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Criminal Penalities for Creating a Toxic Environment: *Mens Rea*, Environmental Criminal Liability Standards, and the Neurotoxicity Hypothesis

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CRIMINAL PENALTIES FOR CREATING A TOXIC ENVIRONMENT: *MENS REA*, ENVIRONMENTAL CRIMINAL LIABILITY STANDARDS, AND THE NEUROTOXICITY HYPOTHESIS

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Recent research in brain biochemistry examining the likely neurological effects of exposure to toxic contaminants continues to demand legal consideration. In this Article, Professor Crawford evaluates the possible consequences of recent neurobiological studies—labeled "The Neurotoxicity Hypothesis" by researchers—for lawyers and the legal system. After summarizing the research, Professor Crawford suggests that as this (or similar) neurobiological research gains increased scientific acceptance, it will be necessary to reduce dramatically the acceptable levels of these toxic elements that can be discharged into the environment. He then examines the implications of such a result for establishing criminal liability under federal environmental statutes, focusing on the criminal liability provisions of the Federal Water Pollution Control Act.

INTRODUCTION

Throughout the 1990s, American politicians and bureaucrats engaged in a sustained and self-congratulatory celebration of the decline in the nation's violent crime rate.[1] New York's mayor, Rudolph Giuliani, proudly declared upon his 1997 re-election that, as a result

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[1] The Federal Bureau of Investigation (FBI) defines "violent" crimes as one of four types: murder, forcible rape, robbery, and aggravated assault. *See* Federal Bureau of Investigation, *FBI 1998 Preliminary Annual Release*, UNIFORM CRIME REP. (1999).

of his administration's anti-crime efforts, "[m]illions have been liberated from the reality and fear of crime."[2] Mayor Giuliani is not alone in taking credit for the much ballyhooed reduction in the United States's violent crime rates.[3] Yet it is worth remembering that more sober assessments of the decline in crime rates have been uncertain as to the exact causes.[4] Furthermore, new research suggests that Mayor Giuliani and his compatriots around the country may not deserve much of the credit they are taking for the decline in violent crime rates. This research, labeled "the Neurotoxicity Hypothesis" by its progenitors,[5] suggests that the long-term benefits of more stringent environmental laws and regulations (and specifically the passage of the lead control laws of the early 1970s),[6] may have played a key role

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[2] Mayor Rudolph W. Giuliani, Second Inaugural Address at City Hall in New York City, New York (Jan. 1, 1998), *available at* <http://www.ci.nyc.ny.us/html/om/html/secondinaug.html>.

[3] For instance, in New York City alone, for the period 1993–97, officials reported that murders were down by 60.2%, armed robberies by 48.4%, and rapes by 13.5%. *See* Office of the Mayor of the City of New York, Press Release No. 006–97, *available at* <http://www.ci.nyc.ny.us/html/om/html/98a/pr006–98/html>. Throughout the 1990s, similar reductions have been registered across the country. *See, e.g.*, Michael Cooper, *Homicides Decline Below 1964 Level in New York City*, N.Y. TIMES, Dec. 24, 1998, at A1; John H. Cushman, Jr., *Serious Crime Fell in U.S. For 6th Year in a Row in '97*, N.Y. TIMES, May 18, 1998, at A14; Ed Jahn, *California's Crime Rate Drops to 30-year Low*, SAN DIEGO UNION-TRIB., June 16, 1998, at B2; Eric Lichtblau, *Crime Rates Continue Record 7-Year Plunge*, L.A. TIMES, May 17, 1999, at A1; Frank Main, *Murders are Down Again in Chicago*, CHI. SUN-TIMES, June 30, 1999, at 30 (reporting that the local murder rate is at a ten-year low); *Major Crime Down in State Cities*, L.A. DAILY NEWS, Feb. 24, 1999, at N3; Ruth L. McKinnie, *Local Homicide Rates Continue to Drop*, SAN DIEGO UNION-TRIB., Mar. 29, 1998, at B1; *Miami Murder Rate Falls to a 20-Year Low*, AGENCE-FRANCE PRESSE, Jan. 7, 1999, *available in* 1999 WL 2525156. *But see* Bill Bryan, *City Ranks No. 1 in Crime Per Capita, FBI Reports Police Chief Disputes Findings for '98: "Crime Has Been Going Down,"* ST. LOUIS POST-DISPATCH, June 4, 1999, at A1 (reporting that, adjusting for population, St. Louis had the highest rates of crime nationally); Graham Rayman, *Troubling Public Safety Report*, NEWSDAY, June 24, 1999, at A06 (noting increases in New York City homicide rates for the first half of 1999).

[4] *See, e.g.*, Fox Butterfield, *Decline of Violent Crimes is Linked to Crack Market*, N.Y. TIMES, Dec. 28, 1998, at 5 (citing the likely importance of decline in crack cocaine sales); Fox Butterfield, *Many Cities in U.S. Show Sharp Drop in Homicide Rate*, N.Y. TIMES, Aug. 13, 1995, at 1; Clifford Krauss, *Mystery of New York, the Suddenly Safer City*, N.Y. TIMES, July 23, 1995, § 4, at 1; Neal R. Peirce, *The Prison Craze and the Crime Rate*, SAN DIEGO UNION-TRIB., Jan. 5, 1999, at B9 (identifying possible explanations for declines in crime rates).

[5] *See infra* Section I.

[6] The most prominent of these is the Lead-Based Paint Poisoning Prevention Act, 42 U.S.C. §§ 4821–4846 (1999). Others include 15 U.S.C. §§ 2681–2692 (1999) (setting forth various measures to effect lead exposure reduction) (original provisions enacted in 1976 and amended in 1992); 42 U.S.C. § 7545 (1999) (regulation of fuel additives) (basic statutory provisions enacted in 1967); 42 U.S.C. § 4831 (1999) (lead-based housepaint). The manufacture of lead-based paint was prohibited in 1977 pursuant to a regulation promulgated by the Consumer Product Safety Commission. *See* 16 C.F.R. Pt. 1303 (West 2000). *See*

in the reductions in violent criminal behavior that have been registered in this decade. Research into the Neurotoxicity Hypothesis further raises the possibility that the most trumpeted aspects of late 20th century criminal law enforcement—more beat cops, "three strikes" sentencing, and accelerated use of the death penalty—may not have the deterrent effects on criminal activity claimed by their advocates.[7] On the contrary, if conclusively established, the Neurotoxicity Hypothesis will force reconsideration of the dominant causal explanations for violent crime.

Simply put, the hypothesis suggests that certain environmental stimulae should be viewed as significant *co-factors* that likely contribute to violent criminal behavior. The consequences of the hypothesis for regulation of criminal behavior are, however, anything but simple.

Prevailing notions of criminology tend to rely upon social development models that pay "a great deal of attention to social setting and social learning, with special attention to groups rather than individuals."[8] The Neurotoxicity Hypothesis complicates this picture considerably, and in at least two respects. First, the Neurotoxicity Hypothesis

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generally statutes cited *infra* note 29; Colin Crawford, *Trends in the Regulation of Lead*, 2 ENVTL. L. N.Y. 145 (1991).

[7] *See supra* note 3; *see also* Ed Jahn, *California Crime Rate Drops to 30-Year Low*, SAN DIEGO UNION-TRIB., June 16, 1998, at B2 (crediting the "three-strikes law"); Rick Orlov & Phillip W. Browne, *Valley Crime Plunges; Latest Statistics Reflect 6-Year Trend*, L.A. DAILY NEWS, July 15, 1999, at N1 (quoting LAPD Commander Val Paniccia crediting the "three strikes" law and aggressive community policing for driving down crime); Vincent J. Schodolski, *Experts Split Over Effect of "3 Strikes" Laws on Crime*, CHI. TRIB., Mar. 3, 1999, at 7 (reporting that statistics reflect a crime decrease and prison population increase in the twenty-four states that have adopted "three strikes" or other similar laws); John Strauss, *Democrats, Peterson Ready to Make Run, Mayoral Candidate Wins Party Support and Calls for Collaborative Campaigning*, INDIANAPOLIS STAR, Feb. 18, 1999, at C01 (reporting that Mayor Stephen Goldsmith noted an overall decrease in crime in Indianapolis as a result of more funding for the police); Sue Weibezahl & Erik Kriss, *Some Sad, Some Pleased by "Death;" Opponents Say Penalty Wrong*, POST-STANDARD, Aug. 21, 1999, at A3 (quoting New York State Senator Dale Volker attributing drop in murder and crime rates to New York's capital punishment law). *But see* Mike Kataoka, *"Three Strikes" Law Not Working, Study Says But Prosecutors Dispute Institute's Findings*, PRESS ENTERPRISE, Mar. 3, 1999, at A03 (evaluating the Justice Policy Institute's findings and theorizing that an improved economy and the leveling off of the crack cocaine trade are reasons for the crime reduction); Scot Leigh & Frank Phillips, *Views of Cellucci, Professor Characterize Death Penalty Issue*, BOSTON GLOBE, Mar. 22, 1999, at B4 (stating that there is little public clamor for a capital punishment law because the crime rate of Massachusetts is down so significantly).

[8] C. Ray Jeffery, *Criminology and Criminal Law: Science Versus Policy and the Interaction of Science and Law*, *in* ADVANCES IN CRIMINOLOGICAL THEORY 3, 8 (1999) [hereinafter *Criminology and Criminal Law*]. *See also* C. Ray Jeffery, The Prevention of Juvenile Violence 3 (paper presented at the annual meeting of the Academy of Criminal Justice Sciences, Mar. 13, 1998) (unpublished paper, on file with author).

will require expanding the field of analysis. That is, although the hypothesis does not discount the importance of social setting and social learning, it *does* demand that the field of inquiry be broadened considerably, so that students of criminal behavior consider not merely social stimulae—such as poverty, poor nutrition, and unhealthy living conditions—but also neurological functions. Furthermore, integrating biochemical information into assessments of criminal behavior will require distinguishing between individuals rather than just looking at criminals as a group. It will also require lawyers to draw upon not merely sociological data, but also to learn from biology and neurochemistry.

This Article will identify areas of concern for lawyers and judges in light of the Neurotoxicity Hypothesis. It proceeds on the assumption that ongoing neuroscience research demands lawyers' attention. As data supporting the Neurotoxicity Hypothesis continues to accumulate and gain wider acceptance, this research seems likely to affect the future content and administration not only of U.S. criminal law, but also of U.S. environmental law. Those better situated to do so have already begun to limn the outlines of an affirmative criminal defense in light of neurotoxic contamination.[9] In what follows, my aim—as an environmental lawyer—is somewhat different. I offer a preliminary exploration of the consequences of the Neurotoxicity Hypothesis for U.S. environmental law.[10] The Article is divided into three main

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[9] *See* Deborah W. Denno, *Considering Lead Poisoning as a Criminal Defense*, 20 FORDHAM URB. L.J. 377, 385 (1993) (stating that "[e]ven in a racially and environmentally homogeneous sample of children, environmental factors predominated in predicting who would be a criminal").

[10] In related contexts, lawyers have begun to take note of the importance of biological knowledge to the law. *See generally* DEBORAH W. DENNO, BIOLOGY AND VIOLENCE: FROM BIRTH TO ADULTHOOD (1990) (reporting and analyzing the results of "the Biosocial Project," a study of 1000 individuals in Philadelphia from birth to young adulthood); Deborah W. Denno, *Gender, Crime, and the Criminal Law Defenses*, 85 J. CRIM. L. & CRIMINOLOGY 80 (1994); Deborah J. [sic] Denno, *Neuropsychological and Early Environmental Correlates of Sex Differences in Crime*, 23 INT'L J. NEUROSCIENCE 199 (1984); Deborah W. Denno, *Sociological and Human Developmental Explanations of Crime: Conflict or Consensus?*, 23 CRIMINOLOGY 711 (1985); E. Donald Elliott, *Law and Biology: The New Synthesis?*, 41 ST. LOUIS U. L.J. 595 (1997); Owen D. Jones, *Evolutionary Analysis in the Law: An Introduction and Application to Child Abuse*, 75 N.C. L. REV. 1117 (1997) (positing the value of biological approaches to legal analysis); Owen D. Jones, *Law and Biology: Toward an Integrated Model of Human Behavior*, 8 J. CONTEMP. LEGAL ISSUES 167 (1997) (arguing for more cross-disciplinary fertilization to develop a model of human behavior not rooted in traditional social science models); Owen D. Jones, *Sex, Culture, and the Biology of Rape*, 87 CAL. L. REV. 827 (1999); Vicki Quade, *Hair May Hold the Secret*, 69 A.B.A. J. 1814 (1983) (reporting chemical imbalances as a possible cause of violent behavior).

parts. Part I will more fully describe the Neurotoxicity Hypothesis and related research in brain biochemistry. Part I will also emphasize aspects of the Neurotoxicity Hypothesis likely to prove relevant for U.S. law, focusing in particular on *mens rea* and standards of liability.

Part II is the heart of the Article and, as such, it merits discussion in outline form here. The law need not only consider the *mens rea* of individuals who commit violent crimes due to neurotoxicity, but also of those who create the toxic conditions that result in neurotoxicity. As a result, Part II concentrates on the criminal enforcement features of federal environmental statutes as they relate to the evidence in support of the Neurotoxicity Hypothesis. Part II will identify those respects in which the criminal provisions in federal environmental laws are ill-equipped to respond to the increasingly convincing evidence presented by the Neurotoxicity Hypothesis. This is especially true given continuing concern in the courts and among legal commentators that the standards used to enforce federal environmental laws, especially criminal provisions, are ambiguous. Part II argues that this is largely because courts and commentators continue to differ about the proper standard of liability for regulatory crimes.[11]

Part II further suggests that unless the liability standards in the major federal environmental law statutes are reconsidered in light of this neurotoxicity research, the credibility and widespread acceptance of criminal enforcement of U.S. environmental laws could be seriously compromised.[12] Neurotoxicity research will, once further confirmed, almost certainly compel the relevant environmental regulatory authority to *lower*, perhaps significantly, the acceptable levels of toxic metals able to be discharged into the environment. Presumably,

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[11] *See infra* Section II.A.1.b.

[12] The legal arguments outlined in Sections II and III, *infra*, do not rest solely upon the ultimate credence given what has been labeled "the Neurotoxicity Hypothesis." On the contrary, the argument advanced in this Article is animated by the belief that if not this research, then other neurobiological and/or neurochemical research will force attention to the issues considered here. Samples of scientific and social scientific research that promise to demand legal consideration in coming years include, generally, MARGARET GRUTER, LAW AND THE MIND: BIOLOGICAL ORIGINS OF HUMAN BEHAVIOR (1991); LAW, BIOLOGY & CULTURE (Margaret Gruter & Paul Bohannan eds., 1983); THE SENSE OF JUSTICE: BIOLOGICAL FOUNDATIONS OF LAW (Roger D. Masters & Margaret Gruter eds., 1992); SARNOFF A. MEDNICK ET AL., THE CAUSES OF CRIME: NEW BIOLOGICAL APPROACHES (1997); ADRIAN RAINE, THE PSYCHOPATHOLOGY OF CRIME (1993); Michael T. McGuire, *Biochemical Screening to Predict Behavior*, 65 S. CAL. L. REV. 565 (1991).

For more popular reports on this research, see *Pesticides and Aggression*, RACHEL'S ENV'T AND HEALTH WEEKLY No. 648 (Apr. 29, 1999); Wray Herbert, *Politics of Biology: How the Nature Vs. Nurture Debate Shapes Public Policy—and Our View of Ourselves*, U.S. NEWS & WORLD REP., Apr. 21, 1997, *available in* 1997 WL 8331924.

therefore, ever larger numbers of individuals could become directly subject to possible criminal liability for violation of those statutes. Inasmuch as courts have widely divergent readings of the proper interpretation of the liability provisions of those statutes, wildly inconsistent results are not only possible but likely. Such a result would severely compromise the integrity of and erode confidence in the environmental enforcement arm of the legal system.

