TECHNOLOGIES OF ACCIDENT:
FORENSIC MEDIA, CRASH ANALYSIS, AND THE REDEFINITION OF PROGRESS

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ABSTRACT

GREG SIEGEL: Technologies of Accident: Forensic Media, Crash Analysis, and the Redefinition of Progress
(Under the direction of Lawrence Grossberg)

This study suggests that by the mid-twentieth century, transportation accidents were no longer thought to be something that could be eradicated through the eradication of human error. Neither were they something to be simply accepted. Instead, they were something to be expertly monitored and measured, scrutinized and analyzed, explained and contained. To these ends, transportation accidents were subjected to rigorous investigation and controlled experiment, and new means and methods were designed and implemented to technologically write, scientifically read, and institutionally manage them.

Technologies of Accident advances three basic propositions: (1) the transportation accident was made into an object of scientific and institutional analysis, knowledge, and control in the United States during the 1940s and ’50s; (2) the transportation accident, regarded in the nineteenth century as an impediment to technological progress, was reconstituted in the twentieth as a catalyst for technological progress; and (3) accident technologies and forensic media such as the flight-data recorder, the cockpit-voice recorder, and the high-speed motion-picture camera embodied and enabled the twin transformations described in the first two propositions.

This study examines the origins and implications of a cultural and institutional project driven by two interrelated imperatives: discover the transportation accident’s “truth” (in the name of history or science) and discipline the transportation accident’s signification (in the name of education). Particular attention is paid to how accident technologies and forensic media articulated and were articulated by their cultural and discursive contexts, as well as the ways in which they rearticulated earlier technocultural imaginings and practices.

To my mom and my dad,
for a lifetime's worth of support, encouragement, and love.

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I came to graduate school to study popular music with Larry Grossberg, the best and biggest name in the field. For reasons that still aren't entirely clear to me, I realized early on that my heart wasn't into researching and writing about popular music from a scholarly perspective (even though I enjoyed and continue to enjoy teaching courses on the subject). Instead, my interests and inclinations led me to study, of all things, the use of large-screen video displays in sports stadiums. I am glad that I decided to keep working with Larry during my years as a Master's student, and I am grateful that he allowed me to keep working with him. Yet I am even more glad and grateful to have worked with Larry during my years as a Ph.D. student. Here again, I chose an unusual topic for an aspiring media and cultural studies scholar: the use of "forensic media" to record, represent, or reconstruct transportation accidents. I thank Larry for his open mind and willingness to let me follow my muse into such strange and uncharted territory. I thank him, too, for helping me make sense of and map out that territory. Through oral conversation and written commentary, Larry brought his deep erudition and massive intellect to bear on my ideas and words in ways that were motivating, fascinating, challenging, and heartening. What's more, in his role as advisor, Larry seemed to know just when to nudge me along and, equally important for someone of my temperament, just when to leave me alone. Finally, I am indebted to Larry for offering sound counsel and moral support during some very difficult times, personal and professional. I couldn't have asked for a better mentor, collaborator, and friend.

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Whoever smugly rubs their hands in remembrance of the sinking of the Titanic because the iceberg supposedly dealt the first blow to the thought of progress, forgets or suppresses that this unfortunate accident, otherwise in no way fateful, prompted measures which guarded against unplanned natural catastrophes in shipping during the following half-century. It is part of the dialectic of progress that the historical setbacks which are themselves instigated by the principle of progress — what would be more progressive than the race for the blue ribbon? — also provide the condition for humankind to find means to avoid them in the future.

— Theodor Adorno[1]

Any scientific progress implies accident progress.

— Paul Virilio[2]

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[1] Theodor Adorno, "Progress," Benjamin: Philosophy, History, Aesthetics, ed. Gary Smith (Chicago: U of Chicago P, 1989) 94.

[2] Paul Virilio, "Paul Virilio on the Accident," interview with Thomas Boutoux, trans. Rosemary McKisack, Flash Art International Jan.-Feb. 2003 <http://www.flashartonline.com/issues/228international/virilio.asp>.

INTRODUCTION

PROGRESS AND THE PROBLEM OF THE ACCIDENT

Whatever Can Go Wrong

I begin with a story about accidents.

From April 1947 to June 1951, more than 250 rocket-sled experiments using animals, humans, and anthropomorphic dummies were conducted at Edwards Air Force Base (then known as Muroc Army Air Field) in California’s Mojave Desert. The stated purpose of the experiments was to study the strength of airplane seats and harnesses under simulated crash conditions and to determine the limits of human tolerance to rapid deceleration. Air Force officer and flight surgeon John Paul Stapp directed the experiments, and he himself often served as a test subject, the only live human to do so.

One day in 1949, after an especially punishing ride on the “Gee Whiz” rocket-sled, experimenters discovered to their dismay that all sixteen electrical sensors, which had been so carefully affixed to various parts of Stapp’s body, had malfunctioned. In fact, they had failed to register any information whatsoever. Instead of yielding a meaningful numerical value, each sensor read “zero.” Perplexed, the team of researchers sought to ascertain the cause of the malfunction. Why didn’t the instruments generate any data? What went wrong? The problem, it turned out, was that the sensors had been improperly attached to the test subject: they had been put on backward. Upon learning of the mishap, Captain Edward A.

