myriad Genetics*, the Court held that the discovery of the BRCA1 and BRCA2 genes locations was not patent eligible while creation of a sequence of complementary DNA or cDNA was.¹⁸⁷ Concerning their understanding of genetics, Justice Scalia observed:

I join the judgment of the Court, and all of its opinion except Part I–A and some portions of the rest of the opinion going into fine details of molecular biology. I am unable to affirm those details on my own knowledge or even my own belief. It suffices for me to affirm, having studied the opinions below and the expert briefs presented here. . . .¹⁸⁸

Indeed, commentators have taken the Court to task for its misconstruction of genetic science independent of their legal reasoning.¹⁸⁹ And in *Maryland v. King*, the majority's rationalization that DNA was infallible and limited to confirmatory identification has also been the subject of criticism.¹⁹⁰ On too many occasions, courts and lawyers have pronounced DNA infallible *ex cathedra*.¹⁹¹ It seems to be human nature to embrace forensic tools before they have been properly vetted.¹⁹²

Professor Thompson has cataloged the most common reasons for distrusting DNA sampling, testing and matching: (1) cross-contamination; (2) mislabeled samples; and (3) misinterpretation of results; in addition to recording errors, problems with mixtures, and partially degraded, or contaminated samples.¹⁹³ Any one or a combination of these circumstances can re-

¹⁸⁷ *Ass'n for Molecular Pathology v. Myriad Genetics*, 133 S. Ct. 2107, 2110 (2013).

¹⁸⁸ *Id.* at 2120 (Scalia, J., concurring).

¹⁸⁹ See, e.g., Noah Feldman, *The Supreme Court's Bad Science on Gene Patents*, BLOOMBERG (June 13, 2013), <http://www.bloomberg.com/news/articles/2013-06-13/the-supreme-court-s-bad-science-on-gene-patents>; Noam Prywes, *The Supreme Court's Sketchy Science: Their BRCA Patent Ruling Reads Like an Earnest Seventh Grader's Book Report*, SLATE (June 14, 2013), http://www.slate.com/articles/health_and_science/science/2013/06/supreme_court_patent_case_science_the_justices_misunderstand_molecular_biology.html; Steven Salzberg, *Supreme Court Gets Decision Right, Science Wrong, on Gene Patents*, FORBES (June 13, 2013), http://www.slate.com/articles/health_and_science/science/2013/06/supreme_court_patent_case_science_the_justices_misunderstand_molecular_biology.html.

¹⁹⁰ See, e.g., Liptak, *supra* note 106, at A15; Strutin, *DNA, Privacy and Personhood: The Crime of Being Alive*, *supra* note 10.

¹⁹¹ William C. Thompson et al., *Forensic DNA Statistics: Still Controversial in Some Cases*, CHAMPION, Dec. 2012, at 12, 22.

¹⁹² See generally NAT'L RESEARCH COUNCIL OF THE NAT'L ACADEMIES, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD (2009) (discussing the need to improve forensic science practices); Ken Strutin, *Strengthening Forensic Science: The Next Wave of Scholarship*, LLRX (Nov. 23, 2009) <http://www.llrx.com/features/forensicscience.htm> (discussing improving the forensic science disciplines).

¹⁹³ William C. Thompson, *Forensic DNA Evidence: The Myth of Infallibility*, in GENETIC EXPLANATIONS: SENSE AND NONSENSE 229–33, 241–42 (Sheldon Krinsky et al. eds., 2013). See generally Mark Hansen, *Crime Labs Under the Microscope After a String of Shoddy, Suspect and Fraudulent Results*, 99 A.B.A. J. 44 (2013).

sult in false reports of DNA matches (laboratory analysis), false cold hit (database search), consumption of small samples prohibiting retesting or confirmatory testing, problems related to low copy number or low template or touch DNA, investigator bias and observer expectancy.¹⁹⁴ Even retesting cannot purge a conclusion of all errors,¹⁹⁵ any more than cross-examination can expose all falsehoods and mistakes.¹⁹⁶ No human endeavor is free of human error or human bias.¹⁹⁷ Indeed, biases generally can spillover into the aims of prosecution and law enforcement and the judgments of experts.¹⁹⁸

For years Germany, France and Austria were inundated by a bizarre chain of dozens of crimes including six homicides all threaded with a single DNA link pointing to a female suspect.¹⁹⁹ The Phantom of Heilbronn, as she became known, had confounded investigators and profilers as her DNA kept popping up in new and cold cases.²⁰⁰ In 2009, the German authorities realized that a fundamental error had been misleading them and retraced their forensic steps back to the cotton swabs used for collecting genetic samples from the crime scenes.²⁰¹ While the swabs were sterilized at the

¹⁹⁴ William C. Thompson, *Forensic DNA Evidence: The Myth of Infallibility*, in GENETIC EXPLANATIONS: SENSE AND NONSENSE, *supra* note 193, at 232–33.

¹⁹⁵ Thompson et al., *supra* note 191, at 12.

¹⁹⁶ See Jules Epstein, *Cross-Examination: Seemingly Ubiquitous, Purportedly Omnipotent, and at Risk*, 14 WIDENER L. REV. 427, 427–28 (2009); Jules Epstein, *The Great Engine That Couldn't: Science, Mistaken Identifications, and the Limits of Cross-Examination*, 36 STETSON L. REV. 727, 729 (2007).

¹⁹⁷ See, e.g., Itiel E. Dror & Greg Hampikian, *Subjectivity and Bias in Forensic DNA Mixture Interpretation*, 51 SCI. & JUST. 204, 204 (Dec. 2011).

¹⁹⁸ See generally Brandon L. Garrett & Peter J. Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 VA. L. REV. 1 (2009) (discussing the validity of expert testimony); Saul M. Kassin et al., *Confessions That Corrupt: Evidence From the DNA Exoneration Case Files*, 23 PSYCHOL. SCI. 41 (2012) (discussing the corruptive potential of confessions); Roger Koppl & Meghan Sacks, *Criminal Justice System Creates Incentives for False Convictions*, 32 CRIM. JUST. ETHICS 126 (2013) (discussing incentives for police, prosecutors, and forensic scientists to convict someone); Erin Morris, *Cognitive Bias and the Evaluation of Forensic Evidence*, CHAMPION, May 2012, at 12 (discussing cognitive bias in the chain of forensic analysis); Daniel C. Murrie et al., *Are Forensic Experts Biased by the Side That Retained Them?*, 24 PSYCHOL. SCI. 1889 (2013) (discussing bias in forensic science procedures); William C. Thompson, *Beyond Bad Apples: Analyzing the Role of Forensic Science in Wrongful Convictions*, 37 SW. L. REV. 971 (2008) (discussing how misuse of forensic science can lead to wrongful convictions).

¹⁹⁹ See Claudia Himmelreich, *Germany's Phantom Serial Killer: A DNA Blunder*, TIME, Mar. 27, 2009, <http://content.time.com/time/world/article/0,8599,1888126,00.html>.

²⁰⁰ *Id.*

²⁰¹ *Id.* ("Trying to establish the identity of a burned corpse found in 2002, they were re-examining the fingerprints of a male asylum seeker taken from his asylum application made many years earlier. The fingerprints contained the Phantom's female DNA. Impossible, they thought, so they repeated the test with a different cotton swab — and this time found no trace of the Phantom's DNA.").

factory to eliminate "bacteria, viruses and fungi," they left undisturbed the DNA of anyone who might have handled them.²⁰²

The lessons from the Phantom case were not lost on the police.²⁰³ It was a new type of contamination that would chasten law enforcement forensics. And for the defense bar it affirmed the dangers of tunnel vision created by DNA's reputation:

What we need to avoid is the assumption that the producer of the traces is automatically the culprit. Judges tend to be so blinded by the shiny, seemingly perfect evidence of DNA traces that they sometimes ignore the whole picture. DNA evidence on a crime scene says nothing about how it got there. There is good reason for not permitting convictions on the basis of DNA circumstantial evidence alone.²⁰⁴

Generally, a newly unearthed genetically linked crime will impact the bail, guilt and sentencing in the new arrest where the DNA has been sampled. Hence, DNA linkages can change the dynamic of a case not involving DNA evidence by introducing a connection to another felony before any challenges to the reliability and accuracy of that match can be raised.