Part II briefly concludes by considering the implications of the Neurotoxicity Hypothesis for civil liability under federal environmental standards, and indicates the relevance of the interpretation of civil standards for criminal environmental liability. Part III looks to solutions, and will briefly outline ways in which U.S. laws—in particular federal criminal environmental laws—might be reformulated to take account of the research undertaken in light of the Neurotoxicity Hypothesis.

I. THE NEUROTOXICITY HYPOTHESIS

A. *Introduction*

On its face, the Neurotoxicity Hypothesis is elegant in its simplicity. The Neurotoxicity Hypothesis holds that biochemical imbalances in heavy metals and other elemental toxins may contribute significantly to anti-social behavior by disrupting the normal functioning of a person's brain biochemistry. In particular, research on the Neurotoxicity Hypothesis has focused on uptake of lead, manganese, cadmium and certain fluoride compounds.[13] At the outset, however, it is crucial to understand that the Neurotoxicity Hypothesis is anything

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[13] *See, e.g.*, Roger D. Masters et al., *Brain Biochemistry and Social Status: The Neurotoxicity Hypothesis, in* INTELLIGENCE, POLITICAL INEQUALITY AND PUBLIC POLICY 141 (1997) [hereinafter *Brain Biochemistry*]; Roger D. Masters et al., *Brain Biochemistry and the Violence Epidemic: Toward a "Win-Win" Strategy for Reducing Crime, in* SUPER-OPTIMIZING EXAMPLES ACROSS PUBLIC POLICY PROBLEMS (Stuart Nagel ed., forthcoming); Roger D. Masters et al., *Environmental Pollution, Neurotoxicity and Criminal Violence, in* ENVIRONMENTAL TOXICOLOGY: CURRENT DEVELOPMENTS 13 (1998) (reviewing evidence linking lead and manganese neurotoxicity to aggressive behavior and crime for all 3141 U.S. counties); THE NEUROTRANSMITTER REVOLUTION: SEROTONIN, SOCIAL BEHAVIOR AND THE LAW (Roger D. Masters & Michael T. McGuire eds., 1993) [hereinafter THE NEUROTRANSMITTER REVOLUTION]; Roger D. Masters, *Environmental Pollution and Crime*, 22 VT. L. REV. 359, 375 (1997) (arguing, *inter alia*, that "[b]oth crime prevention and effective sentencing need to consider a broader range of risk factors than has hitherto been customary."); Roger D. Masters & Myron Coplan, *Water Treatment with Silicofluorides and Lead Toxicity, in* INT'L J. OF ENVTL. STUDIES (forthcoming 1999) (linking silicofluoride treatment of public water supplies with increased childhood lead uptake in Massachusetts towns).

but reductive. That is, it does not contend that exposure to heavy metals single-handedly *creates* criminals. On the contrary, the hypothesis focuses on individual brain biochemistry, as influenced by both individual genetic makeup and environmental exposure, as well as other social conditions.[14] Consequently, a key aspect of the Neurotoxicity Hypothesis is the recognition that factors such as diet, alcohol, and drug use play a role in permitting the speedier absorption of heavy metals into an individual's system.[15] In short, advocates of the hypothesis stress that neurotoxicity should not be understood as *the* determining variable for predicting violent behavior. Instead, they make it clear that neurotoxicity is just one among many causes, "at most functioning as a catalyst which, in addition to poverty, social stress, alcohol or drug abuse, individual character, and other social factors, increases the likelihood that an individual will commit a violent crime."[16]

B. *Measuring Neurotoxicity*

It is not the place of this Article to defend the science that undergirds the Neurotoxicity Hypothesis, but it is necessary to explain the basic premises underlying the hypothesis. Specifically, the Neurotoxicity Hypothesis looks at two kinds of environmental toxicity: direct and indirect. Direct toxicity refers to demonstrable exposure to a toxic element, with detectable (and undesirable) consequences. An example of direct toxicity would be childhood lead poisoning as a consequence of ingesting lead paint, with resulting abnormal brain development.[17] By contrast, indirect—or subclinical—toxicity looks, for instance, at "[c]hanges in brain biochemistry that are not at first obviously associated with environmental pollution [but] can have significant effects on behavior."[18] Thus, for example, exposure to subclinical levels of certain toxic elements might disrupt normal neurotransmitter function.[19] The neurotransmitters serotonin and dopa-

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[14] *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 154.

[15] *See id.* at 156.

[16] Masters et al., *Environmental Pollution, Neurotoxicity and Criminal Violence*, *supra* note 13, at 18.

[17] *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 154.

[18] *Id.* at 155.

[19] "Neurotransmitters may be defined as chemical messengers, which allow the transfer of information between neurons. . . . The neurotransmitters are of different types of molecules, including amino acids, neuropeptides, and the biogenic amines." Dan J. Stein & Michael Stanley, *Serotonin and Suicide*, *in* THE NEUROTRANSMITTER REVOLUTION, *supra*

mine are essential to "impulse control and planning."[20] Evidence suggests that neurotoxic metals (notably manganese) can lower levels of these key neurotransmitters,[21] thereby making it possible for an individual's neurotoxic exposure to result in violent activity.

The hypothesis concludes "that ecological factors such as environmental pollution have effects that appear to be genetic (and, indeed, may be associated with a genetically based vulnerability to toxicity that is quite distinct from a gene for intelligence)."[22] This might mean, for example, that twin children exposed to the same levels of environmental toxins from birth might be differently affected by that exposure, depending on their individual genetic makeup.[23] This aspect of the hypothesis has raised concern regarding its potential use to support eugenic ends. Critics of this sort of research might contend, for example, that identification of a "gene" for toxicity vulnerability could be used to justify discrimination against such persons (or worse) if it was also shown that individuals with that vulnerability were more likely than others to commit violent crimes.[24] This criticism is of

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note 13. *See also* Arthur Yuwiler et al., *The Basics of Serotonin Neurochemistry*, *in* THE NEUROTRANSMITTER REVOLUTION, *supra* note 13, at 37–46.

[20] Masters et al., *Brain Biochemistry*, *supra* note 13, at 154.

[21] *See id.* at 153–54.

[22] *Id.* at 152.

[23] This is the thrust of some of the unpublished work of William Walsh, of the Health Research Institute of Napierville, Illinois. Walsh conducted a study of twenty-four pairs of twins where one twin was either not violent or less violent than an extremely violent twin. The study revealed that the more violent twin had abnormal levels of trace heavy metals. Telephone Interview with William Walsh, Ph.D., Health Research Institute (June 1, 1998). Walsh's Institute is dedicated to correcting behavioral disorders through biochemical means. *See, e.g.*, William J. Walsh et al., *Elevated Blood Copper/Zinc Ratios in Assaultive Young Males*, 62 PHYSIOLOGY & BEHAVIOR 327 (1997); William J. Walsh, Biochemical Treatment and Behavior Outcomes (Aug. 1996) (unpublished manuscript on file with author); William J. Walsh, Biochemical Treatment of Mental Illness and Behavior Disorders, Address at the Minnesota Brain Bio Association (Nov. 17, 1997); William J. Walsh et al., Biochemical Treatment of Behavior Disorders (May 9, 1996) (unpublished materials presented at the 149th Annual Meeting of the American Psychiatric Association, New York, New York, on file with author); William J. Walsh, Zinc Deficiency, Metal Metabolism, and Behavior Disorders (Sept. 1994) (unpublished manuscript on file with author); *see also* H. Ron Isaacson et al., *Autism: A Retrospective Outcome Study of Nutrient Therapy*, 48 J. OF APPLIED NUTRITION No. 4 (1996) (describing the use of nutrient therapy to treat behavioral and learning disorders, depression, schizophrenia, and autism); *Nutrition: A Deficiency Made Me Do It*, 30 PSYCHOL. TODAY 14, 14 (Nov./Dec. 1997).

[24] *See* Sheldon M. Novick, *Racial Images of the "Criminal": A Cognitive Disorder*, 22 VT. L. REV. 383 (1997) (questioning the underlying assumptions and implications of the work of, *inter alia*, Deborah Denno and Roger Masters); Joan Vogel, *Biological Theories of Human Behavior: Admonitions of a Skeptic*, 22 VT. L. REV. 425, 425 n.1 (1997) (citing extensive literature on "the uses and misuses of biological theories"). *But see* DENNO, BIOLOGY AND VIOLENCE, *supra* note 10, at 1–2 (noting the concern that biological explanations of behavior

special concern in light of neurotoxicity research suggesting that some racial and ethnic groups may, because of their diet and racially-linked characteristics, be more vulnerable than others to environmental toxins.[25] The response of neurotoxicity researchers is that these differences highlight the need to act in light of evidence of neurotoxic contamination.[26] Nonetheless, the concern that this will lead to profiling of particular social groups—and above all racial profiling—is sure to remain a flashpoint as the relevance of this research continues to be debated.[27]

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will fuel prejudices, but emphasizing that such criticisms are reductive); *but see generally* Roger D. Masters, *Is Sociobiology Reactionary? The Political Implications of Inclusive-Fitness Theory*, 57 Q. REV. BIOLOGY 275 (1982) (concluding that biological explanations are not necessarily ideological in content). For a survey of some recent literature considering the kinds of racial disparities discussed by Novick, see Nicholas Lemann, *Justice for Blacks?*, N.Y. REV. BOOKS 25 (Mar. 5, 1998).

The typical concern raised in this context is that neurotoxicity research could be used to manage populations in pernicious ways, as in the infamous case of *Buck v. Bell*, involving Carrie Buck, a "feeble-minded white woman," whose mother and child were also "feeble-minded." *See* 274 U.S. 200, 205 (1927). The State of Virginia sought to sterilize Buck under a state statute. *See id.* Justice Holmes, declaring that "[t]hree generations of imbeciles are enough," agreed with the State, and offered the following, chilling words in support of his view:

> [w]e have seen more than once that the public welfare may call upon the best citizens for their lives. It would be strange if it could not call upon those who already sap the strength of the State for these lesser sacrifices, often not felt to be such by those concerned, in order to prevent our being swamped with incompetence. It is better for all the world, if instead of waiting to execute degenerate offspring for crime, or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind.

Id. at 207.

For a general overview of the social implications of new work in genetics, see generally TROY DUSTER, BACKDOOR TO EUGENICS (1990). *See also generally* JARED DIAMOND, GUNS, GERMS, AND STEEL: THE FATES OF HUMAN SOCIETIES (1997). Among other things, Diamond looks at the way historical incidents have affected the development of different races and geographic regions. As such, Diamond's argument could be viewed as an endorsement of research like that on the Neurotoxicity Hypothesis to anticipate harms by using the most recent advances in human knowledge. *See generally id.*

[25] Masters, for example, notes that "all individuals are not equally vulnerable to ecological pathways of toxins." Masters et al., *Environmental Pollution, Neurotoxicity and Criminal Violence*, *supra* note 13, at 31. He goes on to explain that the poor in the United States often suffer from dietary deficiencies, including vitamin D and calcium deficiencies. *See id.* He explains that these deficiencies are made worse when an individual also suffers from manganese exposure, because calcium can help reduce uptake of neurotoxic metals. *See id.*

[26] *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 150–54.

[27] On the concern with racial profiling as a result of this research, see, for example, Novick, *supra* note 24, at 390 (arguing that even the focus on "violent crime" is a social construction borne of inherently prejudicial racial stereotypes).

Assuming that the Neurotoxicity Hypothesis correctly identifies a contributing factor to criminal behavior, it begs the question of solutions. In this respect, advocates of the hypothesis stress that potential solutions are relatively simple and inexpensive compared to the costs of other forms of criminal enforcement, such as incarceration. Neurotoxicity researchers conclude, for example, that health and nutrition are key in preventing violent, anti-social behavior. For instance, "[d]ietary deficiencies, especially in calcium and other basic vitamins and minerals, can be overcome," possibly correcting the anti-social behavior caused by exposure to toxic elements.[28]

"To be plausible, the Neurotoxicity Hypothesis requires the identification of precise biochemical mechanisms underlying correlations between individual concentrations of toxic metals and violent behavior."[29] To date, neurotoxicity research has focused on the dangers presented by four toxic heavy metals in particular. Before exploring the legal implications of the hypothesis, it is useful to review the elemental toxins on which this research has concentrated.[30]

1. Lead

The knowledge of the toxicity of elemental lead is ancient and well-documented.[31] Despite the fact that lead reduction must be recognized as one of this country's greatest environmental regulatory successes,[32] the presence of lead in water (from deteriorating plumbing), urban soil, and the wall paint of aging housing stock has not disappeared.[33] Much of the research on lead poisoning, however, has

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[28] Masters et al., *Brain Biochemistry, supra* note 13, at 156 (noting that "[a]lthough some researchers argue that the behavioral consequences of toxic elements are reversible with individualized vitamin treatments, others have been critical of the research to date."(citations omitted)).

[29] *Id.* (citations omitted).

[30] *See id.*

[31] "Concern over the effect of lead on infant and child development is, of course, of long standing. Noted in antiquity by Hippocrates and two centuries ago by Benjamin Franklin, the danger of lead poisoning has been the subject of widespread scientific analysis." *Id.* at 157.

[32] *See, e.g.,* Lead Paint Poisoning Prevention Act, 42 U.S.C. §§ 4821–4826 (1999); 15 U.S.C. §§ 2681–2692 (1999); 42 U.S.C. § 7545 (1999); 42 U.S.C. § 4831 (1999).

[33] *See* Lead Exposure Reduction Act, 15 U.S.C. §§ 2681–2692 (1999); Residential Lead-Based Paint Poisoning Prevention Act of 1992, 42 U.S.C. §§ 4851–4856 (1999); Lead Contamination Control Act of 1988, 42 U.S.C. §§ 247b-1, 300j-21–300j-26 (1999); *see generally* Committee on Environmental Hazards, *Statement on Childhood Lead Poisoning,* 79 JAMA 457 (Mar. 1987). The dangers of lead continue to merit study and regulation. *See, e.g.,* Management and Disposal of Lead-based Paint Debris, 63 Fed. Reg. 70,190 (Dec. 18, 1998) (to be codified at 40 C.F.R. pt. 745); *Notice of the Revised Priority List of Hazardous Substances That*

focused on its adverse effects on the entire body—particularly on nervous system damage[34]—and not on brain lead levels in particular. Even at so-called subclinical levels, neurotoxicity research suggests, lead can have serious adverse consequences as a cause of violent behavior.[35] Of particular seriousness is the fact that infants and children absorb lead at much higher levels than do adults, causing "neuronal damage during early development, resulting in lasting cognitive and behavioral deficits associated with prolonged exposure to even very low doses."[36] Moreover, "[t]he highest levels of lead uptake are reported for males and blacks—i.e. those who are most likely to commit violent crimes."[37]

Will be the Subject of Toxicological Profiles, 63 Fed. Reg. 61,332 (Nov. 17, 1997) ("This announcement provides notice that the agencies have developed and are making available a revised CERCLA Priority List of 275 Hazardous Substances, based on the most recent information available to ATSDR and EPA."). Among the top twenty-five substances listed on the 1997 Priority List of Hazardous Substances, lead placed second while cadmium placed seventh. *See* 63 Fed. Reg. 70,190. *See also*, Herbert L. Needleman M.D. et al., *Bone Lead Levels and Delinquent Behavior*, 275 JAMA 363 (1996) (studying 850 boys ages seven to eleven and concluding that lead exposure increases the risk of antisocial and delinquent behavior). *But see* Letter from Henrietta K. Sachs, M.D., to the Editor, *Journal of the American Medical Association*, 275 JAMA 1725 (June 12, 1996) (challenging Dr. Needleman's results); Steve La Rue, *Lead Poisoning Continues to Plague Kids*, SAN DIEGO UNION-TRIB., July 18, 1999, at B1 (noting continuing exposure to lead in various forms, including, *inter alia*, house paint, particularly among Hispanic- and African-Americans); Andrea Mandel-Campbell, *Mexico Spotlight on Lead-Producing Companies*, FIN. TIMES, Aug. 21, 1999, at 4; John O'Neil, *Study Finds Lead Poisoning is Tied to Children's Tooth Decay*, N.Y. TIMES, June 23, 1999, at A14.