Murphy, Jr., one of the test technicians, remarked in frustration, “Whatever can go wrong, will go wrong.” Thus was born “Murphy’s Law.”

As Murphy’s Law is a major popular expression, so the story of its origins is a minor popular legend. And like all popular legends, that story has many different and conflicting versions, any or all of which might be apocryphal. At least five key aspects of the Murphy’s Law story are in dispute: who/what was riding the rocket sled; why the sensors did not work; whose fault it was; who uttered the famous words; and what exactly those words were.

In most accounts, Stapp rode the sled, but in at least one account the test subject was a chimpanzee.[3] In some retellings, the sensors were attached incorrectly; in others, they were defective to begin with. (The quantity of sensors also varies from one version to the next.) It was Murphy’s fault, or his assistant’s fault, or the sensor manufacturer’s fault. Murphy made the famous statement; Stapp made the famous statement. (Conversely, there’s also the question of who made the statement famous: Who popularized it, and how?) Then there’s the wording of the “law” itself. “If there is any way to do it wrong, he [an anonymous test technician] will.” “If there’s any way they [the team of test technicians] can do it wrong, they will.” “If anything can go wrong, it will.” “If it can happen, it will.” “If that guy [Murphy’s assistant] has any way of making a mistake, he will.” “If there’s more than one way to do a job, and one of those ways will result in disaster, then somebody will do it that way.” “Whatever can go wrong, will go wrong.”

Which, if any, of these versions is “true” does not much matter for our purposes. What matters, rather, is the <u>popular</u> truth embodied in the story and expressed in the saying. The Murphy’s Law story is a parable about the many kinds of failure and frustration endemic

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[3] For information on the various versions of Murphy’s Law, I relied on Nick T. Spark, “The Fastest Man on Earth,” <u>Annals of Improbable Research</u> Sept.-Oct. 2003: 4-24.

to contemporary human-technology relations. It points to the irreducible complexity of those relations and to the unruly contingencies that trouble them. It implies the inevitability of the accidental.

Accidentality is doubly implicated in the narrative: it is text and subtext. The accident operative at the textual level is the problem with the sensors. Depending on the version, the accident lies in the misapplication of the sensors, or in their malfunction. The contrast between these two versions is instructive, because it effectively thematizes a constitutive tension in human-technology relations. On the one hand, accidents are the result of human error: somebody screwed up and put the sensors on backward. On the other hand, accidents are the result of mechanical failure: the sensors didn't do what they were supposed to do. The tension here is between a moralist and an amoralist exegesis of the accidental. Is some <u>one</u> to blame? Or some <u>thing</u> to blame? And further, if some thing is to blame, is it really the thing's fault? Or should blame be traced back to another human, such as the manufacturer? Are humans inherently fallible, or are machines inherently unreliable? In any case, the problem with the sensors illustrates the fraught relationship between humans and technologies.

Yet what makes the Murphy's Law story more than a simple anecdote about a single accident is its ironic subtext. The irony is this: Stapp's rocket-sled research was accident research. In fact, it was state-of-the-art accident research. As I explain in Chapter Three, the corporal effects of transportation accidents had never before been studied with such scientific precision and technological sophistication. The experiments were extremely complex and dangerous, and extraordinary steps were taken to ensure the smoothness and safety of the operation. Even still, the accidental proved irrepressible. Hence, the ultimate meaning of

Murphy's Law: the accident thwarts even the most "advanced" attempts to tame it. Its demons have the power to disturb even the scene of their own exorcism.

Like the story of the origins of Murphy's Law, Technologies of Accident is about the attempt to technoscientifically tame the transportation accident in the postwar period. And like the saying, it is about the inevitable inability to ever fully do so.

The discussions of modernity, technological accident, and technological progress in the next two sections are meant to provide a broad historical and conceptual framework for this study. I offer them as a way to ground the narrower histories and more focused analyses in the chapters that follow.

Accidentality and Modernity

In the introduction to their edited volume, Accidents in History, Roger Cooter and Bill Luckin lament the lack of historiographical work on accidents and the accidental.[4] Part of the blame for this deficit, Cooter and Luckin contend, falls with Whiggish economic and technology historians who conceptualize complex processes of economic or technological change in terms of "logical successors." Part of the blame falls with medical historians who reduce the social history of the accident to the history of occupational health, "which highlights institutional and administrative structures rather than the social experience of sudden death and injury."[5] And, finally, part of the blame falls with sociologists of "risk" who too often take for granted the naturalness and political neutrality of accidents. In each of

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[4] Roger Cooter and Bill Luckin, "Accidents in History: An Introduction," Accidents in History: Injuries, Fatalities and Social Relations, ed. Roger Cooter and Bill Luckin (Amsterdam: Rodopi, 1997) 1-16.

[5] Cooter and Luckin 1-2.

these cases, the accident tends to be treated uncritically, uncontextually, and ahistorically, if it is treated at all. It is likely to be regarded, at least implicitly, as an isolated event, a chance occurrence unconnected to wider social structures and forces, something that bursts into the historical scheme of things haphazardly. Accidents and the accidental do not demand serious historiographical study because, tautologically, they are inherently ahistorical. Arguing against this position (and the transcendentalist epistemology that underpins it), Cooter and Luckin want to redeem the accident for serious historiography by insisting on its profound social and historical imbrication.