In *Maryland v. King*, Justice Kennedy described DNA testing as "unparalleled" and "irrefutable."²⁰⁵ Such absolute faith tends to skew critical thinking about other evidence. The reflected glory and subtle biases behind the process of DNA matching are doubly dangerous in the rush to judgment and can inflate otherwise dubious evidence. Unvetted and uncorroborated DNA matches create a presumption of guilt and shift the burden of proof. Prejudgment, even when based on science, is not evidence of guilt beyond a reasonable doubt. In every DNA prosecution the defendant is forced to respond to evidence presumed infallible, thus diverting resources from other viable evidentiary challenges and warping the theory of the case as well as its presentation. The genetic match imposes on a defendant an obligation to offer proof to negate it. Thus, DNA evidence can impose burdens on the ac-

²⁰² *Id.* ("Cotton swabs are sterilized before being used to collect DNA samples, but while sterilizing removes bacteria, viruses and fungi, it does not destroy DNA. " Germany's Federal Criminal Police Office is investigating the theory that certain batches of cotton swabs could have been contaminated at some point in their production, from when the raw cotton was picked to when the swabs were packed. Forensic analysts in Stuttgart have been testing unused cotton swabs for the Phantom's DNA but say that so far they have found no evidence of contamination.").

²⁰³ *Id.* ("Berlin police spokesman Michael Merkle tells TIME that the city's investigators are now checking whether they also use cotton swabs from Greiner Bio-One. "A consequence of the present case may be to start randomly checking the cotton swabs we are supplied with for traces of DNA — which, in turn, harbors the risk of contaminating them," he says.").

²⁰⁴ Himmelreich, *supra* note 199 (quoting Stefan König of the Berlin Association of Lawyers).

²⁰⁵ See *Maryland v. King*, 133 S.Ct. 1958, 1972 ("[T]he only difference between DNA analysis and the accepted use of fingerprint databases is the unparalleled accuracy DNA provides. . . . The DNA collected from arrestees is an irrefutable identification of the person from whom it was taken.").

cused's Fifth Amendment right against self-incrimination;²⁰⁶ the decision whether to testify or present evidence; and defense counsel's ability to effectively challenge it.

The latest fly in the ointment is the risk created by fabrication and planting of evidence stemming from police, analyst or third-party misconduct.²⁰⁷ For instance, false positive matches might be attributable to planting evidence at the crime scene that has been copied from CODIS.²⁰⁸ Then there is the scenario where the defendant reveals to her attorney that she planted such evidence to implicate someone else.²⁰⁹ The discovery that genetic profiles can be duplicated (impersonated) or totally artificial (fabricated) detracts from the uniqueness of DNA and its verity.²¹⁰ It compels reopening assumptions about DNA matches that have not been authenticated against fakery. Artificial DNA is a genetic mask that can mislead investigators, distract analysts and inculcate the wrong people.²¹¹ Indeed, laboratories are

²⁰⁶ See, e.g., *State v. Gauthier*, 298 P.3d 126, 132 (Wash. Ct. App. 2013) (finding introduction of defendant's refusal to consent to DNA sampling was reversible error). See generally Jeremy Gans, *Something to Hide: DNA, Surveillance and Self-Incrimination*, 13 CURRENT ISSUES CRIM. JUST. 168 (2001-2002); Strutin, *DNA and the Double Helix of Constitutional Rights*, *supra* note 4.

²⁰⁷ See William C. Thompson, *Forensic DNA Evidence: The Myth of Infallibility*, in GENETIC EXPLANATIONS: SENSE AND NONSENSE, *supra* note 193, at 250-53.

²⁰⁸ The experience with fingerprint falsification and forgery is also informative. See, e.g., Boris Geller et al., *Fingerprint Forgery—A Survey*, 46 J. FORENSIC SCI. 731, 732 (2001) ("One of the worst possible mistakes that can be made in the field of fingerprint examination is to overlook a forgery. Professionally produced forgeries are not easy to detect, especially when most technicians have never seen, nor claim that they ever have seen a forged fingerprint." ; Boris Geller et al., *A Chronological Review of Fingerprint Forgery*, 44 J. FORENSIC SCI. 963, 963 (1999); see generally NELSON E. ROTH, THE NEW YORK STATE POLICE EVIDENCE TAMPERING INVESTIGATION, REPORT TO THE HONORABLE GEORGE PATAKI, GOVERNOR OF THE STATE OF NEW YORK (1997); Richard Perez-Pena, *Supervision of Troopers Faulted in Evidence-Tampering Scandal*, N.Y. TIMES, Feb. 4, 1997, at B1, <http://www.nytimes.com/1997/02/04/nyregion/supervision-of-troopers-faulted-in-evidence-tampering-scandal.html> ("Concluding a four-year investigation into the worst scandal in state police history, a special prosecutor said today that troopers were able to plant evidence routinely in criminal cases across a broad swath of rural New York because they had no fear of detection by supervisors, who maintained a willful ignorance.").

²⁰⁹ See generally Ken Strutin, *Preserving Attorney-Client Privilege at the Cost of Another's Innocence*, 17 TEX. WESLEYAN L. REV. 499 (2011).

²¹⁰ See Frumkin et al., *supra* note 108, at 95.

²¹¹ Moreover, law enforcement investigation might need to someday employ repurposed, fabricated or planted DNA. In a similar vein, federal authorities have already used actual social media profiles to conduct in-depth undercover operations, much to the consternation of those impersonated and their social media hosts. See, e.g., Radley Balko, *Once You've Dehumanized Drug Offenders, It's Easy to Steal Their Identities*, WASH. POST., Oct. 7, 2014, <http://www.washingtonpost.com/news/the-watch/wp/2014/10/07/once-youve-dehumanized-drug-offenders-its-easy-to-steal-their-identities/>; Terrence McCoy, *DEA Created a Fake Facebook Profile in This Woman's Name Using Seized Pics — Then Impersonated Her*, WASH. POST., Oct. 7, 2014, <http://www.washingtonpost.com/news/morning-mix/wp/2014/10/07/dea-created-a-fake-facebook-profile-in-this-womans-name-using-seized-pics-then-impersonated-her/>; Assoc. Press, *Facebook Unfriends Federal Drug Agency*, POLITICO (Oct. 17, 2014), <http://politi.co/1wby63q>; Chris Hamby, *Government Set Up a Fake Facebook Page in This Woman's Name*, BUZZFEED NEWS (Oct. 6, 2014), <http://www.buzzfeed.com/chrishamby/government-says-federal-agents-can-impersonate-woman-online#uxLrQEGz8> ("The Justice Department is claiming, in a little-noticed court fil-

unable to differentiate between fake DNA and the real thing without authentication, i.e., a test for methylation.²¹² In effect, fabricated DNA can cause the same damage to the accuracy and reliability of legal judgments as cross-contamination.