[34] *See* Committee on Environmental Hazards, *supra* note 33, at 459 (noting that "[n]europsychologic dysfunction, characterized by reduction in intelligence and alteration in behavior, has been shown conclusively to occur in asymptomatic children with elevated blood lead levels."). The report also noted that because of increased concerns in 1987 about the seriousness of excessive blood lead contamination, an Advisory Committee to the Centers for Disease Control determined that the level for excessive blood lead should be reduced by nearly twenty percent. *See id.*

[35] *See generally* Masters et al., *Brain Biochemistry*, *supra* note 13, at 153 ("It has long been known that serious behavioral and cognitive deficits are caused by exposure to lead, especially during infancy and childhood. Subclinical lead poisoning has been correlated with learning disabilities, Attention Deficit Disorder, and other psychological abnormalities sometimes associated with deviant behavior."); Stein & Stanley, *Serotonin and Suicide*, *supra* note 19; Yuwiler et al., *The Basics of Serotonin Neurochemistry*, *supra* note 19.

[36] Masters et al., *Brain Biochemistry*, *supra* note 13, at 157.

[37] *Id.* (citing Debra Brody et al., *Blood Lead Levels in the U.S. Population*, 272 JAMA 277–83 (1994); Derik Bryce-Smith, *Lead Induced Disorder of Mentation in Children*, 1 NUTRITION & HEALTH 179–94 (1983); Howard W. Mielke, *Lead Dust-Contaminated Communities and Minority Health: A New Paradigm*, *in* THE NATIONAL MINORITY HEALTH CONFERENCE (1992)). It might have been more appropriate for Professor Masters and his co-authors to say that young black men between the ages of eighteen and thirty-five are more likely to be "arrested" for criminal activities than to "commit" them. Many argue that certain demo-

2. Manganese

Manganese, the metal alloyed with steel to give it toughness and durability, can "produce highly complex toxic effects" such as lowering the brain levels of neurotransmitters essential to behavior control, such as serotonin, norepinephrine, and dopamine.[38] Because "abnormal levels of the neurotransmitter serotonin are associated with mood disturbances, poor impulse control, and increases in aggressive behavior . . . it has been hypothesized that manganese uptake in the brain lowers the levels or activity of dopamine and serotonin, leading to loss of impulse control, violence, and even heart disease."[39]

3. Other Neurotoxic Metals

Insofar as scientists have documented the possibility that heavy metals like lead and manganese may disturb brain function, it seems likely that "hitherto unsuspected toxins may act in addition to or in combination with lead and manganese."[40] Of special concern are elements that may be associated with violent behavior, notably chromium, cadmium, and sodium.[41] Neurotoxicity research has not yet focused on the possible contributions of these elements to violent be-

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graphic groups, particularly young African-American men, commit more crimes per capita or are more likely to be arrested because of their skin color. For example, one criminal justice reform group has documented the fact that nearly one in three African-American males between the ages of twenty and twenty-nine is, on any given day, in prison or jail, or on probation or parole. The report questions whether that high percentage truly reflects a need to punish instead of a practice of targeting specific groups. *See generally* The Sentencing Project, *Report Summary*, YOUNG BLACK AMERICANS & THE CRIMINAL JUSTICE SYSTEM: FIVE YEARS LATER (1995). Of course, if some demographic groups are arrested disproportionately as compared to those who actually commit crimes, it would be necessary for neurotoxicity research to take account of that fact, in part for some of the critical judgments leveled against neurotoxicity research by Novick. *See generally* Novick, *supra* note 24.

[38] *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 158.

[39] *Id.* As noted above, an especially important feature of neurotoxicity research is the contention that contamination from heavy metals can only be understood in connection with other empirical data. For instance, bottle-fed infants and those with diets low in calcium and essential vitamins appear to be "especially susceptible" to manganese uptake. Notably, African-American and Latino-American infants are more likely than other infants to be bottle-fed. What is more, the black and Latino poor appear to consume far less calcium and Vitamin D, which plays a central function in calcium uptake, than do whites. For example, African-American teenage males consume on average about two-thirds of the calcium of their white counterparts. *See id.* at 165. Once again, then, the Neurotoxicity Hypothesis points to the conclusion that certain demographic groups may, as a result of genetic predisposition, exposure to toxic heavy metals, and other factors like inadequate nutrition, be more likely to commit violent criminal acts.

[40] *Id.* at 159.

[41] *See id.*

havior. However, neurotoxicity researchers have noted that the likely role of these elements needs to be pursued, especially in light of the strong correlations between lead and manganese and violent behavior.[42]

4. Other Potentially Toxic Elements

Recent neurotoxicity research points to an important "intervening variable" in lead uptake, namely chemical fluoridation agents.[43] Specifically, "[e]levated levels of lead in water supplies are associated principally with systems that introduced the use of [the fluoridation agent] fluorosilicic acid after 1975, indicating that fluoridation procedures are probably a key factor" in lead uptake.[44] Preliminary research looked at 350 Massachusetts communities, some of which used a fluoridation agent and some of which did not. In those communities that treated water with fluorosilicic acid, the lead levels were nearly double those of unfluoridated communities.[45] As the research notes, this suggests a hitherto unsuspected possible cause of lead neurotoxicity.[46] Once further established, this research will demand legal action. To the extent that the safety of water supplies are concerned, legal action will include amendment of environmental laws and regulatory standards.[47] For purposes of this Article, this research need not be

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[42] *See generally* Needleman et al., *supra* note 33; Walsh et al., *Elevated Blood Copper/Zinc Ratios in Assaultive Young Males*, *supra* note 23; Walsh, Biochemical Treatment and Behavior Outcomes, *supra* note 23; Walsh, Biochemical Treatment of Mental Illness and Behavior Disorders, *supra* note 23; Walsh et al., Biochemical Treatment of Behavior Disorders, *supra* note 23; Walsh, Zinc Deficiency, Metal Metabolism, and Behavior Disorders, *supra* note 23.

[43] *See generally* Roger D. Masters & Myron D. Coplan, Public Water Supplies and Lead Toxicity: The Role of Silicofluoridation Agents (1991) (unpublished manuscript on file with author); Roger D. Masters & Myron D. Coplan, The Triune Brain, the Environment, and Human Behavior: Homage to Paul MacLean (July 16, 1999) (paper presented at Festschrift in Honor of Paul MacLean, on file with author).

[44] Masters & Coplan, Public Water Supplies and Lead Toxicity, *supra* note 43; *see* Masters & Coplan, The Triune Brain, the Environment, and Human Behavior, *supra* note 43.

[45] *See* Masters & Coplan, Public Water Supplies and Lead Toxicity, *supra* note 43, at 6–7.

[46] *See id.* at 10.

[47] For example, the recent decision of the City of Los Angeles to fluoridate its public water supplies might have to be reversed. *See* Patrick McGreevy, *Contract Clears Way for Fluoridation*, L.A. TIMES, Jan. 20, 1999, at B7. The research on the neurotoxicity of silicofluorides has not yet documented possible correlations between those cities treating with the potentially harmful fluoridation agents, namely fluorosilicic acid or sodium chloride, although the researchers did note "in [this] context that more than a dozen large crime cities have been treating their water with these agents for between 20 and 40 years." Masters & Coplan, Public Water Supplies and Lead Toxicity, *supra* note 43, at 10.

conclusively proven. Rather, it points to a rapidly evolving body of work that, as demonstrated in the remainder of this Article, will demand legal attention.

C. *Related Concerns*

As stressed above, a key aspect of the Neurotoxicity Hypothesis is the multi-causal character of influences on violent behavior. Neurotoxicity researchers stress the interaction of several other factors along with toxic exposure. The most notable of these are "[d]ietary deficits in calcium, zinc, and essential vitamins or minerals [that] can result in greater absorption of lead, manganese, and other toxic metals from water supplies or food and uptake of such neurotoxic elements in brain cells."[48] Of particular importance in this connection may be the comparative infrequency of breast feeding among the urban poor. Studies indicate that black children are three times less likely than white children to be breast rather than bottle fed.[49] Moreover, "National Nutritional Surveys show that black teenage males consume on average only two-thirds as much calcium as do whites; calcium intake among Hispanics was also below the white average."[50] Problems of calcium delivery are not limited only to teenagers, however. Hispanic and African-American infants are more likely to be bottle- than breast-fed, and "[i]nfants bottle-fed with cows' milk formula absorb five times more manganese than those who are breast-fed."[51] In addition, infant formula is often mixed using water from pipes in aging water systems that "transmit lead and manganese, further increasing the risks."[52] Thus, black and Hispanic children may be more likely to suffer neurotoxic poisoning—and therefore may be more inclined to commit violent crimes later in life—because their diets are comparatively low in calcium.

For lawyers, this is important but complicating information. The information makes the lawyers' task more difficult because it requires environmental policies to be formed in the context of a broad appreciation of public health and welfare strategies—that is, devising ways to combat potential environmental risks with comprehensive diet and health planning. Similarly, neurotoxicity research suggests that alco-

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[48] Masters et al., *Environmental Pollution*, *supra* note 13, at 19–20.

[49] *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 166.

[50] *Id.* at 164, 166 (citations omitted).

[51] *Id.* at 160.

[52] *Id.*

hol and drug use, both of which are "highly correlated with loss of impulse control and violence," may increase "the cellular uptake of cadmium, another of the toxic metals implicated in behavior dysfunction and violence."[53] Again, therefore, the optimal legal response would be one that coordinated environmental and public health policy, combatting toxic heavy metal exposure simultaneously with the implementation of strategies to reduce alcohol and drug consumption.

D. *The Connection Between Neurotoxic Contamination and Crime*

To test the plausibility of the Neurotoxicity Hypothesis, Roger Masters, a Professor of Political Science at Dartmouth College, engaged with his research assistants in an exhaustive comparison of federal data on the distribution of environmental pollutants and crime.[54] First, Masters used the U.S. Environmental Protection Agency's (EPA) Toxics Release Inventory (TRI) for 1991.[55] He focused particularly on lead and manganese exposure for all 3,141 U.S. counties. Masters then looked at Federal Bureau of Investigation (FBI) crime reports for those counties to measure the incidence of property and violent crimes against the TRI lead and manganese exposure data.[56]

Masters' findings are highly suggestive of a likely crime-environmental contamination link. First, he noted that eighty percent of U.S. counties have no reported release of either compound.[57] In

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[53] *Id.* at 159.

[54] *See* Masters et al., *Environmental Pollution*, *supra* note 13, at 15–16, 32.

[55] *See id.* at 16, 32. The TRI is produced annually by the EPA pursuant to Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, and Section 6607 of the Pollution Prevention Act of 1990. *See* 42 U.S.C. §§ 11023, 13106 (1999). The 1997 TRI, the most recent, was published in April 1999. *See* Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, *1997 Toxics Release Inventory Public Data Release Report*, *available at* http://www.epa.gov/optintr/tri/tri97/drhome.html.

[56] *See* Masters et al., *Environmental Pollution*, *supra* note 13, at 16. The 242 counties reporting no incidence of violent or property crimes in that year were dropped from Masters's comparison. *See id.* at 32.

One possible concern about the use of FBI data is that they may reflect, to a disproportionate degree, a bias from large urban centers, which may contain relatively more efficient information-collection systems. Local crime reports may therefore present a more reliable statistical base, although they are not easily obtained and such data might be difficult to standardize.

[57] *See id.* It bears mentioning that Masters and his research colleagues also looked at levels of alcoholism as they may have related to violent crime. Suffice it to say that they also found a correlation between crime and alcoholism, a connection that is already a well-established feature of the criminology literature. *See* Masters et al., *Brain Biochemistry*, *supra*

those counties with no reported lead or manganese releases, "rates of violent crime are below average (216 per 100,000 compared to the national mean of 298)."[58] Second, by contrast, "the 52 counties with toxic releases from both metals . . . have almost four times as much violent crime (920 per 100,000)."[59]

Clearly, such powerful correlations demand attention. Yet from the perspective of many scientists, trained in the methods of controlled clinical studies and multiple attempts to replicate the same results, such correlations are inherently suspect. The concern is that such correlations are subject to the "ecological fallacy," that is, the notion that one should be wary of turning correlations into causes.[60] Proponents of the hypothesis do not discount the possible relevance of the ecological fallacy, but insist that it cannot be used as a means to forestall serious consideration of their data. Inevitably, they argue, it is simply impossible to control for every conceivable variable. It would be unethical (if not practically impossible) to have a control group that was exposed to toxic contamination in order to test the reliability of the findings.[61] It is possible, however, to imagine forms of control to demonstrate that Masters' correlations are indeed causes.[62]

To correct for the possible relevance of the ecological fallacy, proponents of the hypothesis argue, it is essential constantly to antici-

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note 13, at 159. This Article avoids discussion of that issue since its focus is on environmental law and policy and not on each of the variables.

[58] Masters et al., *Brain Biochemistry, supra* note 13, at 159

[59] Masters et al., *Environmental Pollution, supra* note 13, at 32.

[60] Concern about the ecological fallacy should be especially heightened among lawyers, in light of several well-publicized misuses of scientific data. *See generally* MARCIA ANGELL, SCIENCE ON TRIAL: THE CLASH OF MEDICAL EVIDENCE AND THE LAW IN THE BREAST IMPLANT CASE (1996). Angell discusses the ecological fallacy—without using the term of art. *See id.* at 98.

[61] "Although epidemiologists are increasingly aware of such synergistic interactions, most conventional models of violent crime have looked at individual variables rather than complex effects of ecological and lifestyle factors on brain chemistry and behavior." Masters et al., *Environmental Pollution, supra* note 13, at 32.

[62] Possibilities suggested by Michael McGuire, a professor of psychiatry and biobehavioral science at the University of California at Los Angeles, would be longitudinal studies or animal studies on non-human primates. Telephone Interview with Professor Michael McGuire, UCLA (June 3, 1998). Diana Fishbein, a criminologist and psychobiologist at the University of Maryland, offered that human control groups might be formed where the head hair of subjects was tested for possible toxic contamination, or to perform blood assays on a subject population. Telephone Interview with Diana Fishbein, Criminologist/Psychobiologist, University of Maryland (Mar. 25, 1998). Adrian Raine, a professor of clinical neuroscience, observed that this "very exciting [neurotoxicity] research" next needs "experimental intervention studies" to test the credibility of the findings. Telephone Interview with Professor Adrian Raine (Feb. 10, 1998) (notes on file with author).

pate potential problems with the data. To this end, Masters and his team further scrutinized their data, noting that "[t]he correlations between environmental pollution and crime interact significantly with population density."[63] Thus, for example, the researchers found that in densely-populated counties with lead and manganese pollution, there were "970 violent crimes per 100,000, or three times the national average, while the four low density counties with similar neurotoxicity have only 138 violent crimes per 100,000."[64] The evidence is highly suggestive that the "stress involved in urban living has neurochemical correlates that exacerbate the effects of neurotoxicity."[65] In short, toxic pollution seems likely to constitute a previously unsuspected risk factor that contributes, perhaps significantly, to geographic differences in violence. As Masters and his colleagues therefore conclude, their findings indicate that "urbanism, ethnicity and toxicity emerge as important correlates of violent crime."[66] As a result, "the traditional approaches to crime in the United States need to be reconsidered from an ecological point of view."[67]

For Masters and his group, political scientists and neuroscientists by training, there are at least four important policy implications of the Neurotoxicity Hypothesis. Subject to further empirical confirmation, for example, they have suggested that, first, proof of the Neurotoxicity Hypothesis will result in *increased* individual responsibility for criminal behavior.[68] That is, if we can reliably identify an individual's biochemical susceptibility to impulsive behavior, it will be possible to hold an individual personally responsible for failing to take steps to control his behavior.[69] Second, they project that improved educational performance will be possible as a result once the hypothesis is more conclusively proven and widely accepted. Because "[t]he link between dietary deficiency, neurotoxicity and violence has also been associated with low I.Q. and learning disabilities . . . nutritional components of Head Start, school lunch programs, and food stamps may be of great importance, provided they are monitored for necessary vitamins and

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[63] Masters et al., *Environmental Pollution*, *supra* note 13, at 33.