Judith Green's essay, "Accidents: The Remnants of a Modern Classificatory System" provides a useful way of beginning to think about the relationship between modernity and accidentality.[6] Keen to stress the social constructedness of the accident, Green reminds us that while "misfortunes are probably universal to human society, ways of classifying them, understanding them and dealing with them are not. In contemporary cultures, accidents are an important category of misfortunes."[7] Following Green, we can say that the accidental is crucial to Western modernity because it works to stabilize the fault line between deterministic rationalities inherited from the Enlightenment, on the one hand, and probabilistic rationalities produced in the nineteenth century, on the other, without resorting to explanations rooted in either "primitive" or providential cosmologies. Put differently, the accidental is ideologically indispensable because it fills in the gap between that which modern reason and science know or can know with certainty (deterministic laws) and that

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[6] Judith Green, "Accidents: The Remnants of a Modern Classificatory System," Accidents in History: Injuries, Fatalities and Social Relations, ed. Roger Cooter and Bill Luckin (Amsterdam: Rodopi, 1997) 35-58.

[7] Green 35.

which modern reason and science know or can know only with probability (statistical regularities).

Consider, in this connection, the role of the accident in nosology, the branch of modern medicine that deals with the classification of diseases. Here, as Green notes, the accident

> is an event for which there was no motivation, but which lay on a boundary between the need for a cause, as all fatalities must now be accounted for, and the lack of a "real" cause as defined by the new scientific principles of statistics. . . . [By] 1839, accidents had become the residual category of medical classifications of causes of death: those which occurred with no known medical cause, or at least none that fitted into the rational system of medical knowledge.[8]

With the emergence of the statistical sciences in the nineteenth century, allied as they were with what Ian Hacking calls "the erosion of determinism" and "the avalanche of printed numbers," the medically defined accident becomes something excessive to the system and, at the same time, an excess the system requires for self-coherence and self-completion.[9] The accident is supplementary, in the Derridian sense, to the medical order. "The limits to this new [probabilistic] cosmology, in which death rates and the behavior of populations were as worthy of study as the physical laws which were seen to govern the universe, necessitated a category of events which could not be explained."[10] By trading on what Culture of Accidents author Michael Witmore calls "the curious ontological status of the accident," by making a

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[8] Green 49.

[9] Ian Hacking, The Taming of Chance (Cambridge: Cambridge UP, 1990) passim.

[10] Green 46.

necessity of the accident's very liminality, nineteenth-century medical science was able to rationalize what it could not really explain.[11]

As I alluded above, Western modernity constructs the accidental as an explanatory category antithetical to "primitive" magic, providential theology, and other "superstitious" ways of thinking. For colonial anthropologists such as Lucien Levy-Bruhl and E. E. Evans-Pritchard, a culture's ability to conceptualize the accident's irreducible accidentality — to acknowledge and accept that some things "just happen" — is precisely the mark and the measure of reason and enlightenment.[12] "Uncivilized" peoples have no conception of chance, contingency, or coincidence: every occurrence is willed and fraught with moral meaning; everything happens for a reason. In this worldview, there are no such things as accidents, strictly speaking. Witmore has shown how a similar epistemology of the accident operated in the early modern period, for example in John Calvin's belief in "special providence," which "dictated that all events, no matter how unexpected or inconsequential, are actively brought about by a 'disposing' God."[13] Modern populations, by contrast, are supposed to understand that some events in the world happen without motivation and, therefore, contain no intrinsic meaning. Modernity makes the accident possible as such.

Octavio Paz writes:

> In every civilization, including the first period of our own (medieval Catholicism), earthquakes, epidemics, floods, droughts, and other calamities were seen as a supernatural aggression. . . . Modern science has eliminated

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[11] Michael Witmore, Culture of Accidents: Unexpected Knowledges in Early Modern England (Stanford: Stanford UP, 2001) 10.

[12] Green 37-39. I should make clear that I am not endorsing the ethnocentrism that permeates Levy-Bruhl's and Evans-Pritchard's anthropological assumptions. My intention, rather, is to emphasize the pivotal position occupied by the accidental in the cultural imaginary of modernity.

[13] Witmore 2.

> epidemics and has given us plausible explanations of other natural catastrophes: nature has ceased to be the depository of our guilt feelings; at the same time, technology has extended and widened the notion of the accident, and what is more, it has given it an absolutely different character.[14]

To claim, as I have, that in modernity the accidental performs an important ideological function is not to say that the accident is ideologically unproblematic. On the contrary, the accident in modernity is arguably more ideologically problematic than ever. This is because, as Paz suggests, as soon as it is articulated to industrial machinery and technology, the accident takes on "an absolutely different character."