The result is the real possibility of DNA identity theft and evidence planting. The availability of DNA samples and profiles from multiple sources only increases the risks.²¹³ Documented cases of forensic fraud by analysts, laboratories, and private parties suggest the possibilities.²¹⁴ "The incidents of falsification of forensic evidence, the availability of DNA samples and profiles and the ease of DNA fabrication underscore the need to reevaluate the way we look at DNA admissibility and reliability."²¹⁵ DNA fabrication, i.e., copying, manufacturing and planting, is the latest link in a catalog of errors, misconduct and fallacies that can cast doubt on DNA sampling, testing, profiling, reporting and expert testimony. The manufacture of DNA is new science and it warrants a second look at admissibility issues.²¹⁶ The CSI effect will further exacerbate the problem because lay people will not be making the fine distinctions between genuine and fake DNA and the myriad concerns over DNA reliability and accuracy.²¹⁷ Unfortunately, like fingerprints, DNA has received a pass in the public mind as well as in judicial decisions.

The potential collective problems with every DNA sampling and analysis demand a preliminary hearing of some kind to review the science and its administration in each case. "[T]he discovery of the ability to easily fabricate DNA evidence as well as a long history of DNA falsification and gross ineptness by crime laboratories demonstrate that DNA-based evidence's sterling reputation is undeserved."²¹⁸ Thus, this tell all biologic is susceptible to being fabricated, copied, stolen, swapped and planted to avoid apprehension or implicate someone falsely.

ing, that a federal agent had the right to impersonate a young woman online by creating a Facebook page in her name without her knowledge. Government lawyers also are defending the agent's right to scour the woman's seized cell phone and to post photographs — including racy pictures of her and even one of her young son and niece — to the phony social media account, which the agent was using to communicate with suspected criminals."). See generally Strutin, *Social Media and the Vanishing Points of Ethical and Constitutional Boundaries*, *supra* note 93.

²¹² Kristen Bolden, *DNA Fabrication, A Wake Up Call: The Need to Reevaluate the Admissibility and Reliability of DNA Evidence*, 27 GA. ST. U. L. REV. 409, 414 (2011).

²¹³ *Id.* at 416.

²¹⁴ *Id.* at 417–19.

²¹⁵ *Id.* at 424–25.

²¹⁶ *Id.* at 409.

²¹⁷ Bolden, *supra* note 212, at 431–32, 436.

²¹⁸ Bolden, *supra* note 212, at 440 (suggesting the application of the Frye-Kelly test to combat authentication issues).

Human error and human bias increase the risk of false accusation and wrongful conviction. Subjectivity is the enemy of accuracy in investigation, interrogation, forensic analysis and prosecution. And then there is the inflationary impressiveness of forensic-scientific evidence.²¹⁹ The results can be false database matches,²²⁰ mislabeled samples, intentional falsification or fabrication, cross-contamination and secondary transfer.²²¹ Practically speaking, duplicate and mislabeled entries are plagued with potential errors unrelated to science, i.e., spelling errors; false names or aliases; and transcription errors. The same types of human errors found in rap sheets and other criminal justice documents can plague all forensic recordkeeping.²²²

Convictions based on outmoded analytical protocols, in addition to those cases where no DNA testing had been performed, should also be reviewed.²²³ Many wrongfully convicted persons in prison would benefit from the historical revisionism of new science and new standards. Indeed, new evidence theory should acknowledge these developments and review cases where DNA matches were admitted based on lower thresholds than today. Indeed, convictions based on science or technology should have ex-

²¹⁹ See Saul Kassin et al., *Confessions That Corrupt: Evidence From the DNA Exoneration Case Files*, 23 PSYCHOL. SCI. 41, 42–43 (2012). Based on a study of wrongful convictions collected by the Innocence project, researchers discovered a spillover or CSI effect tied to the presence of confessions. "Multiple evidence errors were significantly more likely to exist in false-confession cases than in eyewitness cases; in order of frequency, false confessions were accompanied by invalid or improper forensic science, eyewitness identifications, and snitches and informants; and in cases containing multiple errors, confessions were most likely to have been obtained first." *Id.* See generally Ken Strutin, *Forensic Evidence and the CSI Effect*, LLRX (May 9, 2010), <http://www.llrx.com/features/forensicevidenceccsieffect.htm>.

²²⁰ See, e.g., OFFICE OF INSPECTOR GEN., U.S. DEP'T OF JUSTICE, A REVIEW OF THE FBI'S HANDLING OF THE BRANDON MAYFIELD CASE 269 (2006), available at <http://www.justice.gov/oig/special/s0601/financial.pdf> ("[T]he examiners committed errors in the examination procedure, and . . . the misidentification could have been prevented through a more rigorous application of several principles of latent fingerprint identification.").

²²¹ See generally William C. Thompson, *Forensic DNA Evidence: The Myth of Infallibility*, in GENETIC EXPLANATIONS: SENSE AND NONSENSE, *supra* note 193.

²²² See William C. Thompson, *Forensic DNA Evidence: The Myth of Infallibility*, in GENETIC EXPLANATIONS: SENSE AND NONSENSE, *supra* note 193 at 227–33.

²²³ See John Roman et al., *Post-Conviction DNA Testing and Wrongful Conviction*, URBAN INST. 11 (2012), available at <http://www.urban.org/UploadedPDF/412589-Post-Conviction-DNA-Testing-and-Wrongful-Conviction.pdf?RSSFeed=Urban.xml> ("The Virginia (VA) model of post-conviction DNA testing . . . is unique. Rather than start with claims of actual innocence from living convicted offenders, the state received funding to test all existing physical evidence that might contain DNA for serious person crimes that resulted in conviction. The claims of actual innocence (or admittance of actual guilt) therefore did not influence the decision to conduct DNA testing. This 'test-them-all' approach to postconviction DNA testing has never been replicated by any other state.").

piration dates compelling courts to reexamine judgments rendered before the rules changed.²²⁴

Another response might be a categorical exclusionary rule for "unvalidated" genetic evidence.²²⁵ This "common sense"²²⁶ remedy might be based on state constitutional rights and legislative enactments that protect genetic privacy as a civil right and public policy, supplementing the Health Insurance Portability and Accountability Act of 1996 (HIPPA)²²⁷ and the Genetic Information Nondiscrimination Act of 2008 (GINA).²²⁸ A Genetic Bill of Rights would also provide pre-emptive protection against prying information from DNA with new technologies, which can only now be obtained with a warrant or probable cause upon an arrest for a qualifying offense.²²⁹ Overall, DNA as identification is complicated and fallible in ways that other metrics are not. Every step from extraction, evidence collection, storage, databanking, profiling, and matching to expert analyses is subject to error. Thus, DNA evidence is not the perfection that the *King* majority imagined.

III. THE DIGITAL DIVIDE

In *United States v. Jones* and *Kyllo v. United States*, the Supreme Court ruled that global positioning system (GPS) and thermal imaging tools, respectively, were invasive because they captured the secret dimensions of

²²⁴ See, e.g., ENFSI DNA WORKING GRP., DNA-DATABASE MANAGEMENT REVIEW AND RECOMMENDATIONS, 33 (Apr. 2014), available at http://www.enfsi.eu/sites/default/files/documents/enfsi_2014_document_on_dna-database_management_0.pdf (addressing the concerns over errors due to false or partial matches based on coincidence rather than causal link: "ENFSI-recommendation 24: DNA-database managers should be aware of the possibility of adventitious matches and be able to calculate their expected numbers for the matches they report. When reporting a DNA-database match, a warning should be included indicating the factors that increase the possibility of finding an adventitious match (size of the database, number of searches, mixed and partial profiles/random match probability, presence of family members.")).

²²⁵ See, e.g., Rory K. Little, *Addressing the Evidentiary Sources of Wrongful Convictions: Categorical Exclusion of Evidence in Capital Statutes*, 37 SW. L. REV. 965, 985 (2008) (putting forward a model statute that would enlarge the court's gatekeeper role in summarily vetting unreliable evidence as revealed by exoneration litigation and forestall capital prosecutions based principally on certain types of proof: "(a) eyewitness [stranger] identification testimony; (b) a confession; (c) a criminal informant; or (d) unvalidated forensic evidence.").