[64] *Id.*

[65] *Id.*

[66] *Id.* at 37.

[67] *Id.*

[68] For example, it may be important to correct calcium deficiencies, since calcium is key to blocking uptake of manganese. *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 172–73.

[69] *See id.* at 171.

minerals."[70] Third, Masters and his colleagues are hopeful that further proof of the Neurotoxicity Hypothesis will have economic benefits in the form of vitamin supplementation that, in the long term, would be far less costly than incarceration as a means of rehabilitating violent criminals.[71] Fourth and finally, they speculate that proof that "violence is associated with abnormal brain biochemistry" will help screen violent criminals for biochemical imbalances and, thus, lead to further improvements in the administration of criminal justice.[72] Masters and his collaborators are quick to note, however, that improving criminal justice administration should not become a means to react in an overly-punitive manner, adding that "it is also essential to consider the ethical and legal implications of our approaches to criminal violence."[73]

1. Individual Criminal Liability

Despite this admonition, Masters and his associates steadfastly maintain that, no matter how strong the connection between neurotoxic contamination and crime revealed by their research, the principle of *mens rea* should not be abandoned.[74] Masters, in fact, believes that neurotoxicity data may heighten rather than diminish individual responsibility, since the effects of the contamination can be controlled to some extent through measures such as an improved diet.[75] That a researcher documenting the likely influence of what are typically classified as "external" causes of crime should hew to the principle of *mens rea*, which typically looks to choices within an individual's control, is a noteworthy feature of his research. In particular, if it is true that, as Masters' research suggests, poorer members of certain racial minority groups are disproportionately affected by neurotoxic contamination, an unwavering insistence on the notion of *mens rea* could

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[70] *Id.* at 171–72.

[71] *See id.* at 172.

[72] *Id.*

[73] Masters et al., *Brain Biochemistry*, *supra* note 13, at 172.

[74] *See* Masters, *Environmental Pollution and Crime*, *supra* note 13, at 359 & n.1 (citing source which concludes that, in addition to being the locus of neurochemical processes, the nature of the central nervous system is such that "moral and law abiding behavior needs to be seen as a *skill*").

[75] *See* Masters et al., *Brain Biochemistry*, *supra* note 13, at 171 (noting that "some people are particularly likely to engage in impulsive behavior after consuming alcohol or drugs. . . . If such a vulnerability can be reliably identified, we can hold such individuals responsible for avoiding alcoholic beverages and drugs, much as is now the case with repeat offenders for driving under the influence.").

have volatile political implications. On one hand, the hypothesis seems to present data that would be most welcome to the political left since it offers an explanation for criminal action that focuses on larger social explanations for crime, rather than on some individual action. For example, evidence of neurotoxicity could become a new form of individual criminal defense like involuntary intoxication, which may result in acquittal for certain types of criminal offenses.[76]

On the other hand, however, an insistence on the application of *mens rea*—for the reasons mentioned above—also could provide grist to a conservative view of criminal behavior since it focuses attention back on the choice of the errant individual. That is, neurotoxicity could be used to make even more likely a finding of criminal liability for persons who failed to correct a toxic condition. A prosecutor thus might argue that because a defendant had been identified as having elevated blood lead and manganese levels, that individual was responsible to take steps to mitigate the effects of the contamination. If the defendant had not taken steps to correct those known levels and still committed a violent crime, neurotoxic contamination might be used to underline a case arguing malicious or, at a minimum, reckless behavior.[77]

2. *Mens Rea* and Criminal Liability for Environmental Discharges of Toxic Substances

Strikingly, the discussion of *mens rea* and neurotoxicity has focused almost exclusively on the kinds of possibilities sketched out above. That is, the discussion has concentrated on the mental state of violent individuals whose behavior may have been caused in some measure by exposure to neurotoxic heavy metals. *Mens rea* needs to be evaluated, however, with respect to *any* person whose behavior is implicated by neurotoxicity, including those responsible for discharges of neurotoxic materials into the environment. This Article now turns, therefore, to the question of the implications of neurotoxicity research for the understanding of *mens rea* as applied to the prosecution of federal environmental crimes.

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[76] This refers, in particular, to general-intent offenses and offenses based upon Model Penal Code (MPC) standards of liability. *See, e.g.*, JOSHUA DRESSLER, UNDERSTANDING CRIMINAL LAW 305–07 (2d ed. 1995).

[77] A major concern presented by such an argument is that such a prosecution would proceed on the assumption that such a defendant, who is likely to be poor and marginalized, would have the opportunity to learn about this research and any consequent obligations, and have the means to correct the problem.

As the federal environmental crime example makes clear, insisting on the inviolability of *mens rea* is much easier said than done. Masters' insistence on not abandoning *mens rea* may be a way to ensure that the Neurotoxicity Hypothesis be given more serious consideration by criminologists and politicians.[78] But the mere statement that *mens rea* should not be abandoned glosses over a host of extremely complicated questions. *Mens rea* is, famously, one of the most ill-defined concepts in Anglo-American criminal law. In Justice Holmes' oft-quoted view, "most of the difficulties as to the *mens rea* [are] due to having no precise understanding [of] what the *mens rea* is."[79] In particular, as discussed below, a uniform notion of *mens rea* has not been consistently applied in cases of environmental crime, owing, at least in part, to some apparent moral ambivalence about holding people criminally liable for environmental harm. As explained in the next section, inconsistent application of a *mens rea* standard is likely to be exacerbated by the results of the neurotoxicity research described above. This Article now turns, therefore, to some of the legal implications of the Neurotoxicity Hypothesis—and above all, the implications for criminal intent standards.

II. Federal Environmental Law and the Neurotoxicity Hypothesis

The principal statute to be examined in this section is the Federal Water Pollution Control Act, more popularly known as the Clean Water Act (CWA),[80] although reference will also be made to two other central environmental laws, namely the Clean Air Act (CAA),[81] and the Resource Conservation and Recovery Act of 1976 (RCRA).[82] With respect to the Neurotoxicity Hypothesis, these statutes could prove particularly important inasmuch as the majority of releases of toxic heavy metals occur by air, water, or through improperly-handled hazardous waste. Therefore, consideration of the civil and criminal enforcement provisions of these statutes provides an excellent opportunity to assess the potential responsiveness of federal environmental laws to the Neurotoxicity Hypothesis.

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[78] *See* Masters, *Environmental Pollution and Crime*, *supra* note 13, at 359.

[79] 1 Holmes-Laski Letters: The Correspondence of Mr. Justice Holmes and Harold J. Laski, 1916–1935, at 4–5 (Mark DeWolfe Howe ed., Harvard University Press 1953).

[80] Clean Water Act, 33 U.S.C. §§ 1251–1377 (West 1999).

[81] Clean Air Act, 42 U.S.C. §§ 7401–7671q (West 1999).

[82] Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901–6992 (West 1999).

This Section will begin by examining the criminal and civil enforcement sections of the CWA in light of the Neurotoxicity Hypothesis. This is crucially important because neurotoxicity research will likely require the legal system to consider the *mens rea* of those who create toxic contamination leading to violent, neurotoxic-influenced behavior.

The CWA is a useful example for several reasons. First, waterborne exposures to heavy metals are not uncommon.[83] Second, the CWA is a fairly typical environmental statute in structure; the CWA is supported by a complex regulatory apparatus and sets not only federal water quality standards but also many state standards through the delegation process.[84] Third, like other principal environmental statutes, the CWA provides for citizen suits.[85] All of these characteristics make it worth studying in view of the fact that wider publication of neurotoxicity research likely will result in lawsuits marshaling neurotoxicity data in support of claims under federal and state environmental statutes. This may lead, in turn, to criminal prosecutions. Fourth, the CWA traditionally has been enforced according to a best available treatment (BAT) standards model,[86] in contrast to the CAA's airshed management model. As discussed below, these different models could affect the outcome of lawsuits brought using evidence of neurotoxic contamination.[87] Fifth, and perhaps most importantly in the context of the Neurotoxicity Hypothesis, "[t]he confrontation over mens rea in the [United States] Supreme Court is instead most likely to arise in a felony prosecution brought pursuant to the Clean Water Act."[88] Therefore, it is advisable to attempt to head off the possibility of such a confrontation sooner rather than later.

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[83] *See generally* ENVIRONMENTAL DEFENSE FUND, LEGACY OF LEAD: AMERICA'S CONTINUING EPIDEMIC OF CHILDHOOD LEAD POISONING 19–20 (1990); NATURAL RESOURCES DEFENSE COUNCIL, THE LEAD CONTAMINATION CONTROL ACT: A STUDY IN NON-COMPLIANCE (1991).

[84] The delegation process is described in most standard environmental texts. Of course, state common law is also an important environmental enforcement tool. *See, e.g.*, ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE AND POLICY 117–223 (2d ed. 1996).

[85] *See* 33 U.S.C. § 1365.

[86] BAT stands for "Best Available Technology Economically Achievable." OLGA L. MOYA AND ANDREW L. FONO, FEDERAL ENVIRONMENTAL LAW: THE USER'S GUIDE 356 (West).

[87] *See infra* Section III.A.

[88] Richard J. Lazarus, *Mens Rea in Environmental Criminal Law: Reading Supreme Court Tea Leaves*, 7 FORDHAM ENVTL. L.J. 861, 879 (1996) (also citing the possibility of a liability standard confrontation under either RCRA or the CAA).

A. *Criminal Provisions of Major Federal Environmental Statutes*

1. Clean Water Act

a. *Statutory Scope*

The most comprehensive criminal statutory scheme contained in any major federal environmental law appears in the CWA. As with many federal environmental laws, the CWA's principal criminal enforcement sections have a tripartite structure. First, the statute creates penalties for negligent violations.[89] Second, it penalizes knowing violations.[90] Third, and finally, the CWA punishes knowing endangerment.[91]

In each case, these provisions focus on what a violator knew or reasonably should have known. Thus, for example, negligent violation of the CWA subjects a person to punishment, with fines of up to $25,000 per day of violation, and/or imprisonment of up to one year (with double penalties following first convictions under this subsection) when she either negligently violates the CWA' s national effluent limitations, water quality, and treatment standards, or:

> negligently introduces into a sewer system or into a publicly owned treatment works any pollutant or hazardous substance which such person knew or reasonably should have known could cause personal injury or property damage or, other than in compliance with all applicable Federal, State, or local requirements or permits, which causes such treatment works to violate any effluent limitation or condition in any permit issued to the treatment works.[92]

The provision for "knowing" violations tracks the above-quoted language exactly, excepting that the first word above—"negligently"—becomes "knowingly."[93] The penalties for knowing violations, however, are greater: up to $50,000 per day of violation and/or imprisonment for up to three years.[94] Importantly, federal case law interpreting the

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[89] *See* 33 U.S.C. § 1319(c)(1).

[90] *See id.* § 1319(c)(2).

[91] *See id.* § 1319(c)(3). In addition, the CWA criminally punishes false statements, and "treatment of single operational upset." *Id.* §§ 1319(c)(4), (5). This Article will not address these provisions since they are relatively less important than the others.

[92] *Id.* § 1319(c)(1)(B).

[93] *See id.* § 1319(c)(2).

[94] *See* 33 U.S.C. § 1319(c)(2).

"knowing" standard has consistently provided that the requisite knowledge needed to establish a violation is merely knowledge that the materials discharged into waterways are dangerous, and not that the discharge is illegal.[95] This is in keeping with the ambitious aims of the statute, although commentators often point out that such a comparatively low threshold for a finding of criminal liability creates considerable enforceability problems.[96]

The knowing endangerment provision differs somewhat from the previous two in that they concern actions that place "another person in imminent danger of death or serious bodily injury," with fines of "not more than $250,000 or imprisonment of not more than 15 years, or both."[97] As with both negligent and knowing violations, violations after first convictions are subject to double fines and terms of imprisonment. Additionally, this section addresses problems of proof for purposes of determining whether an individual knowingly endangered the life or well-being of another. Circumstantial evidence that a defendant affirmatively attempted to shield herself from knowledge of potential harm may be submitted (although defendant has a statutory affirmative defense to such evidence).[98]

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[95] *See generally* United States v. Wilson, 133 F.3d 251 (4th Cir. 1997); United States v. Sinskey, 119 F.3d 712 (8th Cir. 1997).

[96] *See, e.g.*, Lazarus, *supra* note 88, at 864–67; *see also* Section II.A.1.b, *infra.*

[97] 33 U.S.C. § 1319(c)(3)(A). In each of the three statutes examined here, "serious bodily injury" is defined as "bodily injury which involves a substantial risk of death, unconsciousness, extreme physical pain, protracted and obvious disfigurement, or protracted loss or impairment of the function of a bodily member, organ, or mental faculty." *Id.* § 1319(c)(3)(B)(iv); Resource Conservation and Recovery Act, 42 U.S.C. §§ 6928(f)(6), 7413(c)(5)(F) (West 1999).

[98] *See* 33 U.S.C. § 1319 (c)(3)(B). Section 1319(c)(3)(B) provides, in relevant part:

> [I]n determining whether a defendant who is an individual knew that his conduct placed another person in imminent danger of death or serious bodily injury—
>
> (I) the person is responsible only for actual awareness or actual belief that he possessed; and
>
> (II) knowledge possessed by a person other than the defendant but not by the defendant himself may not be attributed to the defendant;
>
> Except that in proving the defendant's possession of actual knowledge, circumstantial evidence may be used, including evidence that the defendant took affirmative steps to shield himself from relevant information. . . . [However] a defendant may establish an affirmative defense under this subparagraph by a preponderance of the evidence.

Id.

Additional affirmative defenses to this section include explanations that "the person endangered and that the danger and conduct charged were reasonably foreseeable hazards of . . . an occupation, a business or a profession," or "medical treatment or medical or scientific experimentation."[99]

b. *Interpretation and the Neurotoxicity Hypothesis*

In light of the neurotoxicity research described in Part I of this Article, the issue presented by CWA's criminal liability standards is simple; subject to scientific confirmation of the Neurotoxicity Hypothesis (or similar neuroscientific research), EPA and/or state agencies will be compelled to lower the acceptable discharges of neurotoxic heavy metals into the environment. This, in turn, is sure to lead to increased CWA criminal prosecutions, under each of the criminal liability provisions described above. For example, under federal law, lead and cadmium are currently classified as "toxic pollutants" subject to national effluent discharge limitations under the CWA.[100] Once the acceptable discharge thresholds are reduced, permit and other regulatory violations will be more prevalent, thereby expanding the field of criminal prosecution under the CWA.[101] As described in the previous subsection, most observers already consider a determination of CWA criminal liability to be relatively easy.[102] If, in addition, threshold levels for discharge of toxic heavy metals into the environment are dramatically lowered, criminal liability could become commonplace. This, in turn, could further exacerbate the inconsistent application of criminal liability provisions under federal environmental laws such as the CWA. In no respect is this inconsistency clearer than in the case of

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[99] *Id.*

[100] *See id.* § 1317(a) (authorizing EPA to publish a list of toxic pollutants subject to the CWA); *see also* 40 C.F.R. § 401.15 (West 1999) (setting forth the CWA's list of toxic pollutants).