Exactly what Paz has in mind by this phrase is not entirely clear, but it seems to me that the technological accident's differential specificity hinges, in large part, on the differential specificity of the terror it activates and articulates. Sometimes the terror of the technological accident lies in the enormous scope and scale of its devastation (oil-tanker spills, nuclear meltdowns, electrical blackouts, chemical-plant releases). Sometimes it lies in the breathtaking speed and suddenness of its irruption (train wrecks, plane crashes, automobile collisions, space-shuttle explosions). In any case, what ultimately makes the technological accident so terrifying, I would argue, is the way in which it exposes the body to new kinds of danger, opens it up to new kinds of wounds, inflicts on it new kinds of violence. As Wolfgang Schivelbusch notes, the first wave of medical literature on railroad accidents, dating from 1866, argued that railroad accidents "did not differ from other accidents in principle but in the degree of violence, with the additional observation that that degree was a new and previously unknown one."[15] The accident in the age of heavy machinery and high

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[14] Octavio Paz, Conjunctions and Disjunctions, trans. Helen R. Lane (New York: Viking, 1974) 110-111.

[15] Wolfgang Schivelbusch, The Railway Journey: The Industrialization of Time and Space in the 19th Century (Berkeley: U of California P, 1986) 139.

technology is terrifying because it turns the body-technology interface into a place where previously unknown corporal and existential vulnerabilities, incapacities, and insecurities are produced and experienced. And in a disenchanted and desacralized world, in a natural order exorcised of our “guilt feelings,” there is no one to implicate — or, for that matter, propitiate — but ourselves.

Yet there is another sense in which the technological accident is ideologically problematic: it threatens the sovereignty of science and, correlatively, the secular faith in progress.

The Question of Progress

Jennifer Daryl Slack and J. Macgregor Wise observe that research in the cultural studies of technology has often critically engaged three central questions, or problematics, concerning the relationship between technology and culture: the question of causality; the question of technological dependence; and the question of progress.[16] The first problematic asks whether technology drives social and cultural change, or vice versa. Is technology intrinsically politically effective or intrinsically politically neutral? The second problematic wonders if we (inhabitants of industrialized societies) have, in effect, become slaves to the machines we have created, and the third inquires into the relationship between technology and progress.

Slack and Wise contend that cultural studies works with and against these problematics by recognizing and critiquing the ways in which they have shaped

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[16] Jennifer Daryl Slack and J. Macgregor Wise, “Cultural Studies and Technology,” Handbook of New Media, ed. Leah A. Lievrouw and Sonia Livingston (London: Sage, 2002) 486-487.

understandings of, and debates about, the relationship between technology and culture.[17] This study aims, in part, to provide such a critique. The question of technology's political effectivity or neutrality, for instance, comes up in Chapter Three in relation to early twentieth-century discourses of automobility and accident. And insofar as the question of the dangers of our technological dependence haunt every image, account, artifact, and experience of transportation crash and catastrophe, the whole of Technologies of Accident can be said to intersect the second problematic. However, it is the third problematic, the question of progress, with which this dissertation is most directly concerned.

According to Robert Nisbet, author of History of the Idea of Progress:

> the idea of progress holds that mankind has advanced in the past — from some aboriginal condition of primitiveness, barbarism, or even nullity — is now advancing, and will continue to advance through the foreseeable future. In J. B. Bury's apt phrase, the idea of progress is a synthesis of the past and a prophecy of the future. It is inseparable from a sense of time flowing in unilinear fashion.[18]

Nisbet identifies two closely related but distinguishable propositions underlying the notion that human history is a record of inexorable advancement from the inferior to the superior.[19] The first proposition is that both the quantity and the quality of human knowledge, embodied in the arts and sciences, have been increasing or improving, and will continue to increase or improve, through time. Where the first proposition emphasizes humankind's material advancement, the second emphasizes its moral advancement, evidenced in the steady accumulation and ever-widening dissemination of abstract virtues such as freedom,

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[17] Slack and Wise 486-487.

[18] Robert Nisbet, History of the Idea of Progress (New Brunswick: Transaction, 1994) 4-5. I have omitted Nisbet's emphasis.

[19] Nisbet 5.

happiness, and serenity. This proposition is bound up with a belief in human perfectibility and, further, with the idea that history is nothing other than human perfectibility's gradual realization.

The concept of progress has a long history in the West. Nisbet traces the notion all the way back to ancient Greece, claiming that "No single idea has been more important than, perhaps as important as, the idea of progress in Western civilization for nearly three thousand years."[20] This is not to say that the idea has remained the same, or even consistent, over the course of three millennia. On the contrary, its specific meanings and uses — particularly its political uses — have mutated in complex relation with the social, cultural, and historical contexts they have articulated and have been articulated by. In other words, Nisbet's two propositions notwithstanding, "progress" meant one thing for the ancient Greeks, another for Europeans of the Middle Ages, and yet another for Europeans and Americans of the eighteenth and nineteenth centuries. Yet, as Bruce Mazlish and Leo Marx argue, only in the latter case — that is, "only in the West, during the modern era" — did the idea "come to dominate the worldview of an entire culture."[21]

Significantly, what distinguished the "progress" of the eighteenth and nineteenth centuries from historically prior definitions of progress was its inextricable intertwining with a widespread and seemingly unshakeable faith in modern science and technology. In Leo Marx's view, "the full-blown modern concept of Progress" derived from the pervasive perception of man's double domination of nature: first by means of Enlightenment science

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[20] Nisbet 4.