²²⁶ See *Mapp v. Ohio*, 367 U.S. 643, 657 (1961) ("[O]ur holding that the exclusionary rule is an essential part of both the Fourth and Fourteenth Amendments is not only the logical dictate of prior cases, but it also makes very good sense. There is no war between the Constitution and *common sense*." (emphasis added)).

²²⁷ Health Insurance Portability and Accountability Act of 1996, Pub. L. No. 104-191, 110 Stat. 1936.

²²⁸ Genetic Information Nondiscrimination Act of 2008, Pub. L. No. 110-233, 122 Stat. 881.

²²⁹ See generally Jaclyn G. Ambriscoe, *Massachusetts Genetic Bill of Rights: Chipping Away at Genetic Privacy*, 45 SUFFOLK U. L. REV. 1177 (2012); Elizabeth Collins, *Do You Know Where Your DNA Is? The Need for DNA Legislation in Ohio*, 26 J.L. & HEALTH 349 (2013).

private life.²³⁰ However, in *King*, the Court did not ask whether taking a piece of someone and putting it under a microscope was less intrusive than through-the-wall technologies. Sanctioning warrantless genetic sampling upon arrest, the *King* decision demonstrated that forensics was not aligned with science but rather with criminalistics or the legal impression of science. Genetic testing has become the metadata of identification forensics. According to the *King* majority's reasoning, one cheek swab could identify the arrestee, reveal his disposition for violence and measure his risk for flight as well as free the innocent. It was the miracle booking procedure. But in reality it surreptitiously created a link to unsolved crimes without probable cause.

Which poses the greatest threat to privacy, the cell phone searched incident to an arrest or the DNA sampled from it? Human DNA is hard to contain, it leaves a trail throughout the biosphere, including and especially on those items that might be seized, used or touched in the course of an arrest.²³¹ If an arrestee has an expectation of privacy in an object, like a cell phone, is there an expectation of privacy in the DNA deposited on it by the owner?²³²

In response to revelations about mass digital surveillance by the government, the custodians of cell phone information services have responded with new levels of encryption and privacy protection.²³³ This in turn has created a new tension for criminal investigators who cannot access the technology.²³⁴ Some regulatory backdoor access might be the answer for law enforcement, but they will encounter the same privacy objections to the retention of archival data.²³⁵ A new layer of privacy protection, such as a

²³⁰ United States v. Jones, 132 S.Ct. 945, 949 (2012); *Kyllo v. United States*, 533 U.S. 27, 34 (2001).

²³¹ See *Raynor v. State*, 99 A.3d 753, 754 (Md. 2014), cert. den. *Raynor v. Maryland*, 135 S. Ct. 1509 (2015). In this post-*King* decision, the defendant had refused consent to DNA sampling in the course of a rape investigation. Nonetheless, the police obtained biological residue from the chair he was sitting in at the precinct. *Id.*

²³² See Elizabeth E. Joh, *Reclaiming "Abandoned" DNA: The Fourth Amendment and Genetic Privacy*, 100 NW. U. L. REV. 857, 866, 869 (2006) (suggesting that shed or abandoned DNA should be treated as *sui generis* due to its unique and hybrid nature — a physical body element that is also an information container.)

²³³ See David E. Sanger & Matt Apuzzo, *F.B.I. Director Hints at Action as Google and Apple Lock Up Cellphone Data*, N.Y. TIMES, Oct. 17, 2014, at A19.

²³⁴ See *id.* ("Apple and Google have announced new software that would automatically encrypt the contents of cellphones, using codes that even the companies could not crack."); Orin Kerr, *Would a New Crime of "Willful Refusal to Comply with a Decryption Order" Be the Best Answer to the Device Decryption Puzzle?*, WASH. POST: THE VOLOKH CONSPIRACY (Oct. 17, 2014) <http://www.washingtonpost.com/news/volokh-conspiracy/wp/2014/10/17/would-a-new-crime-of-willful-refusal-to-comply-with-a-decryption-order-be-the-best-answer-to-the-device-decryption-puzzle/>.

²³⁵ Cf. Theresa Papademetriou, EUROPEAN UNION: ECJ INVALIDATES DATA RETENTION DIRECTIVE 4 (Lib. Cong. 2014).

DNA biometric password, might become the focal point of privacy expectations in technology.²³⁶

Law enforcement can use test-on-arrest, traffic stops, and stop-and-frisk as physical predicates for collecting quantities of information disproportionate to the inquiry.²³⁷ DNA extends the limits of human bodily information, even beyond the scope of a cavity search; hence it extends the boundaries of privacy. Moreover, *Katz* protects medical privacy.²³⁸ Thus, it might be wise to anticipate the cross-over question of how far can the police go in searching biotechnology, such as medical implants or commercial chip devices that can hold reams of private data.²³⁹

In essence, *King* was a search for evidence incident to an arrest made constitutionally equivalent to a stationhouse booking procedure. Both *King*

²³⁶ See, e.g., Elisabeth Hulette, *Police Can Require Cellphone Fingerprint, Not Pass Code*, VIRGINIAN-PILOT, Oct. 30, 2014, <http://hamptonroads.com/2014/10/police-can-require-cellphone-fingerprint-not-pass-code> ("Judge Steven C. Frucci ruled this week that giving police a fingerprint is akin to providing a DNA or handwriting sample or an actual key, which the law permits. A pass code, though, requires the defendant to divulge knowledge, which the law protects against, according to Frucci's written opinion."). See also *Commonwealth v. Baust*, 2014 Va. Cir. LEXIS 93 (Va. Cir. Ct. Oct. 28, 2014).

²³⁷ See generally *Sodal v. Cook Cnty.*, 506 U.S. 56, 69 (1992) ("In our view, the reason why an officer might enter a house or effectuate a seizure is wholly irrelevant to the threshold question whether the Amendment applies. What matters is the intrusion on the people's security from governmental interference. Therefore, the right against unreasonable seizures would be no less transgressed if the seizure of the house was undertaken to collect evidence, verify compliance with a housing regulation, effect an eviction by the police, or on a whim, for no reason at all. As we have observed on more than one occasion, it would be 'anomalous to say that the individual and his private property are fully protected by the Fourth Amendment only when the individual is suspected of criminal behavior.'" (citations omitted)); *Arizona v. Hicks*, 480 U.S. 321, 325 (1987) ("It matters not that the search uncovered nothing of any great personal value to respondent — serial numbers rather than (what might conceivably have been hidden behind or under the equipment) letters or photographs. A search is a search, even if it happens to disclose nothing but the bottom of a turntable.").

²³⁸ See, e.g., *Malcomson v. Liberty Nw.*, 376 Mont. 306, 314, 339 P.3d 1235 (2014) (holding that informational privacy governed by *Katz* (*Katz v. United States*, 389 U.S. 347 (1967)), encompasses medical records).