[101] The kind of lawsuit envisioned here would be one using neurotoxicity data to prosecute facts similar to those establishing criminal liability in *United States v. Wells Metal Finishing, Inc. See* 922 F.2d 54, 56 (1st Cir. 1991). In *Wells*, a metal finishing plant was found to have released excess amounts of zinc and cyanide into a public sewer system, "vastly in excess of federal pretreatment limits." *Id.* The appellate court refused to overturn defendant's conviction in light of convincing evidence that "[t]oo much zinc and cyanide could kill beneficial microorganisms in the treatment plant and render its operations much less efficient and therefore much more costly." *Id.* at 57. The First Circuit also noted that "excessive amounts of cyanide may mix with acidic sewer wastes to form highly lethal cyanide gas." *Id.*

[102] *See supra* notes 89–99 and accompanying text.

what is meant by the term "criminal intent" for purposes of an environmental crime.

i. The Problem of Criminal Intent

Simply put, courts are confused as to what constitutes criminal intent for purposes of the federal environmental statutes. This confusion stems largely from disagreement as to whether common law "general" and "specific" intent categories should be used, or whether MPC categories should apply. This subsection will examine that confusion. Ultimately, the analysis indicates, the MPC standards are preferable because they employ a more objective test. No matter which set of categories is used to analyze criminal intent, however, data like that produced by the Neurotoxicity Hypothesis raises a serious possibility of increased criminal liability for environmental violations.

Susan Mandiberg has made the case that it is necessary to define a normative jurisprudence for environmental crimes in particular, and many regulatory crimes more generally.[103] As Mandiberg notes, in the regulatory crime context there is considerable "confusion about mental state [that] results from the lack of a coherent jurisprudential framework for federal regulatory crimes," a situation complicated by the fact that "the Supreme Court has increasingly interpreted regulatory crimes by reference to the traditional common-law notion of *mens rea*, which it treats as a normative concept."[104] As Mandiberg further explains, however, current analysis of federal regulatory crimes like those identified in the principal environmental statutes, "is not yet

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[103] *See generally* Susan F. Mandiberg, *The Dilemma of Mental State in Federal Regulatory Crimes: The Environmental Example*, 25 ENVTL. L. 1165 (1995) [hereinafter *The Dilemma of Mental State*]; Susan F. Mandiberg, *Moral Issues in Environmental Crime*, 7 FORDHAM ENVTL. L.J. 881 (1996). *See also generally* Kevin A. Gaynor et al., *Environmental Criminal Prosecutions: Simple Fixes for a Flawed System*, 3 VILL. ENVTL. L.J. 1, 4 (1992) (stating that "[g]iven the serious nature of the [environmental] crimes and penalties involved, the complexity of the laws, and the broad applicability of the federal environmental laws to American society; a higher level of culpability [than "knowing" violations] should be imposed, either as a matter of prosecutorial discretion or through statutory amendment."); Richard J. Lazarus, *Assimilating Environmental Protection Into Legal Rules and the Problem with Environmental Crime*, 27 LOY. L.A. L. REV. 867 (1994) [hereinafter *Assimilating Environmental Protection*]; Richard J. Lazarus, *Meeting the Demands of Integration in the Evolution of Environmental Law: Reforming Environmental Criminal Law*, 83 GEO. L.J. 2407 (1995) [hereinafter *Meeting the Demands*]; Lazarus, *Mens Rea in Environmental Criminal Law: Reading Supreme Court Tea Leaves*, *supra* note 88; Richard J. Lazarus, *The Reality of Environmental Law in the Prosecution of Environmental Crimes: A Reply to the Department of Justice*, 83 GEO. L.J. 2539 (1995); Lois J. Schiffer & James F. Simon, *The Reality of Prosecuting Environmental Criminals: A Response to Professor Lazarus*, 83 GEO. L.J. 2531 (1995).

[104] Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1167–68.

well suited to answering some of the thorny questions that regulatory crime statutes present."[105] In particular, she notes the Supreme Court has applied an analytical framework that, following a common law paradigm, applies "specific intent" principles to some regulatory crimes and "general intent" principles to others (notably to crimes deemed "public welfare offenses").[106]

As Mandiberg argues, however, it is important to recognize that the common law categories, which will be discussed more fully below, have been applied in the prosecution of environmental crimes where the meaning of the relevant statutory standards is unsettled with respect to the requisite *mens rea*.[107] By contrast, Richard Lazarus has vigorously argued that the "nonintegration" of criminal law standards and environmental law standards has created serious problems for the long-term success and credibility of the federal model of criminal environmental law.[108] Mandiberg's approach suggests, however, that the "nonintegration" that Lazarus identifies may be less serious a problem than it at first glance appears. Instead, her analysis suggests that although the application of common law *mens rea* standards to the prosecution of federal statutory environmental crimes may have made their enforcement confusing and inconsistent, it does not necessarily indicate fundamentally different ways of thinking about environmental and criminal law enforcement.[109]

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[105] *Id.* at 1168.

[106] *See id.* at 1205–06.

[107] *See id.* at 1177–79.

[108] *See* Lazarus, *Meeting the Demands*, *supra* note 103, at 2412. Lazarus is not alone in these concerns. *See generally* Michael Herz, *Structures of Environmental Criminal Enforcement*, 7 FORDHAM ENVTL. L.J. 679 (1996) (examining differing enforcement priorities between the Department of Justice and the EPA).

[109] *See generally* Mandiberg, *The Dilemma of Mental State*, *supra* note 103. One respect in which Lazarus may overstate his case is in his view of criminal law as essentially static, as when he observes that one of the fundamental differences between criminal and environmental law is that "[c]riminal law emphasizes settled norms, while environmental law constantly changes and aspires for fundamental and dramatic change." *Id.* at 2445. *See also* Lazarus, *Assimilating Environmental Protection*, *supra* note 103, at 879–85. What Lazarus clearly overlooks, however, is that criminal law can be equally dynamic and unsettled. Examples of this include the criminalization of activities like "date rape," "stalking," and others that were not traditionally viewed as criminal behavior. For an overview of the emergence of activities not previously subject to criminal prosecution, see Sanford Kadish, *Fifty Years of Criminal Law: An Opinionated Review*, 87 CAL. L. REV. 943, 975–78 (1999) (discussing the impact of feminism on the criminal law). Notable examples include the decriminalization of consensual sodomy. *See, e.g.*, LESBIANS, GAY MEN, AND THE LAW 87–88 (1993) (noting that "[a]s of 1961, all fifty states in the United States still had some sort of sodomy laws on their books. Today, fewer than half the states do."(citation omitted)). A more recent example is the effort to de-criminalize marijuana use for medical purposes.

The application of common law principles to federal statutory environmental crimes, in fact, may reflect a fundamental unwillingness to apply the existing, "knowing" statutory standards, standards rooted in the conceptual reforms of the MPC.[110] It may be that resistance to the application of the statutory standards does not stem from a belief that environmental harms do not merit prosecution. Rather, it is possible that the resistance is due to the broad reach of those standards or because environmental malefactors, unlike many common law criminals, perform social services even as they commit acts for which criminal liability should be assessed.[111]

In addition, the ambiguity of federal environmental statutes may have forced courts to insert common law paradigms into the analysis of statutory standards. For example, although the CWA punishes "knowing" violations, it does not explain what a defendant is charged with knowing. Thus, case law has focused to an exceptional degree on questions such as whether a defendant charged with criminal liability under the CWA knew merely whether the materials discharged in ex-

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See, e.g., Ethan A. Nadelmann, *New Approach to Drugs That's Grounded Not in Ignorance or Fear But Common Sense*, CHI. TRIB., Oct. 10, 1999, at C23 (advocating decriminalization for medical marijuana). *But see Reno Opposes Medical Marijuana Initiatives*, The White House Bull., Oct. 7, 1999 (stating official White House view against such efforts, "until or unless scientists or medical experts find specific medicinal properties unique to marijuana") (LEXIS, News Library, Curnws File).

[110] In fact, congressional amendment may be understood to reflect the MPC's conceptual clarifications. As the Eighth Circuit noted in *United States v. Sinskey*:

> In 1987, Congress amended the act [33 U.S.C. Sec. 1319 (c)(2)(A)] in part to increase deterrence by strengthening the criminal sanctions for its violation. *See, e.g.*, H.R. Conf. Rep. No. 99–1104, at 138 (1986) and S. Rep. No. 99–50, at 29–30 (1985). To that end, Congress changed the term "willfully" to "knowingly" in that section of the act dealing with intentional violations. *See* 133 Cong. Rec. H131 (daily ed. Jan. 7, 1987) (statement of Rep. J. Howard), *reprinted in* 1987 U.S.C.C.A.N. 5, 28, and 33 U.S.C. § 1319, historical and statutory notes, 1987 amendment, at 197 (West Supp. 1997). Although Congress did not explicitly discuss this change, it may logically be viewed as an effort to reduce the mens rea necessary for a conviction, as the word "willfully" generally connotes acting with the knowledge that one's conduct violates the law, while the word "knowingly" normally means acting with an awareness of one's actions.

119 F.3d 712, 716 (8th Cir. 1997).

Sanford Kadish recently called the promulgation of the MPC "[t]he event of looming significance this past half-century in the field of criminal law." SANFORD KADISH & STEPHEN SCHULHOFER, CRIMINAL LAW AND ITS PROCESSES: CASES AND MATERIALS 946, 947–53 (5th ed. 1989).

[111] That is to say, for example, that while most would agree that the life-harming release of cadmium merits criminal conviction, few would support an end to manufacture of long-life cadmium batteries.

cess of permitted levels were toxic, or whether the discharge was unpermitted.[112]

Because neurotoxicity research is likely to force a drastic reduction of acceptable levels of toxic materials that may be discharged into the environment, these problems in assessing federal environmental criminal liability are likely to become even more acute. In short, neurotoxicity research suggests that pollution may have even more devastating health consequences than previously thought. This may open the door to increased litigation. Moreover, whatever the nature of the underlying differences, if any, between environmental and criminal law, both Lazarus and Mandiberg agree that the analytical framework used to establish *mens rea* under federal environmental statutes is unsatisfactory.[113]

The reasons for this deserve consideration as they bear directly upon the potential challenges the Neurotoxicity Hypothesis presents for enforcement of federal environmental crimes. A difference between many environmental and common law crimes is that, for most statutory environmental crimes, a prosecutor is not required to prove a number of different elements in order to establish environmental criminal liability.[114] However, this has not stopped courts—even the Supreme Court—from attempting to impose a classical common law *mens rea* framework onto the language of "knowing" environmental crimes, like violations of the CWA. This is true even where, as with the CWA, the statute is silent as to criminal intent.[115]

In her examination of Supreme Court regulatory crimes jurisprudence, Mandiberg concludes that a two-part structure has been developed "for interpreting mental state in ambiguous federal regulatory crime statutes."[116] That structure, she concludes, closely tracks common law crime distinctions.[117]

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[112] *See* Section III.A., *infra.*

[113] *See* Lazarus, *Meeting the Demands*, *supra* note 103, at 2412; Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1167–68.

[114] *See* Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1170–76 (discussing inconsistent approaches as to what might be proved to establish a scienter requirement under RCRA and the Migratory Bird Treaty Act, 16 U.S.C. §§ 703–712 (1994)).

[115] *See id.* at 1201–02 (discussing Staples v. United States, 511 U.S. 600 (1994), a prosecution under the National Firearms Act, 26 U.S.C. §§ 5801–5872 (1988)). Like the CWA, the statute at issue in *Staples* did not speak to mental state ("[s]ilence on this point by itself does not necessarily suggest that Congress intended to dispense with a conventional *mens rea* element"). *See Staples*, 511 U.S. at 605.

[116] Mandiberg, *supra* note 103, at 1203.

[117] *See id.* at 1204–15.

Specifically, Mandiberg notes that the Court classifies some regulatory crimes as "public welfare offenses," using an analysis that closely parallels the common law category of "general intent" crimes.[118] A general intent crime is one where culpability is "objectively assessed."[119] That is to say, "'[g]eneral' intent can mean a number of different things, but in this context it generally means that it is sufficient to convict when the defendant did what in ordinary speech we would call simply an intentional action."[120] A specific intent crime is one in which, by contrast, culpability "is subjectively assessed. The prosecution must prove that the defendant engaged in the actions 'with some specified purpose in mind' or that the defendant was subjectively aware 'of some specific circumstance.'"[121]

For example, bigamy is a general intent crime, while burglary, which requires a breaking and entering under cover of night *with the specific intent to commit a crime therein*, is a specific intent crime.[122] Without an intention to commit a crime such as theft therein, a defendant would only be guilty of criminal trespass. This distinction, however, is not one that lends itself to intellectual clarity. As Joshua Dressler notes:

> [t]he terms 'specific intent' and 'general intent' are the bane of criminal law students and lawyers. This is because the terms are critical to understanding various common law rules of criminal responsibility, yet the concepts are so 'notoriously difficult . . . to define and apply . . . [that] a number of text writers recommend that they be abandoned altogether.[123]

Nonetheless, Mandiberg observes that "general" and "specific intent" crimes "parallel . . . the Court's regulatory crime categories. . . . The 'public welfare offense' category is at least superficially similar to 'general intent' in some striking ways," notably "conduct-circumstance combinations that are so dangerous and uncommon

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[118] *See id.*

[119] *Id.* at 1206.

[120] KADISH & SCHULHOFER, *supra* note 110, at 230.

[121] Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1206 (citing, *inter alia*, KADISH & SCHULHOFER, *supra* note 110; DRESSLER, *supra* note 76, at 109–10).

[122] *See, e.g.*, N.Y. PENAL LAW § 140.25 (West 1999); CAL. PENAL CODE §§ 459–460 (West 1999).

[123] DRESSLER, *supra* note 76, at 118 (citations omitted) (ellipses and bracketed text in the original). *See id.* at 102–03 (quoting various authorities on the ambiguity of the term *mens rea*). *See also supra* note 67 and accompanying text.

that everyone should know they are regulated."[124] She further explains that "[t]here are even more compelling parallels between 'innocent activity offenses' and 'specific intent' crimes."[125] To be exact, "[i]n traditional 'specific intent,' the defendant is subjectively aware of a circumstance, goal, or motive that is immoral in the traditional sense. This may also be true in 'innocent activity offenses' when the 'something extra' is the defendant's awareness of violating the law."[126] In the context of criminal clean water violations, a public welfare offense that is comparable to the common law "general intent" category would be any discharge of substances known to be toxic to humans, so long as such discharge is "uncommon."[127] By contrast, in the "innocent activity offense" context, a criminal clean water violation paralleling a common law "specific intent" crime might be the deliberate violation of a permitted discharge that had the effect of endangering the public.

Mandiberg concludes her comparison by observing that the Supreme Court has developed what she identifies as a two-step protocol for analyzing regulatory crimes. At a deep level, this protocol is informed by the common law of crimes and the "traditional normative jurisprudence" that the common law reflects. Specifically, she argues:

> [i]f the Court can say that the situation is physically dangerous and uncommon enough to cause widespread community concern, the crime is a 'public welfare offense.' In those cases, *mens rea* consists of the defendant's awareness of engaging in that conduct under those circumstances. For other statutes, the crime is an 'innocent activity offense'; *mens rea* therefore consists of the defendant's awareness of the conduct, the factual circumstances, and either the law or a probable unlawful consequence.[128]

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[124] Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1210. "Perhaps" Mandiberg muses, "'public welfare offenses' are the 'general intent' crimes of the modern era." *Id.*

[125] *Id.* at 1220.

[126] *Id.*

[127] *Cf.* United States v. International Minerals & Chem. Corp., 402 U.S. 558 (1971) (transport of dangerous chemicals). As Mandiberg notes, the jurisprudential basis of the "uncommon" requirement is unclear. Her observation is accepted for purposes of this Article, although it merits further consideration. For a discussion of the requirement, see Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1212–13.

[128] Mandiberg, *The Dilemma of Mental State*, *supra* note 103, at 1215.