[21] Bruce Mazlish and Leo Marx, "Introduction," Progress: Fact or Illusion?, ed. Leo Marx and Bruce Mazlish (Ann Arbor: U of Michigan P, 1996) 1. Contrary to Mazlish and Marx, Nisbet contends that "from Hesiod and possibly Homer on, the faith in progress has been . . . the dominant faith" (Nisbet 4). I find Mazlish and Marx's claim to be the more convincing of the two.

(knowledge about nature), then by means of Industrial Age technology (power over nature).[22] Along these same lines, Siegfried Giedion states: “Eighteenth-century faith in progress as formulated by Condorcet started from science; that of the nineteenth century, from mechanization. Industry, which brought about this mechanization with its unceasing flow of inventions, had something of the miracle that roused the fantasy of the masses.”[23] Indeed, by the second half of the nineteenth century, with the “miracle” of mechanization in full swing in Western Europe and the United States, moral and social progress had become powerfully identified with — or, as Lewis Mumford implies, tragically reduced to — technological progress:

> The notion that the machine by reason of its rationality of design and its austere perfection of performance was now a moral force, indeed the moral force, one that set new standards of achievement for man, made it easier to equate the new technology, even in its most sordid manifestations, with human improvement.[24]

This was especially the case in America, where the visible, audible, and palpable presence of mechanical marvels — the railroad and the telegraph chief among them — seemed to leave little doubt as to the superiority of the present to the past. “During the nineteenth century,” Marx writes, “no one needs to spell out the idea of progress to Americans. They can see it,

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[22] Leo Marx, “The Domination of Nature and the Redefinition of Progress,” Progress: Fact or Illusion?, ed. Leo Marx and Bruce Mazlish (Ann Arbor: U of Michigan P, 1996) 202.

[23] Siegfried Giedion, Mechanization Takes Command: A Contribution to Anonymous History (New York: Norton, 1969) 31.

[24] Lewis Mumford, The Myth of the Machine: The Pentagon of Power (New York: Harcourt Brace Jovanovich, 1970) 206.

hear it, and, in a manner of speaking, feel it as the idea of history most nearly analogous to the rising tempo of life."[25]

According to every major commentator on the subject, including the ones mentioned above, the concept of technological progress confronted new and formidable challenges in the twentieth century. World War I constituted one such challenge. Michael Adas has shown how scientific and technological gauges of human worth and potential dominated European thought, expression, and political practice (especially colonialist policy) in the eighteenth and nineteenth centuries.[26] The atrocities of the Great War — the suicidal standoff in the trenches, the homicidal efficiency of the new machinery of warfare — strongly suggested that those gauges were in need of radical recalibration, that the West's evaluation of its own moral and material preeminence was dangerously delusional, even self-defeating. The conflict's mechanization of slaughter evidenced not so much man's mastery of nature as his brutal subjugation to the techniques and technologies that were supposed to enable that mastery. In the eyes of many Europeans, the dream of technological progress had turned into a nightmare.

> Henry James's poignant expression of the sense of betrayal that Europeans felt in the early months of the war, when they realized that technical advance could lead to massive slaughter as readily as to social betterment, was elaborated upon in the years after the war by such thinkers as William Inge, who declared that the conflict had exposed the "law of inevitable progress" as a mere superstition. . . . Science had produced perhaps the ugliest of civilizations; technological marvels had been responsible for unimaginable destruction. Never again, he concluded, would there be "an opportunity for

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[25] Leo Marx, The Machine in the Garden: Technology and the Pastoral Ideal in America (New York: Oxford UP, 1964/2000) 193. See also John F. Kasson, Civilizing the Machine: Technology and Republican Values in America, 1776-1900 (New York: Hill and Wang, 1976/1999).

[26] Michael Adas, Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance (Ithaca: Cornell UP, 1989).

> gloating over this kind of improvement." The belief in progress, the "working faith" of the West for 150 years, had been forever discredited.[27]

Most critics and historians of "progress" do not go so far as to say that the First World War "forever discredited" the faith in technological progress, though most do acknowledge how drastically it diminished it. Mazlish and Marx point to a number of other events and forces that undermined techno-progressivist optimism during the twentieth century, including the Holocaust (and the industrialization of death it realized), the atomic bombings of Hiroshima and Nagasaki (and the apocalyptic imaginings "the bomb" excited thereafter), growing skepticism about the objectivity and validity of scientific knowledge, and postmodernist critiques of modernity, modernization, and metanarratives.[28]

Writing in reference to train wrecks and derailments, Schivelbusch observes that in the nineteenth century, "The accident was seen as a negative indicator of technological progress."[29] Mary Ann Doane puts it this way:

> The time of technological progress is always felt as linear and fundamentally irreversible — technological change is almost by definition an "advance," and it is extremely difficult to conceive of any movement backward, any regression. Hence, technological evolution is perceived as unflinching progress toward a total state of control over nature. If some notion of pure Progress is the utopian element in this theory of technological development, catastrophe is its dystopia, the always unexpected interruption of this forward movement.[30]

Following Schivelbusch and Doane, we need to add another entry to Mazlish and Marx's list of twentieth-century challenges to the faith in technological progress: namely,

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[27] Adas 379-380.

[28] Mazlish and Marx 1-2.

[29] Schivelbusch 131.