²³⁹ See, e.g., Barnaby J. Feder & Tom Zeller, Jr., *Identity Chip Planted Under Skin Approved for Use in Health Care*, N.Y. TIMES, Oct. 14, 2004, at A1; Jim Finkle, *U.S. Government Probes Medical Devices for Possible Cyber Flaws*, REUTERS, Oct. 22, 2014, available at <http://www.reuters.com/article/2014/10/22/us-cybersecurity-medicaldevices-insight-idUSKCN0IB0DQ20141022> ("The senior DHS official said the agency is working with manufacturers to identify and repair software coding bugs and other vulnerabilities that hackers can potentially use to expose confidential data or attack hospital equipment. . . . According to the senior DHS official, the agency started examining healthcare equipment about two years ago, when cybersecurity researchers were becoming more interested in medical devices that increasingly contained computer chips, software, wireless technology and Internet connectivity, making them more susceptible to hacking."); Andy Greenberg, *Want An RFID Chip Implanted into your Hand?*, FORBES (Aug. 13, 2012), <http://www.forbes.com/sites/andygreenberg/2012/08/13/want-an-rfid-chip-implanted-into-your-hand-heres-what-the-diy-surgery-looks-like-video/> ("The practical appeal of an RFID implant, in theory, is quick authentication that's faster, cheaper and more reliable than other biometrics like thumbprints or facial scans. When the chip is hit with a radio frequency signal, it emits a unique identifier number that functions like a long, unguessable password.").

and *Chimel* involved taking custody of a suspect's body and approved a limited search of person, personal space and their effects.²⁴⁰ But the Supreme Court in *Riley v. California* rejected the warrantless search of cell phone contents seized incident to arrest.²⁴¹ And its unanimity contrasted with the split in *King*. While both cases involved an arrest and a warrantless search of an arrestee, they differed in the kind and type of information, digital data and DNA, and information containers, a cell phone and human cells. *Riley* was an incidental custodial search into technology,²⁴² while *King* was a bodily custodial intrusion to gather genetic material for identification and investigative purposes.²⁴³

According to the Court's analysis in *Riley*, the Fourth Amendment's "reasonableness" standard demanded warrants for investigative searches, absent specific exceptions.²⁴⁴ Indeed, this standard illuminated the distinctions between probable cause as understood by law enforcement in the act of crime detection and probable cause as applied by a "neutral and detached magistrate".²⁴⁵ Then, Justice Roberts, writing for the majority, acknowledged the century long history of exceptions created for searches incident to arrest,²⁴⁶ which began with *Weeks v. United States*²⁴⁷ and culminated in *Chimel v. California*,²⁴⁸ *United States v. Robinson*²⁴⁹ and *Arizona v. Gant*.²⁵⁰

The chief foundations for this exception, as declared in *Chimel*, were officer safety and evidence preservation.²⁵¹ But in *Robinson* the Court backed off a strict application of an approach that required a court to second guess

²⁴⁰ *Maryland v. King*, 133 S.Ct. 1958, 1965 (2013); *Chimel v. California*, 395 U.S. 752, 763 (1969).

²⁴¹ *Riley v. California*, 134 S.Ct. 2473, 2485 (2014).

²⁴² *Id.* at 2480.

²⁴³ *King*, 133 S.Ct. 1958, 1965 (2013).

²⁴⁴ *Riley*, 134 S.Ct. at 2482.

²⁴⁵ *Id.* ("Such a warrant ensures that the inferences to support a search are 'drawn by a neutral and detached magistrate instead of being judged by the officer engaged in the often competitive enterprise of ferreting out crime.'" (citation omitted)).

²⁴⁶ *Id.* at 2482–84.

²⁴⁷ *Weeks v. United States*, 232 U.S. 383 (1914). "[T]he right on the part of the Government, always recognized under English and American law, to search the person of the accused when legally arrested to discover and seize the fruits or evidences of crime." *Id.* at 392.

²⁴⁸ *Chimel v. California*, 395 U.S. 752 (1969) (defendant arrested in his home for burglary in coin shop led to an extensive search of entire home and furnishings that revealed fruits of crime).

²⁴⁹ *United States v. Robinson*, 414 U.S. 218, 223 (1973). (involving pat down search after traffic stop for driving with revoked license that uncovered "crumpled up cigarette package" holding more than a dozen heroin capsules).

²⁵⁰ *Arizona v. Gant*, 556 U.S. 332 (2009) (defendant arrested during a traffic stop for driving with a suspended license was handcuffed and placed in the back of a patrol vehicle; a search of his jacket sitting on the backseat of his car revealed cocaine).

²⁵¹ *Chimel*, 395 U.S. at 762–63 (finding search incident to arrest encompassed defendant's person and area "within his immediate control" to discover weapons or potential evidence of criminality).

the legitimacy of the search based on what was actually found.²⁵² Thus, the patina of a valid arrest based on probable cause sanitized the seizure of almost anything discovered on the person of the arrestee notwithstanding the *Chimel* principles—unless it involved the special circumstances of a vehicle search as in *Gant*.²⁵³

Against this background, Justice Roberts envisioned a new corollary to the *Chimel* line: Information Age searches that retreated from a "mechanical application" of *Robinson*.²⁵⁴ The cell phone represented a unique merger of people and technology.²⁵⁵ Thus, the expectation of privacy in computer technology was different from the privacy of "physical objects" that fell within *Robinson's* overarching foundations: (1) safety and evidence preservation interests present in every case; and (2) the "significantly diminished" arrestee's privacy expectations.²⁵⁶ There was no common ground between the search of a physical object, such as the cigarette package in *Robinson*, and the ransacking of a personal computer in the guise of a cellular phone. Thus, *Robinson's* holding did not extend into the digital arena of personal technology.²⁵⁷ Indeed, the Court imagined that there was little risk that either of *Chimel's* foundations, officer safety and evidence preservation, would be implicated by imposing a warrant requirement for cell phone

²⁵² *Riley v. California*, 134 S.Ct. 2473, 2483 (2014); see *Robinson*, 414 U.S. at 235 ("A police officer's determination as to how and where to search the person of a suspect whom he has arrested is necessarily a quick ad hoc judgment which the Fourth Amendment does not require to be broken down in each instance into an analysis of each step in the search. The authority to search the person incident to a lawful custodial arrest, while based upon the need to disarm and to discover evidence, does not depend on what a court may later decide was the probability in a particular arrest situation that weapons or evidence would in fact be found upon the person of the suspect. A custodial arrest of a suspect based on probable cause is a reasonable intrusion under the Fourth Amendment; that intrusion being lawful, a search incident to the arrest requires no additional justification. It is the fact of the lawful arrest which establishes the authority to search, and we hold that in the case of a lawful custodial arrest a full search of the person is not only an exception to the warrant requirement of the Fourth Amendment, but is also a 'reasonable' search under that Amendment.").

²⁵³ *Gant*, 556 U.S. at 335 ("The safety and evidentiary justifications underlying *Chimel's* reaching-distance rule determine *Belton's* scope. Accordingly, we hold that *Belton* does not authorize a vehicle search incident to a recent occupant's arrest after the arrestee has been secured and cannot access the interior of the vehicle. Consistent with the holding in *Thornton v. United States*, 541 U.S. 615 (2004), and following the suggestion in Justice Scalia's opinion concurring in the judgment in that case, *id.*, at 632, we also conclude that circumstances unique to the automobile context justify a search incident to arrest when it is reasonable to believe that evidence of the offense of arrest might be found in the vehicle.").

²⁵⁴ *Riley*, 134 S.Ct. at 2484–85.

²⁵⁵ *Id.* at 2484 ("[M]odern cell phones . . . are now such a pervasive and insistent part of daily life that the proverbial visitor from Mars might conclude they were an important feature of human anatomy.").

²⁵⁶ *Id.* ("[W]hile *Robinson's* categorical rule strikes the appropriate balance in the context of physical objects, neither of its rationales has much force with respect to digital content on cell phones.").

²⁵⁷ *Id.* at 2484–85.

searches.²⁵⁸ And of course, exigent circumstances would be available to justify warrantless searches on a case-by-case basis.²⁵⁹

Notwithstanding the fact that taking someone into custody might be a "volatile" scenario, that the arrestee had a diminished expectation of privacy, that the principle reason behind an arrest was to acquire "physical dominion" over a suspect, the Fourth Amendment retained some vitality.²⁶⁰ Citing *Maryland v. King*, Justice Roberts noted that custody did not quash all privacy interests.²⁶¹ Indeed, the Justices appeared to be taken with the idea of the portable computerized phone as a "World on a Wire";²⁶² its sheer capacity for holding data and processing power placed it into a new and an unprecedented category of private personal information.