These distinctions go to the heart of the difficulties courts and commentators have had with the assessment of criminal liability for environmental crimes. In no case is this contrast more clear than in *United States v. Weitzenhoff*.[129]

Perhaps more than any other CWA criminal prosecution, *Weitzenhoff* has occasioned both stern disapproval and widespread celebration for its reading of the CWA's *mens rea* requirement.[130] In *Weitzenhoff*, the managers of a sewage treatment plant on the Hawaiian island of Oahu were found guilty of conspiring to discharge pollutants into the ocean near a popular swimming and surfing beach.[131] The case presented an issue of first impression before a federal Court of Appeals, namely whether the district court was correct in "construing 'knowingly' in section 1319(c)(2) [of the CWA] as requiring only that [defendants] were aware that they were discharging the pollutants in question, not that they knew they were violating the terms of the statute or permit."[132] The Court noted that "[a]s with certain other criminal statutes that employ the term 'knowingly,' it is not apparent from the face of the statute whether 'knowingly' means a knowing violation of the law or simply knowing conduct that is violative of the law."[133] After reviewing the legislative history for section 1319(c)(2), the Court concluded that "congressional explanations of the new penalty provisions strongly suggest that criminal sanctions are to be imposed on an individual who knowingly engages in conduct that re-

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[129] *See* generally 1 F.3d 1523 (9th Cir. 1993).

[130] *See, e.g.*, Kevin P. Cichetti, *United States v. Weitzenhoff: Reading out the "Knowingly" from the "Knowingly Violates" in the Clean Water Act*, 9 ADMIN. L.J. AM. U. 1, 183 (1996); Richard G. Cohn-Lee, *Mens Rea and Permit Interpretation Under the Clean Water Act: United States v. Weitzenhoff*, 24 ENVTL. L. 1351, 1354-57 (1994) (arguing that *Weitzenhoff* correctly applied the CWA as a "general intent" statute by placing the burden to resolve permit ambiguities on the permittee); Katherine H. Setness, *Statutory Interpretation of Clean Water Act Section 1319(c)(2)(A)'s Knowledge Requirement: Reconciling the Needs of Environmental and Criminal Law*, 23 ECOLOGY L.Q. 447, 450 (1996) (criticizing *Weitzenhoff*'s analysis) [hereinafter *Statutory Interpretation of Clean Water Act Section 1319(c)(2)(A)'s Knowledge Requirement*]; Kepten D. Carmichael, Note, *Strict Criminal Liability for Environmental Violations: A Need for Judicial Restraint*, 71 IND. L.J. 729, 731, 748–52 (1996) (criticizing *Weitzenhoff*'s "public welfare" reading of the CWA as an example of *de facto* strict liability and its "intolerable implications" for environmental regulatory violations); Michael J. Penders, *Innocents at Risk? The Rhetoric and Reality of Environmental Criminal Enforcement*, 2 ENVTL. L. 835, 841 (1996) (book review) (discussing the *Weitzenhoff* court's interpretation of the CWA as a "public welfare" statute). *See generally* Ruth Ann Wendell et al., *Erosion of Mens Rea in Environmental Criminal Prosecution*, 21 SETON HALL L. REV. 1100 (1991).

[131] *See* 1 F.3d at 1527–28 n.1.

[132] *Id.* at 1529.

[133] *Id.* Curiously, the Ninth Circuit did not specify the "certain other criminal statutes" to which it referred. *See id.*

sults in a permit violation, regardless of whether the polluter is cognizant of the requirements or even the existence of the permit."[134] Moreover, the Court made clear that in so reading the statutory language of the CWA's "knowing" violations, it viewed the CWA as a "public welfare" statute.[135]

Thus, to return to Mandiberg's explanatory scheme, in *Weitzenhoff* the Court understood the CWA's knowing violation provision much as it would a "general intent" crime in the sense that defendants intentionally authorized employees to discharge waste directly into the ocean.[136] The opinion further makes clear, however, that the Court recognized the possible strength of an argument to the effect that the provision is more like a "specific" than a "general intent" crime. Specifically, the Court explicitly rejected defendant-appellants'

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[134] *Id.*

[135] The *Weitzenhoff* court thus analogized the CWA to federal statutes concerning the transport of corrosive liquids, management of hazardous wastes, drug shipments, and use of firearms. The court thus cited, respectively, *United States v. International Minerals & Chem. Corp.*, 402 U.S. 558 (1971) (dealing with the transport of corrosive liquids); *United States v. Hoflin*, 880 F.2d 1033 (9th Cir. 1989) (holding that knowledge of absence of a permit is not required for a RCRA violation); *United States v. Dotterweich*, 320 U.S. 277 (1943) (construing the Food, Drug and Cosmetic Act); and *United States v. Sherbondy*, 865 F.2d 996 (9th Cir. 1988) (stating that proof that defendant knew she/he was violating law was not required to establish violation of the Firearms Owners' Protection Act). *See Weitzenhoff*, 1 F.3d at 1530. These public welfare cases are sometimes called "strict criminal liability" offenses. For a discussion of these cases, their history, and the development of criminal liability standards in the environmental law context, see CHRISTOPHER HARRIS ET AL., ENVIRONMENTAL CRIMES §§ 5.03–.06 (1992).

It is central to the argument advanced in this Article to recognize that this "public welfare" reading has been applied not only in the context of the CWA, but in cases involving other federal environmental statutes as well. For instance, in the seminal RCRA case of *United States v. Johnson & Towers, Inc.*, 741 F.2d 662 (3d Cir. 1984), the Third Circuit considered whether RCRA's knowing violation section, 42 U.S.C. § 6928(d)(2)(A), "covers employees as well as owners and operators of a facility" that violated its RCRA permit. *Johnson & Towers*, 741 F.2d at 664. Examining both the statutory language and RCRA's legislative history, the court held, however, that:

> it is well established that criminal penalties attached to regulatory *statutes intended to protect public health, in contrast to statutes based on common law crimes, are to be construed to effectuate the regulatory purpose*. . . . It would undercut the purposes of the legislation to limit the class of potential defendants to owners and operators when others also bear responsibility for handling regulated materials.

Id. at 665–66 (emphasis added and citations omitted).

Although *Johnson & Towers* is a RCRA case, the similar structure of the "knowing" language means that this point applies with equal force to other federal environmental criminal provisions like that of the CWA.

[136] *See* 35 F.3d 1275, 1282 (9th Cir. 1993).

analogy to *Liparota v. United States.*[137] In *Liparota,* the prosecution was required to demonstrate that a violation of a federal statute proscribing the unauthorized use of food stamps required proof of the defendant's knowledge that he was violating the law.[138] Unlike *Liparota*'s alleged abuse of food stamp regulations however, the Court in *Weitzenhoff* insisted that knowledge of the law was immaterial for a finding of liability: "[t]he criminal provisions of the CWA are clearly designed to protect the public at large from the potentially dire consequences of water pollution . . . and as such fall within the category of public welfare legislation."[139]

The *Weitzenhoff* court's brief colloquy on the mental state required by the CWA (and, by extension, comparable environmental statutes) goes to the heart of the discomfort many feel about finding criminal fault for violations of environmental statutes. Richard Lazarus's concern is typical. Lazarus worries that, to the peril of the environmental cause, environmentalists have resisted "an argument in favor of accommodating the basic rights of those who violate the law—their right not to be incarcerated in the absence of violation of certain traditional norms of moral culpability."[140] Lazarus's criticism sounds very much like a plea to transform the "general intent"-like public welfare crimes into "specific intent" crimes:

> Does criminal culpability turn on the defendant's awareness of facts with the level of precision actually determinative of the lawfulness of the defendant's activity? Courts have addressed this issue in a variety of environmental law contexts. Their virtually uniform answer is that no such rigorous proof of the defendant's knowledge is necessary—liability is not entirely strict. Yet, given the breadth and depth of relevant facts of which the government need not prove knowledge, liability for knowing violations could be fairly dubbed mostly strict (if such a characterization is not an oxymoron).[141]

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[137] *See id.*; *see generally* 471 U.S. 419 (1985).

[138] *See Liparota,* 471 U.S. at 433.

[139] *Weitzenhoff,* 1 F.3d at 1530 (citations to legislative history omitted).

[140] Lazarus, *Meeting the Demands, supra* note 103, at 2529. *But see* Schiffer & Simon, *supra* note 103, at 2532; *cf.* Lazarus, *The Reality of Environmental Law in the Prosecution of Environmental Crimes, supra* note 103, at 2541–43.

[141] Lazarus, *Meeting the Demands, supra* note 103, at 2472. For Lazarus's critique of the application of the public welfare doctrine, see *id.* at 2472–84.

Lazarus's analysis may be faulted for failing to focus on the distinction between "general" and "specific intent" crimes, which is to say that what he sees as a flaw in the intent standards applied to environmental crimes may in fact reflect an interpretive choice with which he disagrees. Nonetheless, Lazarus is certainly not alone in his view, and the chorus of agreement with him in this respect makes clear that a formal reevaluation of criminal environmental intent standards is long overdue.[142]

ii. Standards of Intent and the Neurotoxicity Hypothesis

What do standards of intent have to do with the powerful correlations between violent criminal behavior and environmental toxins suggested by the Neurotoxicity Hypothesis? Above all, this Article suggests that the kind of data currently being produced in support of the Neurotoxicity Hypothesis could well push the controversy regarding the required mental state in federal environmental criminal prosecutions to the breaking point. That is, lawsuits for criminal liability based on neurotoxicity data can only sharpen the concerns addressed in a case like *Weitzenhoff* as to the appropriate scope of criminal liability for environmental harms. Whether using a "general"- or a "specific intent"-like standard, neurotoxicity seems likely to produce even louder calls for clarification of the appropriate liability standard.

The reason for this is twofold. On the one hand, studies documenting the likely role of neurotoxic contamination as a significant co-factor contributing to violent criminal behavior are likely to increase the pressure to apply a "general intent"-like standard, as is presently the case with interpretation of the CWA as a "public welfare" statute. On the other hand, it is equally true that Lazarus' and related concerns will, in light of neurotoxicity data, result in ever-louder demands to reform the usual intent standards that apply in criminal en-

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[142] *See, e.g.*, Gaynor et al., *supra* note 103, at 17–18 ("The government often tries to water down the knowledge standard by attempting to impose, through jury instructions, an objective standard on the *mens rea* requirement, that is, to hold the defendant liable for factual knowledge she should have had, rather than only for that she actually possessed. However, it has been generally held that when a statute penalizes an act performed 'knowingly' there must be *actual* knowledge of the circumstances. . . . [T]he government should not be able to argue that a person should have known for example, that the waste was hazardous, she should only be held liable if her subjective belief was that the waste was hazardous.") (citing non-environmental cases; citations omitted); Setness, *Statutory Interpretation of Clean Water Act Section 1319(c)(2)(A)'s Knowledge Requirement*, *supra* note 130, at 459 ("Courts employ the ["public welfare" offense] doctrine to reduce or eliminate the criminal law's general requirement of *mens rea*").

vironmental statutes. The reason for this is simple: data supporting the Neurotoxicity Hypothesis is, as indicated previously,[143] likely to require a downward revision of the acceptable discharges of certain toxic heavy metals like lead, cadmium, and manganese to levels currently deemed "sub-clinical." Such a downward revision will likely result in increased criminal prosecution of the manufacturing processes using those metals.[144] In addition, as evermore definite data is released, criticism of the Neurotoxicity Hypothesis is likely to mount, both from the left[145] and right.[146] To the extent that neurotoxicity data is used by government lawyers seeking to enforce a criminal environmental provision like that in the CWA (or by lawyers acting on behalf of clients or others pressuring the government to bring such claims), pressure likely will mount for an "innocent activity"/ "specific

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[143] *See supra* notes 100–01 and accompanying text.

[144] Moreover, there is a solid basis for doing so in light of the more exacting standards applied by other federal environmental statutes. For example, "liability under CERCLA attaches regardless of the concentration of hazardous substances present in a defendant's waste, so long as the defendant's waste and/or contaminants in it are 'listed hazardous substances' pursuant to 40 C.F.R. § 302.4(a). Numerous courts have [so] held." City of New York v. Exxon Corp., 744 F. Supp. 474, 483 (S.D.N.Y. 1990).

[145] *See generally* Sheldon M. Novick, *Racial Images of the "Criminal": A Cognitive Disorder*, 22 VT. L. REV. 383 (1997); Joan Vogel, *Biological Theories of Human Behavior: Admonitions of a Skeptic*, 22 VT. L. REV. 425 (1997). Dr. Peter Breggin, a leading opponent of the use of behavior-modifying psychotrophic drugs like Prozac and Ritalin, also opposes biological explanations for behavior, which he characterizes as borne of "a long tradition that is potentially racist, ... disabling and humiliating to inner city youth." Telephone Interview with Dr. Peter Breggin (Jan. 1, 1998).

[146] The celebrated political scientist James Q. Wilson, after reviewing what he sees as the growing tension between science and law—or the conflict between explaining and identifying causation versus judging behavior—concludes as follows:

> [I]t is important that we let neither science nor compassion decide legal precepts. We [social scientists] want to explain, the law seeks to judge; we want to see the world in shades of gray, the law defines it in black and white. We wish verdicts to encompass the full range of human circumstances, but the law can range only so widely before losing its power to focus our often diffuse sense of self-control. In extreme cases, where the law clearly does not fit, juries may nullify and judges may forgive, but only within the steady, lasting confines of a moral and legal order.

JAMES Q. WILSON, MORAL JUDGMENT: DOES THE ABUSE EXCUSE THREATEN OUR LEGAL SYSTEM? 112 (1997). *See also* JOEL BEST, RANDOM VIOLENCE: HOW WE TALK ABOUT CRIMES AND NEW VICTIMS 93–141 (1990). A considerably less restrained examination of the culture of victimhood appears in ALAN M. DERSHOWITZ, THE ABUSE EXCUSE AND OTHER COP-OUTS, SOB STORIES, AND EVASIONS OF RESPONSIBILITY (1994). C. Ray Jeffery criticizes traditional criminology for working on the basis of a medieval tradition of revenge and deterrence through punishment and prisons rather than incorporating biosocial evidence. *See generally* Jeffery, *Criminology and Criminal Law*, *supra* note 8.

intent"-like reading of a criminal environmental provision like the CWA's.

This is problematic, however, because such an approach would conflict with a plain meaning reading of the federal environmental statutory standards. As noted above, these standards proscribe any "knowing" violation. The possible result is widespread disagreement about or, at worst, disregard of, federal statutory language. Such a result has obvious negative implications for an environmental statutory regime founded on the rule of law.[147]

Therefore, it is essential to seek a possible solution for this likely crisis in statutory interpretation. An effort is required that will both accommodate new findings—such as neurotoxicity data—that bear on the goal of a cleaner environment and also reduce the doctrinal confusion over the appropriate standard of intent in criminal environmental law cases. Possible solutions are outlined in Section III below.

B. *Civil Penalties*

Although this Article focuses primarily on the implications of neurotoxicity research for criminal liability under federal environmental laws, it is useful to outline briefly the implications of neurotoxicity research for civil liability under those statutes. This is worthwhile inasmuch as criminal prosecutions will in most cases be brought simultaneously with civil actions.

Civil liability under the CWA (and the other principal federal environmental statutes) is expansive, and has been made even more so

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[147] This is not a problem, it again deserves emphasizing, limited to the CWA. The same concerns would arise with respect to RCRA. *See, e.g.*, United States v. Hayes Int'l Corp., 786 F.2d 1499, 1503 (11th Cir. 1986) (stating that "in a prosecution under 42 U.S.C. Sec. 6928(d)(1) it would be no defense to claim no knowledge that the paint waste was a hazardous waste within the meaning of the regulations; nor would it be a defense to argue ignorance of the permit requirement"); United States v. Sellers, 926 F.2d 410, 416 (5th Cir. 1991) (noting that "when a person knowingly possesses an instrumentality which by its nature is potentially dangerous, he is imputed with the knowledge that it may be regulated by public health legislation [such as 42 U.S.C. Sec. 6928]."); United States v. Laughlin, 768 F. Supp. 957, 966 (N.D.N.Y. 1991) (stating that "based upon the overall structure of section 6928(d)(2), Congress' objective in enacting RCRA of protecting public health and the environment, and applicable principles of statutory construction, the court holds that the government is not required to prove that defendants in this case knew that a permit was required by law nor that they knew that [defendant] did not have a permit in order to prove that defendants violated section 6928(d)(2)(A)"), *aff'd*, 10 F.3d 961, 963–64 (2d Cir. 1993). *But cf.* United States v. Speach, 968 F.2d 795, 797 (9th Cir., 1992) (holding that, in light of ambiguity of "knowing" requirement with respect to 42 U.S.C. section 6928(d)(1), finding *mens rea* "element conspicuously absent" with respect to transport of hazardous materials to an unpermitted facility).

by case law interpreting the statutes.[148] Although the statute's history spans just over a full generation, it is full of examples of private efforts to force the EPA and state regulators to implement standards in compliance with its sweeping commands. In light of the historically broad reading of the CWA, the parties who would potentially be most affected by the Neurotoxicity Hypothesis would include government regulators, as well as officers and other employees of large corporations. Therefore, as evidence mounts in support of the hypothesis, private as well as public enforcement actions will likely increase.