[30] Mary Ann Doane, "Information, Crisis, Catastrophe," Logics of Television: Essays in Cultural Criticism, ed. Patricia Mellencamp (Bloomington: Indiana UP, 1990) 231.

technological accidents, starting with the sinking of the Royal Mail Steamer Titanic in 1912.[31] As has been said many times, the Titanic disaster — the sinking of an "unsinkable" ocean liner — called into question widely accepted claims of technological progress, and did so, incidentally, two years prior to the outbreak of World War I.

Although I do not deal directly with the disaster in the chapters that follow, the Titanic, along with the aura of myth that has come to surround it and the archaeological expeditions that have recently rediscovered it, can be said to illustrate this study's key concerns in at least three respects. First, and most fundamentally, the disaster and its enduring mythology emblematize the material, cultural, and discursive linkages between "progress," modern transportation technology, and accidentality. As I will explain in a moment, Technologies of Accident endeavors to say something provocative and useful about precisely these linkages.

The second way in which the Titanic disaster resonates with this study has to do with recent attempts to "research and recover" the ship's wreckage. From 1987 to 2004, seven "Titanic Research and Recovery Expeditions" were conducted by RMS Titanic, Inc., a company that, according to its website, "was formed for the purpose of exploring the wreck of the Titanic and surrounding ocean areas, for obtaining oceanographic and scientific data, and for using that data and retrieved artifacts for historical verification, scientific education, and public information."[32] Technologies of Accident is about the emergence and effects of

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[31] I single out the Titanic disaster not only because it has so often been hailed as the quintessential tale of technological hubris in the twentieth century, or only because it has proved an extraordinarily powerful and persistent cultural narrative and symbol, but also because it was a modern technological accident that was also a modern transportation accident. This distinction is important because Technologies of Accident focuses on transportation accidents.

[32] RMS Titanic, Inc. <http://www.titanic-online.com/index.php4?page=448>.

the cultural impulse underlying and animating this three-pronged program of historical verification, scientific investigation, and public dissemination.[33] Put differently, it is about the origins and implications of a cultural project driven by two interrelated imperatives: discover the accident's "truth" (in the name of history and/or science) and discipline the accident's signification (in the name of education). Crucially, it is also about the technologies of recording and reproduction/representation, or "accident technologies," that have been employed in the effort to realize those imperatives. (I define the term "accident technology" in the next section.)

The third line of connection between the Titanic and Technologies of Accident also involves the research-and-recovery expeditions, specifically the fifth one, conducted in 1998. The RMS Titanic website boasts that this expedition

> established, for the first time in history, a live fiber-optic television link from the bottom of the ocean, permitting viewers to watch in real time the exploration of the wreck by a manned submersible, and thus earning the record for the deepest underwater live broadcast. . . . In addition, the bow and stern sections were mapped by ultra high-resolution digital photography and a detailed photo mosaic of the Ship was created from these images.[34]

In reference to this expedition, Steven Biel writes: "The ability of television to keep producing 'unprecedented' images becomes the vindication of technological progress that the Titanic supposedly called into doubt. And so, broadcast history redeems history."[35] While the claim that "broadcast history redeems history" is overstated, I nevertheless agree with what Biel is getting at here. Live television broadcasts, fiber-optic links, deep-sea submersibles,

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[33] Just to be clear: my claim here is that this dissertation is about a broad cultural impulse, not about the particular way in which that impulse finds expression in RMS Titanic, Inc.

[34] RMS Titanic, Inc., <http://www.titanic-online.com/index.php4?page=55>.

[35] Steven Biel, "Introduction: On the Titanic Research and Recovery Expedition and the Production of Disasters," American Disasters, ed. Steven Biel (New York: New York UP, 2001) 3.

high-resolution digital photographs — all of this state-of-the-art technology works to redeem in and for the present one of the most infamous technological failures in history. In this sense, the Titanic research-and-recovery expeditions are not only about “historical verification, scientific education, and public information”; they are also about ideological recuperation — the ideological recuperation of technological progress. Technologies of Accident assembles historical evidence and offers critical analyses in support of the speculation that the discourse of technological progress was rearticulated and redeemed in the twentieth century, in part, through the institutional instrumentalization of accident technologies and techniques.

I should point out that this is admittedly this dissertation’s most purely speculative proposition, and therefore the most difficult to substantiate. I make no claim to having conclusively proved its veracity in these pages, only to having demonstrated its plausibility. That said, I believe the speculation has a certain suggestive utility and provocative value. Offered in the spirit of polemic, the notion that “progress” was redefined and ideologically recuperated in the twentieth century challenges, or at least complicates, the standard historiographies of the idea of progress.