Cell phones differ in both a quantitative and a qualitative sense from other objects that might be kept on an arrestee's person. The term "cell phone" is itself misleading shorthand; many of these devices are in fact minicomputers that also happen to have the capacity to be used as a telephone. They could just as easily be called cameras, video players, rolodexes, calendars, tape recorders, libraries, diaries, albums, televisions, maps, or newspapers.²⁶³

The Fourth Amendment was written for a natural world that placed physical limits on the amount of information that might be carried on someone's person. But the minicomputer, in whatever manifestation, was a virtual host to data far beyond the borderlines of "persons, houses, papers, and effects". And that distance will only become greater.²⁶⁴ Further, as suggested by the GPS trackers in *United States v. Jones*, smartphones opened the door to mosaics of interconnected and interrelated details that would permit law enforcement to compose the timeless lifelogging details of activities, movements, interests, communications and records that no one photograph, video or writing could possibly convey.²⁶⁵ This mosaic theory that Justice Roberts

²⁵⁸ *Riley*, 134 S.Ct., at 2485–88.

²⁵⁹ *Id.* at 2486.

²⁶⁰ *Id.* at 2488.

²⁶¹ *Id.* ("[W]hen 'privacy-related concerns are weighty enough' a 'search may require a warrant, notwithstanding the diminished expectations of privacy of the arrestee.'" (citing *Maryland v. King*, 133 S.Ct. 1958, 1979 (2013))).

²⁶² See *id.* at 2489; Ben Brantley, *Worlds Within Worlds Within Worlds. And a Duane Reade.*, N.Y. TIMES, Jan. 17, 2012, at 7, http://www.nytimes.com/2012/01/17/theater/reviews/world-of-wires-at-the-kitchen-review.html?_r=0 (making reference to the title of a 1973 German made-for-TV movie, "Welt am Draht," based on the American novel *Simulacron-3* (1964) by Daniel F. Galouye that described the intricate interlacing of "real" and "virtual" worlds).

²⁶³ *Riley*, 134 S.Ct. at 2489.

²⁶⁴ *Id.* ("We expect that the gulf between physical practicability and digital capacity will only continue to widen in the future.")

²⁶⁵ *Id.* at 2490 (referencing *United States v. Jones*, 132 S.Ct. 945 (2012)). See generally Strutin, *Mosaic Theory: A New Perspective for Human Privacy*, *supra* note 65, at 5.

embraced is not that far from the concept of linkage that underlies DNA matching. People are more than just their person, they are their digital data, and per force, their biological data. The only other information containers with the "pervasiveness" of cell phones are the cells of the human body.²⁶⁶

Justice Roberts pointed out that the "house" protected by the Fourth Amendment paled in comparison to the digital archive of information that exceeds physical contents in both size and nature.²⁶⁷ In fact, the data accessed through a cell phone might reside in the Cloud, blurring the line between local and networked data and rendering the source of information indistinct, which might create unwarranted bonanzas for law enforcement.²⁶⁸ In the physical world, a house is a house. But in the virtual world, it can be every house, workplace, street, store and school as well as every record, communication and Internet search conducted by or associated with an individual. In reference to the Cloud, Justice Roberts pointed out that it was the potential for accessing volumes of connected data through a device carried on the person that necessitated privacy over investigative interests. "The *possibility* that a search might extend well beyond papers and effects in the physical proximity of an arrestee is yet another reason that the privacy interests here dwarf those in *Robinson*."²⁶⁹

Even more significant than the information container analysis, the *Riley* Court saw two reasons for abnegating warrantless cell phone searches, namely, past crimes and identification. First, "it is reasonable to expect that incriminating information will be found on a phone regardless of when the crime occurred."²⁷⁰ On the subject of pretexts, the Court noted that, "It would be a particularly inexperienced or unimaginative law enforcement officer who could not come up with several reasons to suppose evidence of just about any crime could be found on a cell phone."²⁷¹ The same could be said for DNA sampling that reveals linkage to past crimes and is being gar-

²⁶⁶ *Riley*, 134 S.Ct. at 2490.

²⁶⁷ *Id.* at 2491 ("Indeed, a cell phone search would typically expose to the government far *more* than the most exhaustive search of a house: A phone not only contains in digital form many sensitive records previously found in the home; it also contains a broad array of private information never found in a home in any form—unless the phone is.").

²⁶⁸ *Id.* ("Such a search would be like finding a key in a suspect's pocket and arguing that it allowed law enforcement to unlock and search a house.").

²⁶⁹ *Id.* (emphasis added). And the Court did not have much faith in government protocols to assure privacy in these circumstances. "[T]he Government proposes that law enforcement agencies "develop protocols to address" concerns raised by cloud computing. Probably a good idea, but the Founders did not fight a revolution to gain the right to government agency protocols." *Id.* (citation omitted).

²⁷⁰ *Riley*, 134 S.Ct. at 2492.

²⁷¹ *Id.* (finding that the holding in *Gant* was insufficient to limit the scope of warrantless cell phone searches).

nered from of a growing catalog of arrestable offenses. And the identification and safety rationales for searching electronic devices were also overbroad. "This approach would again impose few meaningful constraints on officers. The proposed categories would sweep in a great deal of information, and officers would not always be able to discern in advance what information would be found where."²⁷² Thus, when it came to smartphones, warrantless searches for confirming an arrestee's identification or evidence of past crimes were interdicted; but when it came to an arrestee's DNA these reasons more than justified the intrusion in spite of the volume of data potentially revealed.²⁷³

Finally, the Supreme Court responded to the argument that pre-digital era approved searches for print materials ought to govern cell phone searches. But this reasoning fell apart when confronted with the massive volume of data that could potentially be examined. The discovery of a picture or a bank statement in someone's pocket did not entitle law enforcement to search through a digital library for years' worth of such records.²⁷⁴ Again, this would also entail information that no one would likely carry about on their person in its physical form. Thus, the "analogue test" failed to protect individual privacy interests when faced with the type and quantity of information that existed in the digital environment.

Similarly, genetic information might, in its most limited way, in the non-coding sections, resemble a physical metric like fingerprints or eye color, but underneath they contain data that dwarfs the memory sticks of the average cell phone. DNA, like digital data, is the modern equivalent of the Domesday Book, an unalterable final survey of everything human. It would be inconceivable for anyone to carry on their person the physical records of everything that technology might reveal from an analysis of their genome. If the Court in *Riley* found law enforcement protocols insufficient to protect against overbroad searches of a person's technology (present and future), why does that reasoning not apply to biological information that can be even more revealing (present and future)?²⁷⁵

²⁷² *Id.*

²⁷³ *Id.* By the same rationale, *King* relied on the fingerprint analogy, which like DNA would confirm identity as well as reveal links to open or unsolved crimes. However, fingerprints do not hold or connect to the massive quantities of data contained within and linked to DNA or found in cell phones.

²⁷⁴ *Id.* at 2493.

²⁷⁵ The Court went on to observe that just as information technology has developed, so too has the means for obtaining search warrants. "Recent technological advances similar to those discussed here have, in addition, made the process of obtaining a warrant itself more efficient." *Riley*, 134 S.Ct. at 2493 (citing *Missouri v. McNeely*, 133 S.Ct. 1552, 1561–62, 1572–73 (2013) (noting the impact of expedited communication technologies, such as email and video conferencing, for search warrant applications)).