It is again essential to repeat a key assumption underlying the argument advanced in this Article. To be exact, this Article proceeds on the assumption that as studies documenting the link between neurotoxic contamination and criminal behavior become more widely disseminated, the EPA and state environmental authorities will be compelled to lower the threshold for tolerable levels of discharged heavy metals. Thus, in light of neurotoxicity data, currently "subclinical" levels will likely be reclassified as threatening to human health.[149]

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[148] *See, e.g.*, 33 U.S.C. § 1319(b), (d) (West 1999). *See also* Natural Resources Defense Council v. Train, 8 ERC 2120, 6 Envtl. L. Rep. 20588 (D.D.C. 1976) (deciding a citizen suit against EPA for failure to implement technology-based effluent limitations for toxic substances led to requirement that EPA issue such limitations).

[149] It seems likely that this could happen. For example, in early 1999, EPA sought to tighten the "reporting requirements for persistent bioaccumulative toxic [PBT] chemicals" and "lowering the threshold for certain PBT pollutants and adding others to the list of chemicals for which TRI reports must be filed." Sara Thurin Rollin, *Toxic Pollutants: Environmental Groups Call for Stricter Reporting to TRI for Persistent Chemicals*, 29 Env't Rep. (BNA) 2086 (1999) (noting also that "environmental advocates faulted EPA's failure to include lead and cadmium on the list of PBT substances subject to reporting").

For data gathered in support of the neurotoxicity hypothesis to have any bite would likely require revision of the effluent standards for each of the toxic heavy metals implicated by the hypothesis. At present, the permissible effluent limitations vary considerably, depending on the nature of the activity. *Cf., e.g.*, 40 C.F.R. § 420.100 (West 1999) (allowing lead discharges into publicly-owned treatment works to as much as 0.000751 kg/kkg); 40 C.F.R. § 41.67(g) (West 1999) (stating that BPT [best practicable control technology] effluent limitations for hard lead refining slag granulation allows no lead discharge). These effluent limitations are arrived at, of course, only after often lengthy review and comment. The data supporting the neurotoxicity hypothesis suggest, however, that established effluent limitations do not prevent lead poisoning sufficient to remove a co-factor for violent behavior: "[a]lthough the effects of early exposure to low levels of lead are often described as subclinical, the evidence for serious cognitive defects is well established." Masters et al., *Brain Biochemistry*, *supra* note 13, at 157. That is, "low" lead levels may still be toxic in combination with other variables such as poor diet and drug use. Thus, even though mean blood lead levels decreased seventy-seven percent between 1976 and 1991, "many thousands of children continue to have toxic lead burdens, especially in minority communities." Needleman et al., *supra* note 30, at 363. In part, it is fair to assume, this is because lead has not been satisfactorily removed from public water supplies:

Release of such revised standards seem certain to result in increased private enforcement actions.

1. Clean Water Act

a. *Statutory Scope*

The plain language of the CWA gives authority for the EPA Administrator "to commence a civil action for appropriate relief, including a permanent or temporary injunction for any violation."[150] In addition, citizen suits have become widely-used tools of CWA enforcement.[151] It is worth noting, as well, that the list of persons subject to prosecution under the CWA is broad. A federal employee acting "within the scope of [his] employment" is subject to prosecution for violation of the CWA.[152] This has been applied, for instance, to the director of a public utility with supervisory authority responsible for a city waste water treatment plant[153] and civilians employed by the armed forces.[154]

> Although regulation of leaded gas and paint may have reduced exposure to solid or aerosol forms of lead, the presence of lead in water—a likely vector influencing neonates and infants in inner cities and aging housing—has not disappeared. . . . Even in modern multi-story buildings, water supplies in the upper floors may be particularly high in lead.

Masters et al., *Brain Biochemistry, supra* note 13, at 157–58 (references omitted). It is easy to imagine a lawsuit in which, for example, private interests would sue to compel the EPA to include subclinical levels of lead and other toxic, heavy metals to be listed as national effluent standards, requiring EPA to comply with its mandate under the CWA to protect the integrity of the nation's waterways. The argument would be straightforward: these levels have demonstrably been shown to compromise human health and therefore require stricter regulation. Following revision of such standards, it is equally possible to imagine violations of the new standards and resulting lawsuits.

[150] 33 U.S.C. § 1319(b).

[151] *See generally* Washington Pub. Interest Research Group v. Pendleton Woolen Mills, 11 F.3d 883 (9th Cir. 1993) (allowing a citizen suit even when EPA administrative compliance order had also been issued).

[152] *See* United States v. Curtis, 988 F.2d 946, 948 (Alaska 1993).

[153] *See generally* United States v. Brittain, 931 F.2d 1413 (10th Cir. 1991).

[154] *See generally* United States v. Dee, 912 F.2d 741 (4th Cir. 1990). In *Dee*, the civilian employees of the U.S. Army, assigned to the Chemical Research, Development, and Engineering Center at the Aberdeen Proving Ground in Maryland were charged for noncompliance with certain RCRA waste reporting requirements. Defendants attempted to assert that, as government employees, they were protected by sovereign immunity. However, the Fourth Circuit held that "sovereign immunity does not attach to individual government employees so as to immunize them from prosecution for their criminal acts." *Id.* at 744.

b. *Interpretation and the Neurotoxicity Hypothesis*

It is appropriate to discuss the applicability of the Neurotoxicity Hypothesis to civil liability under the CWA because of its focus "on implementation of technology-based standards applicable to individual point sources of water pollution—primarily industrial facilities and public sewage treatment plants."[155] In the context of the Neurotoxicity Hypothesis, this is relevant for at least three reasons. First, if effluent standards for toxic heavy metals like lead, manganese, and cadmium are revised in light of the hypothesis, industrial facilities and publicly-owned treatment works (POTWs) would be more likely to violate permit terms. Second, in the event of revised effluent levels, these same facilities would be likely targets of enforcement actions or lawsuits. Third, however, because CWA enforcement has concentrated on technology-forcing standards rather than watershed management, industry would likely claim that the technology required to remove heavy metals from point source discharges would be inefficient and/or that the cost of achieving such standards is economically prohibitive.[156] Thus, although violations of permits would likely put such facilities at risk of non-compliance with revised effluent levels, the facilities would have possible grounds for objection.[157]

c. *L.E.A.D. Group of Berks v. Exide Corp.*

An example of the way neurotoxicity data could be used in a CWA lawsuit is provided by the case of *L.E.A.D. Group of Berks v. Exide*

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[155] This approach contrasts, for example, with the approach of an otherwise quite similar statute, the CAA, which aims instead to control "a diversity of sources of air pollution within regional airsheds." Robert W. Adler, *Integrated Approaches to Water Pollution: Lessons from the Clean Air Act*, 23 HARV. ENVTL. L. REV. 203, 207 (1999).

[156] *Cf.* Thomas A. Cinti, Note, *The Regulator's Dilemma: Should Best Available Technology or Cost Benefit Analysis Be Used to Determine the Applicable Hazardous Waste Treatment, Storage, and Disposal Technology?*, 16 RUTGERS COMPUTER & TECH. L.J. 145, 158–63 (1990) (cataloguing criticisms of BAT as inefficient); John D. Graham, *The Failure of Agency-Forcing: The Regulation of Airborne Carcinogens Under Section 112 of the Clean Air Act*, 1985 DUKE L.J. 138–40 (1985) (criticizing BAT in the context of the CAA as inefficient). Graham argues that "[t]here is never really a 'best' available technology; there are only progressively more stringent and expensive abatement methods." Graham, *supra*, at 138–40.

[157] Remember that this is only true if citizen-plaintiffs allege "a state of continuous or intermittent violation—that is a reasonable likelihood that a past polluter will continue to pollute in the future." In other words, "citizen suits for 'wholly past violations' are not permitted under [Section 505] of the [CWA]." Massachusetts Pub. Interest Group v. ICI Americas, Inc., 777 F. Supp. 1032, 1034 (D. Mass. 1991) (citations omitted) (quoting Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Found., Inc., 484 U.S. 49, 57, 64 (1987)).

Corp.[158] In *L.E.A.D.*, individual and other private plaintiffs sought relief under the CWA, RCRA, and state hazardous waste and clean water laws for claimed violations of, among other things, CWA permits.[159] The individual plaintiffs included people living near the manufacturing—including lead-battery making—facilities of defendants. They maintained that the unpermitted release of toxic substances included the toxic heavy metals antinomy, cadmium, lead, iron, copper, and silver. To advance such claims, the court required plaintiffs to satisfy the three-pronged constitutional standing test advanced in *Lujan v. Defenders of Wildlife*.[160] *Lujan* requires a demonstration that a plaintiff (a) suffered an injury-in-fact, (b) which is fairly traceable to the challenged action of the defendant, and (c) that plaintiff's injuries likely would be redressed by a favorable decision.[161] The court concluded that the plaintiffs in this case did not satisfy the *Lujan* test, but for reasons unrelated to the discharge of the toxic heavy metals studied in connection with the Neurotoxicity Hypothesis.[162] The court did find, however, that claims under, *inter alia*, the CWA, were "redressable by declaratory and injunctive relief," even though the allegedly harmful discharges were "infrequent and episodic, rather than continuing and ongoing violations."[163] Moreover, the court affirmed that a local clean environment group (the named plaintiff) had standing to sue equivalent to that of any individual plaintiff.[164]

In the context of the preceding discussion about CWA and other federal environmental criminal liability standards, the implications of a case like *L.E.A.D.* merit attention. Specifically, wider dissemination of neurotoxicity research is likely to be seized upon first by individuals seeking civil redress for environmental harms—individuals like those

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[158] *See generally* 1999 WL 124473 (E.D. Pa. 1999) (slip op.). "L.E.A.D." stands for Local Environmental Awareness Development.

[159] *See generally id.*

[160] *See* 504 U.S. 555, 560–61 (1992).

[161] *See id.*; *L.E.A.D.*, 1999 WL 124473, at *12.

[162] *See L.E.A.D.*, 1999 WL 124473, at *12.

[163] The court continued: "[w]e hardly see the difference . . . [e]ven if such violations are episodic; they have continued and there is no guarantee that they will cease." *Id.* at *19.

[164] In support of this conclusion, the Court relied on the *Powell Duffryn* test, which provides that an organization may be sued so long as "(1) the organization's members would have standing to sue on their own; (2) the interests that the organization seeks to protect are germane to its purpose; and (3) neither the claim asserted nor the relief requested requires individual participation by its members." *Id.* at *20 (citing Public Interest Research Group of N.J., Inc. v. Powell Duffryn Terminals, Inc., 913 F.2d 64, 70 (3d Cir. 1990)).

in the *L.E.A.D.* case. Such a push is likely to be especially acute with neurotoxicity research because of the highly negative behavioral consequences of the toxic exposure. The likelihood of such lawsuits will certainly lead to a demand for more stringent criminal prosecution of those involved in industries that pollute with toxic heavy metals.

If the liability standards used to enforce such prosecutions are not clarified, they will be subject to further inconsistent application. Following the Supreme Court's lead in regulatory crime cases, some courts can be expected to apply a common law general- and specific-intent rubric. As in *Weitzenhoff*, however, other courts may continue to struggle with the ambiguous definition of "knowing" acts in the criminal liability provisions of the federal environmental statutes. Thus, civil prosecutions of the federal environmental laws, whether advanced by state officers or in private citizen suits, are likely to open the door to greater uncertainty regarding the scope of the federal criminal environmental standards. Even in the civil liability context, therefore, neurotoxicity research underscores the need to amend federal criminal environmental standards, in order to insure the long-term, popular credibility of environmental prosecutions.

III. The Search for Solutions

A. *The Model Penal Code, Neurotoxicity, and Federal Environmental Criminal Liability*

A way out of this impasse is to rethink the criminal intent standards used in federal environmental enforcement. One possible option is to make clear that the intent categories contained in the MPC shall apply to the CWA's statutory definitions for criminal intent. This approach has the advantage of discarding the common law analysis that, as described in the previous section, has consistently proven so nettlesome.

The common law categories of "general" and "specific intent" stand in contrast to the "General Requirements for Culpability" set forth in the MPC.[165] In particular, the MPC takes what has been classified as an "elemental" approach to *mens rea*, meaning that a prosecutor need not establish culpability in the sense that the defendant's actions demonstrated "his bad character, malevolence, or im-

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[165] Model Penal Code § 2.02 (1980). Joshua Dressler observes that "[n]o aspect of the Model Penal Code has had greater influence on the direction of American criminal law" than this section. Dressler, *supra* note 76, at 120.

morality."[166] Instead, an elemental approach requires only that the prosecution establish "the particular mental state provided for in the definition of the offense."[167] Conceptually, the MPC's innovation requires more than proof of moral blameworthiness (a highly normative judgment); in addition, the MPC rejects the confusion of the common law distinction between "general" and "specific intent" crimes.

In their place, the MPC offers four statutory *mens rea* terms, including "knowingly," the mental state that must be established for most federal environmental crimes.[168] The MPC defines "knowingly" in two different ways, each of them with implications for the major federal environmental crimes, particularly because a statute like the CWA does not define "knowingly."[169]

First, an actor "knowingly" causes a result if he "is aware that it is practically certain that his conduct will cause such a result."[170] Consider the example of a battery-manufacturing plant. In the context of a CWA criminal prosecution, a "knowing" release satisfying this standard would be one, for example, where a corporate officer performed or authorized the release of lead-contaminated sludge into a point source at levels in excess of permitted requirements, fully aware that the release was not permitted and that lead has deleterious effects on the nervous system and other vital functions.[171] Alternately, one can be found to act "knowingly" under the MPC if one is "aware that his conduct is of that nature or that such [attendant] circumstances exist."[172]

Awareness of the harmfulness of the conduct is central.[173] Thus, in the example above, if the corporate officers in charge of discharges into the point source did not know that the lead-contaminated sludge contained lead in excess of permitted levels, they would not be guilty

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[166] DRESSLER, *supra* note 76, at 103.

[167] *Id.* (quotations without citations in original).

[168] The others are "purposely," "recklessly," and "negligently." *See* MODEL PENAL CODE § 2.02.

[169] As of 1990, it does, however, define "knowing endangerment," a separate criminal offense from "knowing violations." *See* 33 U.S.C. § 1319(3)(B)(i) (West 1999).

[170] MODEL PENAL CODE § 2.02(2)(b)(ii).

[171] In the case of environmental lead, this would not be particularly difficult to establish. *See supra* notes 27–31 and accompanying text.

[172] MODEL PENAL CODE § 2.02(2)(b)(i).

[173] See DRESSLER, *supra* note 76, at 122.

of a "knowing" crime. If decided under this standard, a number of environmental convictions may not have resulted in liability.[174]

Importantly, however, the MPC requires proof of each and every element of the crime, and conviction might still be possible under a MPC standard in those cases where "attendant circumstances" are established. Even if a person was unaware of the conduct that caused harm (the actual discharge in excess of permitted levels), it nonetheless might be possible to establish a "knowing" violation. For instance, if the corporate officers in the above example knew that there had been a problem at the facility with reducing the amount of lead in the sludge to permitted levels, and had not taken efforts to address it, a knowing violation might well be found.