As I indicated earlier, most historians of “progress” contend that the idea became increasingly problematic, if not altogether untenable, in the twentieth century. For example, in “Progress at Bay,” Nisbet asserts that there is “good ground for supposing that when the identity of [the twentieth] century is eventually fixed by historians, not faith but abandonment of faith in the idea of progress will be one of the major attributes.”[36] Leo Marx

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[36] Nisbet 317. “Progress at Bay” is the title of the ninth chapter of Nisbet’s book.

states that “the belief in Progress has waned since it won all but universal credence within the culture of modernity.”[37] And Giedion declares that

> Now, after the Second World War, it may well be that there are no people left, however remote, who have not lost their faith in progress. Men have become frightened by progress, changed from a hope to a menace. Faith in progress lies on the scrap heap, along with many other devaluated symbols.[38]

Other thinkers such as Mumford and Jacques Ellul suggest that the idea of progress should, by all rights, have been tossed on the scrap heap in the twentieth century but has persisted nonetheless. According to Mumford,

> Since the idea of progress had no way of accounting for new evils or regressions, it tended to sweep away the voluminous evidence, both historic and contemporary, of their existence. To count only the benefits and to take no notice of the losses proved the standard method of retaining the millennial assumptions on which the doctrine of progress had originally been built.[39]

Here, Ellul mocks the mid-twentieth-century will to believe in progress in the face of devastating accidents:

> two wars, two “accidents,” have in no way affected our glorious conception of progress. Spiteful actions of fate, human errors — call them what they will — men refuse to see in them anything that essentially affects the marvelous progress that opens before them. In spite of accidents, they believe that the road is still free. The man of the mid-twentieth century preserves in his heart exactly the same expectations as his grandfather had.[40]

I do not dispute the notion that the discourse of technological progress suffered serious blows in the twentieth century. Neither do I take issue with the suggestion that it deserved to do so. Instead, I want to suggest that something else happened in the twentieth

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[37] Marx 210.

[38] Giedion 715.

[39] Mumford 201.

[40] Jacques Ellul, The Technological Society, trans. John Wilkinson, (New York: Alfred A. Knopf, 1964) 191.

century, too — something that the vast majority of critics and historians of "progress" do not acknowledge (Theodor Adorno and Paul Virilio being notable exceptions, as their epigraphs to this study suggest). Specifically, I want to suggest that the discourse of technological progress was meaningfully amended by, of all things, its abject Other: technological accidents.

The assertions that (1) technological accidents were vexing the discourse of technological progress in the twentieth century, and (2) technological accidents were reconstituting the discourse during the same period, are not mutually exclusive. This is because once the accident became an object of scientific and institutional analysis, knowledge, and control, as I argue it did in the 1940s and '50s, it simultaneously became a means by which to bolster utopian rhetorics and progressivist ideologies of technology. After all, the point of accident investigation and crash analysis was, supposedly, to ensure that mechanized mobility — travel by air, rail, water, or road — could be, and would be, made safer and more secure in the future. Finding out "what went wrong" as part of an institutionally authorized plane-crash investigation, and discovering exactly "what happens" during a scientifically controlled automobile collision, are vitally important, it was thought, because the information obtained thereby holds the key — the secret — to a better technological tomorrow. A safer future is a superior future, and the superiority of the future is the very definition of progress. Seen in this light, "progress" was not totally tossed on the scrap heap of history in the twentieth century, for the simple reason that it found a way to turn the "voluminous evidence" of "evils" and "regressions" and "losses" to its advantage. The road of "marvelous progress" was "still free" and open, not "in spite of accidents," but because of them.

Definitions and Propositions

As the discussions in the previous two sections indicate, Technologies of Accident is broadly concerned with questions of modernity, technological accidents, and technological progress. It engages these questions, however, in a very particular way: through critical historical analyses of the conditions of possibility and cultural and discursive effectivities of what I call "technologies of accident," or, more succinctly, "accident technologies."[41]

A few definitions are in order at this point. I define an accident technology as a technology of recording and reproduction/representation designed and implemented to ascertain the material causes, or to assess the material consequences, of transportation accidents. The "purpose" of an accident technology is to recover and reveal, with clinical exactitude and scientific certitude, the origins, interdependencies, and effects of human error and mechanical failure vis-à-vis airplane and automobile accidents. Following conceptualizations of technology in the scholarship of cultural studies practitioners such as Ken Hillis, Carolyn Marvin, Jennifer Daryl Slack, Jonathan Sterne, and Ted Striphas, I understand the term "technology" to refer to complex articulations or assemblages of material artifacts, devices, and mechanisms, cultural and institutional rhetorics, practices, and ideologies, and social knowledges, competencies, and relationships.[42]

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[41] I use the term "effectivities" here in accordance with Lawrence Grossberg's definition: "Effectivity describes the particular domains and range of the effects of any practice." Lawrence Grossberg, We Gotta Get Out of This Place: Popular Conservatism and Postmodern Culture (New York: Routledge, 1992) 398.

[42] Ken Hillis, Digital Sensations: Space, Identity, and Embodiment in Virtual Reality (Minneapolis: U of Minnesota P, 1999). Carolyn Marvin, "Experts, Black Boxes, and Artifacts: New Allegories for the History of Electric Media," Rethinking Communication Vol. 2: Paradigm Exemplars, ed. Brenda Dervin, et al. (Newbury Park: Sage, 1989) 188-198. Jennifer Daryl Slack, "Contextualizing Technology," Rethinking Communication Vol. 2: Paradigm Exemplars, ed. Brenda

Another key term employed in this dissertation is “forensic media,” which I take to be a more inclusive term than “accident technologies”: all accidents technologies are forensic media, in other words, but not all forensic media are accident technologies. I define a forensic medium as any technology of recording and reproduction/representation utilized in a scientific or other expert/institutional context for its putative evidentiary value. Put differently, forensic media are media technologies that are pressed into service for the production and reproduction of scientific and institutional truths. In this study, then, I use the term “forensic media” when I want to highlight the scientific and/or institutional truth-claims associated with accident technologies.