Millions of Americans use smartphone technology. It seemingly warrants more constitutional attention than the biological information installed in billions of people.²⁷⁶ So it is that the Court has shown its awe of computer-based information:

Modern cell phones are not just another technological convenience. With all they contain and all they may reveal, they hold for many Americans "the privacies of life." The fact that technology now allows an individual to carry such information in his hand does not make the information any less worthy of the protection for which the Founders fought.²⁷⁷

A leap forward in technology does not vitiate privacy by an unreasoning adherence to outmoded, pre-digital thinking. Still, *Riley's* extended discussion and lauding of cell phone processing capabilities and storage features contrast with *King's* lack of reverence for the technology that has opened up the human genome.²⁷⁸

In their essay, analyzing the direction of Fourth Amendment jurisprudence after *Riley*, Professors Lamparello and MacLean scrutinized the Supreme Court's equation of the cell phone and similar data storage devices with the constitutionally protected precinct of the "home."²⁷⁹ The new digital home fit within the expectation of privacy recognized under *Katz*, rather than the exigencies of *Chimel*.²⁸⁰ Computers were a different species of information container both in terms of the type of information they held and their volume—their telephony was incidental and insignificant.²⁸¹ Comparatively speaking, courts should view DNA as an information container that incidentally can serve as an identification metric, a duty that can be ably served by fingerprints or other physical measurements.

²⁷⁶ See Strutin, *DNA and the Double Helix of Constitutional Rights*, *supra* note 4, at 5 ("Internet and computer technologies are our second skin, the shadows and reflections of our most personal and intimate details. And much of the information they contain parallels the biological computer, except in regards to constitutional privacy. DNA is the most compact and enduring of information media. And technology now permits a life's tale to be written into the fabric of life."). See generally Castillo, *supra* note 4; George M. Church et al., *Next-Generation Digital Information Storage in DNA*, 337 SCIENCE 1628 (2012).

²⁷⁷ *Riley*, 134 S.Ct. at 2494–95.

²⁷⁸ In fact, the chief distinction between people and evidence raised by Justice Alito's criticism of *Chimel* in his concurring opinion in *Riley* was mirrored by Justice Scalia's observations in *King*. Compare *Riley*, 134 S.Ct. at 2496 (Alito, J., concurring) (*Chimel* was "a case that involved the lawfulness of a search of the scene of an arrest, not the person of an arrestee."), with *Maryland v. King*, 133 S.Ct. 1958, 1985 (2013) ("King was not identified by his association with the sample; rather, the sample was identified by its association with King."). In each, the scrutiny of Fourth Amendment privacy was seen along a line that separates a person from their surroundings and linkages.

²⁷⁹ Lamparello, *supra* note 5, at 3.

²⁸⁰ Lamparello, *supra* note 5, at 3–4.

²⁸¹ Lamparello, *supra* note 5, at 5–6.

The *Riley* Court endorsed the idea that a personal digital device, like a smartphone, was a veritable warehouse of countless varieties of private information, all the more revealing in the aggregate.²⁸² Indeed, it constituted a portable library, extending into the Cloud, of an individual's life experiences. Porting around these quanta of information was unknown before the Information Age. Similarly, the treasure trove of data contained in our cells was equally unheard of before the discovery of DNA forensics a generation ago. To carry the "home" analogy further, the Court pointed out that no one's house could contain the sum of data stored in a typical computer—in other words, printing out the millions of files on the average computer would raise the average roof.²⁸³ Thus, warrantless searches were limited to the capacity of a person to physically, not digitally, carry information—pockets, not personal computers.²⁸⁴

Thus, it was the information potential of the cell phone that engendered the *Katz* expectation of privacy and warrant requirement. Lamparello and MacLean intimated that in the light of *Riley*, "the Government will now be required to provide a digital-era justification to search the "papers and effects" that are stored in cell phones."²⁸⁵ Similarly, there ought to be a DNA-era justification for comparable searches of the human genome at the custodial stage. Thus, the Supreme Court should reconsider *King* and remove the guess work of dealing with DNA privacy when scientific advances will assuredly change the nature and volume of information discoverable.²⁸⁶

DNA is the house of personhood that eclipses the contents of people, houses, papers and effects. And as in *Riley*, it is the "object" or container in which privacy inheres, not merely the data or contents.²⁸⁷ Again, the "home" analogy strengthens the privacy interest, since computers and nuclear DNA contain more information than will be found in the home or ever could be. Thus, if the expectations of millions can define the privacy interest in cell phones, certainly the expectations of billions should decide the level of privacy in the human genome.²⁸⁸ Lamparello and MacLean also

²⁸² Lamparello, *supra* note 5. at 6.

²⁸³ Lamparello, *supra* note 5. at 7–8.

²⁸⁴ Lamparello, *supra* note 5., at 7–8.

²⁸⁵ Lamparello, *supra* note 5. at 12.

²⁸⁶ Lamparello, *supra* note 5. at 12–13. This might also avoid the uncertainty and confusion created by the Court's *Chimel* progeny.

²⁸⁷ Lamparello, *supra* note 5, at 15 ("[T]he Court implicitly recognized that cell phones, to an even greater degree than private homes, engender privacy protections as *objects*, and not merely because of the private data they contain.").

²⁸⁸ Lamparello, *supra* note 5. at 15–16.

suggested that *Riley* might expand the privacy interest in metadata gleaned from cell towers for tracking locations and movements.²⁸⁹ Similarly, when technology advances to efficiently collect and catalog shed DNA, biological tracking data, another kind of privacy interest might be recognized.²⁹⁰ And since "Riley is the new Katz," as thoughtfully explained by Lamparello and MacLean,²⁹¹ the Supreme Court should take a second look at DNA as data and people as information containers with rights.

King has become the battleground for biological privacy, identity, investigation and crime solving. While the Fourth Amendment's language remains imperturbable, its virtues in the digital age speak clear. *Riley* affirmed the privacy of human technologies, i.e., personal digital containers. And yet, DNA forensics is about converting biologics from human containers into data. Still, data is data, with human cells containing the most valuable data of all. Indeed, forensic databases and digital data are where cases are made. But from the Supreme Court's viewpoint, a person composed of computer chips would have a higher expectation of privacy in themselves than a natural being made up of genes. Nonetheless, the biological man ought to be the equivalent of the digital man, at least for Fourth Amendment purposes.

CONCLUSION

We are data, within and without, and DNA data has the potential to be the most powerful information technology for revealing the "privacies of life." The circumference of human knowledge, in particular self-knowledge, has exploded since the pre-DNA and pre-digital eras. Further, microscopy has opened an entirely new path to personal information. Peering at animalcules through his ground-breaking microscope, Anton van Leeuwenhoek could scarcely have imagined the secrets of human life that would be uncovered by the microbiologists who were to follow in his footsteps.²⁹² Today, law enforcement is accompanying scientists on a Fantastic Voyage through the human genome, a journey as long and as invasive as the one currently being taken through our computer technologies.

²⁸⁹ Lamparello, *supra* note 5,, at 16.

²⁹⁰ See Robert C. Green & George J. Annas, *The Genetic Privacy of Presidential Candidates*, 359 NEW ENG. J. MED. 2192, 2192, 2193 (2008); Mike Silvestri, *Naturally Shed DNA: The Fourth Amendment Implications in the Trail of Intimate Information We All Cannot Help But Leave Behind*, 41 U. BALT. L. REV. 165, 184–89 (2011) (arguing for model statute declaring *per se* reasonable expectation of privacy in shed DNA). See generally Kimberly J. Winbush, Annotation, *Searches and Seizures: Reasonable Expectation of Privacy in Contents of Garbage or Trash Receptacle*, 62 A.L.R.5th 1 (1998).

²⁹¹ Lamparello, *supra* note 5, at 17–19.