Moreover, the MPC makes special provision for dealing with instances of "willful blindness."[175] Jurisdictions differ as to what can constitute willful blindness. In some jurisdictions, the MPC's willful blindness proscription applies only if a person has "actual knowledge" or a "correct belief" of the harmful act. Thus, for example, if the corporate officers in the above hypothetical noticed that sludge discharges from their plant were colored or textured in a way typical of unpermitted lead discharges, they might be found to have personally observed its presence and therefore to have had "actual knowledge." Similarly, they might thus be said to have a "correct belief," even though they did not definitively know—or have had "actual knowledge"—of the unpermitted discharge.[176]

A number of other jurisdictions also allow a finding of knowledge "if the person is aware of a high probability of the existence of the fact in question, and he deliberately fails to investigate in order to avoid confirmation of the fact."[177] To again use the above hypothetical, willful blindness under the MPC would exist so as to establish a "knowing" violation if a corporate officer noticed unusual sludge discharges and failed to ask pertinent questions, while knowing full well that lead is a health danger (this last claim is clearly one that would easily be established for anyone in the industry).

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[174] *See generally* United States v. Weitzenhoff, 1 F.3d 1523 (9th Cir. 1993).

[175] *See* DRESSLER, *supra* note 76, at 110.

[176] *Cf. id.* at 109–10.

[177] *Id.* at 110 (citing cases from the Fifth and Ninth federal circuits and from the Nebraska and North Carolina Supreme Courts); *see also* Eric A. Dubelier, *Mens Rea Element in the Prosecution of Export Control Cases After Ratlaf v. United States*, 733 PLI/Comm. 791, 817 (Practicing Law Inst., Oct. 2, 1995) (discussing *Weitzenhoff*, 1 F.3d at 1523).

Readers may be struck by the extent to which the CWA's "knowing" standard is very much like the one applied in the vast majority of criminal environmental prosecutions. That is, despite the Supreme Court's effort to apply the common law categories of "general" and "specific intent" in regulatory criminal prosecutions, as noted by Mandiberg,[178] the lower courts, in fact, have applied a standard very much like that advocated in the MPC. Contrary to Lazarus' suggestion,[179] then, rather than crafting an ultimately unworkable standard in regulatory crimes cases, the lower courts have struggled to apply federal criminal environmental standards according to a well-established and manageable analytical protocol.

A couple of examples make this clear. *United States v. Boldt* involved the criminal prosecution of managers of a plant that used toxic metals to plate electronic circuit boards.[180] In *Boldt*, the defendant was charged with a knowing criminal violation of the CWA when he permitted overflow from the company's "inadequate" wastewater pretreatment facilities to be discharged into the city sewer system.[181] The overflow was completely untreated and contained toxic heavy metals. The defendant insisted that he was not directly responsible for the discharge. In a separate count, the defendant was charged with directing a subordinate to manually add a caustic chemical to a pretreatment tank and, when this effort was unsuccessful, to dump a tankful of partially treated wastewater into the city sewer. With respect to these charges, the defendant intimated that he felt he had little alternative since the tanks were about to overflow and, in any case, that he was effectively prevented from stopping the discharge due to internal corporate pressures.[182]

The court disagreed, sustaining the defendant's conviction. As for the defendant's tolerance of the direct discharge of untreated toxic wastes, the court found that "the evidence showed that [defendant] was aware of the practice of bypassing the pollution control system and had condoned it on the occasion at issue."[183] Regarding the second charge that the defendant had ordered a subordinate to discharge partially treated toxic wastes, the court observed that "there is no dispute that [defendant] directly ordered his subordinate to dump

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[178] *See supra* notes 104–06 and accompanying text.
[179] *See supra* notes 108–09 and accompanying text.
[180] *See generally* 929 F.2d 35 (1st Cir. 1991).
[181] *See id.* at 37.
[182] *See id.* at 38.
[183] *Id.* at 39.

the copper wastewater."[184] In other words, the court disagreed with the defendant's claims that any other alternative was impossible, or that his actions were necessary.[185]

In the context of the argument advanced in this Article, what is especially striking about the *Boldt* analysis is the extent to which it applies the logic of the MPC for "knowing" criminal violations. In *Boldt*, the defendant clearly was "aware that it [was] practically certain that his conduct [would] cause" the result that led to his conviction, and so satisfied the first prong of the MPC's analysis of "knowing" crimes.[186] In addition, the defendant was "aware that his conduct [was] of that nature or that such [attendant] circumstances exist," and therefore satisfied the awareness prong of the MPC's analysis.[187] Furthermore, under even the least generous of the willful blindness tests adopted pursuant to the MPC, the eponymous defendant in *Boldt* demonstrably had "actual knowledge" and a "correct belief" of the harmful act, even though he did not actually perform the act. In short, Boldt's culpability was appropriately established under the CWA using an MPC analysis.

The same conclusion applies even where the facts are somewhat more problematic in terms of applying the MPC's "knowing" standard. In *United States v. Brittain*, the defendant, a city public utilities director, was found guilty at a jury trial of a criminal misdemeanor violation of the CWA.[188] In particular, he was charged with tolerating discharges of raw sewage into a point source, and then directing a subordinate not to report this permit violation to the EPA, as required by the terms of the permit. Viewed in light of the MPC categories and a "knowing" violation analysis, the facts of *Brittain* are problematic only because the CWA then applied a "willful" or "negligent" standard in the criminal section that today applies a "knowing" standard.[189] Nonetheless, it is fair to conclude that although the defendant was found guilty under a negligence standard, he would almost certainly be found guilty if a "knowing" standard had been applied.

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[184] *Id.*

[185] *See Boldt*, 929 F.2d at 40.

[186] MODEL PENAL CODE § 2.02(2)(b)(ii) (1980).

[187] *Id.* § 2.02(2)(b)(i).

[188] *See generally* 931 F.2d 1413 (10th Cir. 1991).

[189] *See id.* at 1418; *see also* Lazarus, *Meeting the Demands*, *supra* note 103, at 2454 (discussing the implications of a "willful" as opposed to a "knowing" environmental crime). *But see* Schiffer & Simon, *supra* note 103, at 2531, 2536 (questioning Lazarus's view).

This can be seen by looking at the facts leading to the defendant's conviction. The defendant was told that raw sewage was being discharged from a permitted outfall, and "physically observed two such discharges."[190] As in *Boldt*, therefore, even though the defendant did not personally perform actions that led to the discharge, he was "aware that it [was] practically certain that his conduct [would] cause" the result that led to his conviction and, again as in *Boldt*, demonstrated the awareness of the consequences of his conduct needed to establish a "knowing" CWA violation.[191] The court further offered observations that left little doubt as to the defendant's "knowing" violation under the CWA's MPC-like analysis:

> [D]efendant had primary operational responsibility for the treatment plant. . . . Defendant was informed that such illegal discharges were prone to occur during heavy rains and that he reviewed logs recording repeated illegal discharges. . . . It appears from the plant supervisor's testimony that he discussed illegal discharges with defendant several times over a period of years and that the discharges were never reported.[192]

Given such facts, it is unnecessary to perform a "willful blindness" analysis; the defendant's actions clearly satisfied the basic "knowing" violation elements.

The advantage of applying these MPC standards in the case of federal environmental criminal prosecutions—instead of the common law "general" and "specific intent" standards—is that they provide greater intellectual clarity. They do so in two ways. First, they remove the judgment as to the degree of harm a person causes to the public welfare. Second, demonstration of some additional malicious intent is not required.[193] Thus, adoption of the MPC standards uses a more objective standard than does the common law of "general" and "specific intent."

This distinction, in turn, would help resolve the central concern about environmental liability noted by the *Weitzenhoff* court, namely

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[190] *Brittain*, 931 F.2d at 1418.

[191] MODEL PENAL CODE § 2.02(2)(b)(ii).

[192] *Brittain*, 931 F.2d at 1420.

[193] That is, the key questions asked to determine if a defendant had the requisite "special" intent are removed.

the question of whether "knowingly" means a knowing violation of the law or simply knowing conduct that is violative of the law.[194]

Ideally, to insure the continuing credibility of criminal prosecutions under the CWA and similar federal environmental statutes, congressional statutory amendment is desirable. Specifically, the "knowing" and "knowing endangerment" standards require explicit definition according to MPC standards. Thus, federal environmental statutes should clarify that in order to establish a "knowing" violation it is necessary either to demonstrate a defendant's certainty that a result will follow from actions or, at a minimum, satisfy the Code's concept of "willful blindness."

Alternately, statutory amendment might clarify the approach taken in *United States v. Johnson & Towers, Inc.*[195] In that case, the court concluded that a knowing environmental crime is one where defendants knew that the activity in which they were engaged required a permit but that they failed to obtain one. In addition, however, the court added that while this approach required prosecutors to demonstrate that all elements of the offense were "knowing," "the district court may also instruct the jury that such knowledge may be inferred."[196] Such an approach is consistent with both the statutory language and a MPC-influenced reading of the statute that dispenses with "general" and "specific intent"-like readings, and would emphasize the need to know of an actual permit, thereby allowing for good faith errors. Thus, even in light of neurotoxicity-informed discharge standards, such an amendment would likely result in fewer prosecutions. The possibility of inferring knowledge, however—if, for example, a person's job responsibilities suggest that they should have known that an activity was permitted—would target real malefactors. This approach would put a greater burden on regulators than on the regulated by focusing on the permit itself rather than on the nature of the harm.

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[194] *See generally* United States v. Weitzenhoff, 1 F.3d 1523 (9th Cir. 1993).

[195] *See generally* 741 F.2d 662 (3d Cir. 1984). Although *Johnson & Towers* is a RCRA case, the similar structure of the "knowing" language means that this point applies with equal force to other federal environmental criminal provisions like that of the CWA. *See generally id.*

[196] *Id.* at 670. It seems likely that mere position in an organization is likely not enough to infer knowledge; rather, *some* amount of intent probably need be shown. *See, e.g.*, United States v. MacDonald & Watson Waste Oil Co., 933 F.2d 35, 40–56 (1st Cir. 1991); HARRIS ET AL., *supra* note 135, § 5.08.

B. *Concerns About Statutory Reform*

This is not to suggest, however, that statutory amendments explicitly defining knowledge in terms of MPC standards would entirely resolve concerns about federal environmental criminal liability. While the more objective MPC standards represent an improvement over the common law criminal liability standards, they are far from perfect, since an inquiry into a defendant's awareness may result in some degree of subjective assessment as to motive—sometimes based entirely on circumstantial evidence and inferences from that evidence.

Nonetheless, the MPC standards unquestionably represent an improvement over the use of liability standards derived from the common law. Imagine, for instance, facts similar to those in *Boldt* or *Brittain* but involving releases of lead, cadmium, or manganese at levels once classified as "sub-clinical" but, in light of evidence supporting the Neurotoxicity Hypothesis, were recently classified by the EPA as levels below which discharges are not permitted. Further imagine that, knowing of this recent reclassification but disagreeing with it, believing such reclassification to be an instance of unnecessary, overzealous regulation, a lead battery manufacturing plant supervisor allowed discharge of toxic sludge into a point source at an unpermitted level. In that event, as *Boldt* and *Brittain* make clear, a criminal conviction under section 1319 of the CWA would be appropriate. Moreover, as the above analysis suggests, such a conviction would accord with the MPC definitions for the CWA's statutory standards, although not with the common law regulatory protocol recently articulated by the Supreme Court.

Finally, another alternative raised by the Neurotoxicity Hypothesis is that criminal penalties for discharges should be reduced, provided that environmental statutes are correspondingly revised to increase civil penalties. For instance, as indicated previously, neurotoxicity researchers posit that preventing neurotoxic contamination that may lead to violent criminal behavior may be relatively inexpensive.[197]

Conclusion

The above analysis confirms that further data validating the Neurotoxicity Hypothesis is likely to result in increased convictions under the CWA and other federal environmental statutes, assuming revised

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[197] *See supra* note 28 and accompanying text.

discharge standards. Such convictions, importantly, will occur because it will be possible to satisfy the MPC-influenced mental state requirements contained in the CWA's principal criminal provision. Arguably, this is a fair result. On the one hand, the Neurotoxicity Hypothesis is likely to lead to a heightened degree of responsibility for industries that handle neurotoxic metals, at a risk of criminal prosecution. On the other hand, if such prosecutions proceed under federal statutes that clearly define "knowing" violations according to MPC *mens rea* standards, industries will not face the uncertain and highly subjective possibility of being classified as "public welfare" offenders. In the event that the volume of neurotoxicity-related prosecutions under the environmental statutes increases, violators could be forced to help pay for the costs of preventing future contamination by making significant contributions to nutrition and preventative medical programs, in addition to reducing discharges of toxic materials.

To the extent that neurotoxicity data remains controversial, for the reasons outlined above,[198] an increase in such prosecutions could well lead to increased calls from industries that use any of these toxic elements in their production to amend the CWA and other federal environmental criminal laws; industry's demand surely would be to make it much more difficult to secure convictions. It can only be

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[198] This is not to say that, even if federal environmental criminal liability standards are made less ambiguous, that no problems are likely to arise. This is likely to be especially true in instances in which convictions are sought despite the defendant's lack of knowledge about having committed a *legal* violation. For example, in the above hypothetical, suppose that in light of increased contamination to a public waterway, the facility was ordered to cut its discharge of toxics-contaminated waste in half. Suppose that, as in the case of *California Public Interest Research Group v. Shell Oil Co.*, 840 F. Supp. 712 (N.D. Cal. 1993) (which, it should be noted, involved only civil violations of the CWA), the EPA permit revised the facility's discharge of combined lead and cadmium waste to ten pounds per day, such limits "intended to be a cap on current performance." Further assume that the facility admits that it was in violation of the ten pounds per day standard, but claims that it cannot be liable for a knowing violation unless *both* the numeric standard and the "narrative" standard—meaning the language referring to the cap on current performance—are exceeded. This is because, the defendant facility maintains, the revised permit allows for liability "only if there is a change in its 'current performance' or operations." *Id.* at 716. Notwithstanding the lawyerly quality of such a contention, it is fair to observe that, even under MPC standards, a defendant might well have doubted whether she/he was in violation of a permit so long as ambiguity existed in the terms of the permit, and therefore would maintain that no "knowing" violation occurred, despite knowing that the discharged substances were of concern as possible health threats. A solution to such a concern may be more careful drafting of unambiguous permits. The facts of *Shell Oil* suggest that this will be especially important as the neurotoxicity hypothesis is further supported, in light of the probability that it will result in increased criminal environmental prosecutions, or at least the possibility of them. *See id.*

hoped, however, that as the Neurotoxicity Hypothesis is more convincingly supported with hard evidence, the need for the very real threat of criminal prosecution—or some comparable civil deterrent—will continue to be recognized. The overwhelming social interest in maintaining the recent, celebrated declines in violent criminal behavior should never be forgotten.[199]

The data undergirding the Neurotoxicity Hypothesis mounts every month, and therefore demands the attention of lawyers and policymakers. At the very least, it will present real challenges to those who continue to insist upon the importance of the notion of *mens rea* as a—if not the—fundamental tenet of our system of criminal justice. That is, if violent criminals can establish significant evidence of childhood neurotoxic contamination, they will have powerful affirmative defenses to any charges brought against them. This will certainly be true at the sentencing stage, if less so at the conviction stage.

Similarly, the demonstrated link between neurotoxicity and crime likely will result in the increased conviction of those responsible for neurotoxic damage. This Article has outlined some of the ways in which this is so. It is hoped that the Article will also go some distance towards furthering the call for clarification of the liability standards contained in our nation's federal environmental laws. Failure to do so risks calling the fundamental integrity (and successful application) of those laws into serious question.

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[199] *See supra* notes 24–27 and accompanying text.