²⁹² See generally CLIFFORD DOBELL, ANTONY VAN LEEUWENHOEK AND HIS "LITTLE ANIMALS" (1932).

DNA might be a pinnacle of identification metrics, but it can only be viewed through human eyes. From now on, identification will be allied with a genetic rap sheet. In the DNA involved case, challenging the admissibility of the sample taken in the stationhouse will categorically raise the difficulty of defense preparation in the new and cold cases.²⁹³ While the test-on-arrest law has been sanctioned under the Fourth Amendment, this will not totally eliminate an accused's decision to refuse, contest the law in its application or constitutionality under state law, or demand that a search warrant be obtained—albeit risking the consequences of forced extraction.²⁹⁴ Indeed, criminalizing DNA refusal further complicates the issues by introducing the bodily intrusion of forcible extraction and a new aggravating crime unrelated to the arresting offense.²⁹⁵

The defense might raise procedural, forensic and human errors in cases where DNA is the central proof. Nonetheless, the issue becomes complicated because it will stretch across at least two separate cases, the original arrest acquiring the DNA and the derivative cold case in which it becomes proof of guilt. And the information from the DNA match will cast a shadow over the proceedings of the initial case, separate and apart from its role as evidence in the cold case. A DNA match is a presumptive forensic analysis, half science and half police work. As scientific discovery changes the scope of what DNA can reveal, the Supreme Court might need to revisit its holding in *King* as Justice Scalia suggested.

In a world of genetic recidivists, everyone's privacy is diminished. Generalized probable cause for genetic sampling disengages individualized suspicion from the DNA-based case. Moreover, lack of uniformity in state test-on-arrest laws will make people presumed innocent in one jurisdiction

²⁹³ In *King I*, the court characterized the subsequent use of arrestee DNA in a cold case: "The cause-and-effect relationship between King's original buccal swab and the court-ordered second buccal swab is not attenuated in any way. The first buccal swab provided the sole probable cause for King's first-degree rape grand jury indictment. There was no other evidence linking King to the 2003 unsolved rape. Were it not for the buccal swab obtained illegally after King's assault arrest, there would be no second DNA sample which could have been used as evidence in King's trial for the charges enumerated. . . . The DNA evidence presented at trial was a fruit of the poisonous tree." *King v. State*, 42 A.3d 549, 581 (Md. 2012). This logic will still hold true for those states that follow the privacy standards of their constitutions that exceed the floor of the Fourth Amendment.

²⁹⁴ See, e.g., *People v. Smith*, 95 A.D.3d 21, 27 (N.Y. App. Div. 2012) ("We cannot agree with the suppression court that, after 10 to 15 minutes of asking a suspect to comply with a court-ordered buccal swab of which the suspect had no prior knowledge, it is reasonable for the police to taser a nonviolent, handcuffed, and secured defendant in order to force the suspect into submission."). See generally Ken Strutin, *DNA Sampling: A Challenge to Privacy and Dignity*, 247 N.Y. L.J. 5 (2012).

²⁹⁵ See, e.g., CAL. PENAL CODE § 298.1 (West 2014) (stating refusal to provide "specimens, saliva samples, or thumb or palm print impressions" is a misdemeanor; and reasonable force can be used to obtain them).

equivalent to somebody convicted in another. DNA as identification came in under the judicial radar riding on the precedential coattails of fingerprinting. But the logic failed when it became clear that DNA profiling created links to other cases that fingerprints alone could not.²⁹⁶ The Supreme Court has already decried the pretext of an arrest to acquire a subject's fingerprints without probable cause.²⁹⁷ Thus, fingerprinting has remained a metric firmly connected to the instant offense, while genetic sampling is completely unbridled. Under *King*, probable cause for a new felony arrest, and hence genetic sampling, becomes probable cause for a search warrant for genetic information in a cold case—a dangerous conflation of probable cause standards. This test-on-arrest philosophy did not rely on an exigency exception. But it did merge arrest criteria that a crime had been committed with search warrant standards for contraband or evidence of another crime.²⁹⁸

Since *Riley*, there is more privacy in the machinery of computers than in the machinery of people. The Supreme Court's division between privacy in information technology and in information biologics does not further the ends of justice.²⁹⁹ Why indeed should an extension of our memory, e.g., the cell phone, or the extension of our mind, e.g., email and text messaging, or the movement of our bodies in space, e.g., GPS tracking, receive more protections under the Fourth Amendment than the contents of our body that can only be seen under a microscope? After all, DNA is the Big Data of being human.

Molecular biology has compelled the reinterpretation of the body and its boundaries, leading ultimately to new definitions of identity and privacy. Thus, the Fourth Amendment should protect the container of genetic information at least as much as the container of people, the home. Even more so,

²⁹⁶ See Valerie Ross, *Forget Fingerprints: Law Enforcement DNA Databases Poised to Expand*, NOVA NEXT (Jan. 2, 2014), <http://www.pbs.org/wgbh/nova/next/body/dna-databases>.

²⁹⁷ See *Hayes v. Florida*, 470 U.S. 811 (1985); *Davis v. Mississippi*, 394 U.S. 721 (1969). See generally Wayne A. Logan, *Policing Identity*, 92 B.U.L. REV. 1561, 1593–1601 (2012).

²⁹⁸ See, e.g., *In re Welfare of C.T.L.*, 722 N.W.2d 484, 486, 490–91 (Minn. Ct. App. 2006) This was a pre-*King* case in which portions of Minnesota statute authorizing DNA sampling on arrest declared unconstitutional under federal and state constitutions. "The fact that a judge has determined that the evidence in a case brings a charge against the defendant within reasonable probability does not mean that the judge has also determined that there is a fair probability that contraband or evidence of a crime will be found in a biological specimen taken from the defendant." *Id.*

²⁹⁹ This philosophy is exemplified by exaltation of procedural due process over actual innocence. See, e.g., *McCullum v. North Carolina*, 512 U.S. 1254, 1256 (1994) (Blackmun, J., dissenting) (foreshadowing the consequences of unreasoning adherence to mechanical thinking: "Our system of capital punishment simply does not accurately and consistently determine which defendants most 'deserve' to die."); Jonathan M. Katz & Erik Eckholm, *DNA Evidence Clears Two Men in 1983 Murder*, N.Y. TIMES, Sept. 3, 2014, http://www.nytimes.com/2014/09/03/us/2-convicted-in-1983-north-carolina-murder-freed-after-dna-tests.html?_r=0 (A death row inmate and his life term co-defendant were exonerated by DNA testing decades after the Supreme Court rejected their certiorari petition.).

the protections should extend to all dimensions of location, movement and time. Human DNA is not trapped in the body but in the biosphere. There is a matrix of biological and digital data that can all too easily be linked with a person, without a warrant or authentication. Without these protections, human cells will become the "royal road" to prison cells.

Man's biological destiny encompasses the future of privacy and personhood. People are information containers with rights, data in being, and so society's expectations of privacy must grow alongside technological innovation and scientific discovery. Indeed, information might travel along new biological corridors that will transcend the current notions of privacy.³⁰⁰ In whatever manner our laws evolve, our genetic code will continue to be deciphered anew with keen interest. So it is that the registry of human blueprints will be the never-ending battleground of privacy.

³⁰⁰ It has been suggested that human behavior, perhaps even memories, might be the product of "transgenerational epigenetic inheritance." See James Gallagher, *'Memories' Pass Between Generations*, BBC NEWS (Dec. 1, 2013), <http://www.bbc.com/news/health-25156510?print=true>. And researchers have just begun exploring the possibility that environmental information can be conveyed through genes. See Brian G. Dias & Kerry J. Ressler, *Parental Olfactory Experience Influences Behavior and Neural Structure in Subsequent Generations*, 17 NATURE NEUROSCIENCE 89, 94 (2014).