Yet I use the term “forensic media” for another reason as well: namely, to call attention to the cultural versatility and mobility of many of the texts — graphic, audio, and/or visual — that accident technologies generate. Bruno Latour gets at this idea in his theorization of scientific representations as “immutable mobiles,” although he, unlike I, is not particularly interested in the popular currency and potency of such representations.[43] Lisa Cartwright comes closer to what I have in mind, perhaps, when she conceptualizes the film motion study as “an intertext between popular and professional representations of the body.”[44] As I argue in Chapter Four, in the 1950s and ’60s crash-test footage was assumed to have a utility and value for public pedagogy quite apart from its utility and value for science.

Dervin, et al. (Newbury Park: Sage, 1989) 329-345. Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham: Duke UP, 2003). Ted Striphas, “Book 2.0,” Culture Machine 5.1: 2003, <http://culturemachine.tees.ac.uk/Cmach/Backissues/j005/Articles/Striphas.htm>.

[43] Bruno Latour, “Drawing Things Together,” Representation in Scientific Practice, ed. Michael Lynch and Steve Woolgar (Cambridge: MIT, 1990) 19-68.

[44] Lisa Cartwright, Screening the Body: Tracing Medicine’s Visual Culture (Minneapolis: U of Minnesota P, 1995) 4. The emphasis on “intertext” is mine.

It is precisely this cultural versatility, mobility, and intertextuality, I contend, that makes many accident-technology texts media texts, rather than merely scientific “inscriptions.”

Technologies of Accident uses archival research, empirical analysis, and theoretical argument to support three basic propositions: (1) the transportation accident was made into an object of scientific and institutional analysis, knowledge, and control in the mid-twentieth century; (2) the transportation accident, regarded in the nineteenth century as an impediment to technological progress, was reconstituted in the twentieth as a catalyst for technological progress; and (3) accident technologies and forensic media, particularly the flight-data recorder, the cockpit-voice recorder, and the high-speed motion-picture camera, embodied and enabled the twin transformations described in the first two propositions.

For the most part, I examine accident technologies during the periods of their historical emergence, in the dawning of their cultural and discursive effectivities. My approach is not that of a traditional historian of technology, concerned to know the biographies of “great men,” the stories of their moments of eureka, or the technical specifications of their inventions. Instead, I am interested in the ways in which accident technologies articulate and are articulated by their cultural and discursive contexts, as well as the ways in which they can be said to rearticulate earlier technocultural imaginings and practices. Lawrence Grossberg writes: “An event or practice (even a text) does not exist apart from the forces of the context that constitute it as what it is.”[45] Neither does a technology. In line with a genealogical method that “displaces the ‘object’ of study away from an analysis of things (such as a particular new media technology) and toward a patient tracking of the apparatus within which things take on particular meanings and play particular roles,” the

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[45] Lawrence Grossberg, Bringing It All Back Home: Essays on Cultural Studies (Durham: Duke UP, 1997) 255.

historical accounts I offer in this study attempt to find and follow a few of the constituting (and always also constituted) forces that Grossberg describes.[46] Put differently, my genealogies trace some of the material, conceptual, practical, and semiotic lines of determination that condition the possibility of a particular accident technology. I do not pretend to provide a complete map of these forces and lines (as if such a thing were possible). I have been necessarily selective, and what I offer here is admittedly only a beginning. In any event, because every selection (and omission) a historian makes is ultimately a political decision, I have tried to select forces and lines that seem especially amenable to critical cultural analysis.

The archive for this study encompasses a diverse range of materials. Primary sources include scientific papers, technical reports, conference proceedings, personal interviews, trade journals, and popular newspapers and magazines. Additionally, my archive includes audio/visual media. I looked at technical diagrams, crash-test footage, photographs, driver's-education films, television commercials and documentaries, and corporate promotional films. Sometimes I read these materials for historical information; other times I read them with a close critical eye in an attempt to discern how accidents and accident technologies were imagined and figured within a particular context.

Part of what I hope to demonstrate in the chapters that follow is that a novel way of thinking about, talking about, and "working on" the transportation accident emerged and became effective in the United States during the 1940s and '50s. Michel Foucault has argued that

> Each society has its regime of truth, its "general politics" of truth: that is, the types of discourse which it accepts and makes function as true; the

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[46] Slack and Wise 491.

> mechanisms and instances which enable one to distinguish true and false statements, the means by which each is sanctioned; the techniques and procedures accorded value in the acquisition of truth; the status of those who are charged with saying what counts as true.[47]

Adapting Foucault's notion of a "regime of truth," and answering Cooter and Luckin's call for a contextualist historiography of the accident, I want to suggest that a new regime of accident — a new assemblage of knowledges, discourses, technologies, and practices concerning transportation accidents — crystallized in the postwar period. By the phrase "new regime of accident," I do not mean that the accident all of a sudden became a new problem; as I note in the Conclusion to this study, accidents have been considered problematic for one reason or another ever since Aristotle expelled them from his metaphysical scheme. I mean, rather, that the accident became problematized anew. It became a site of intensive scientific experimentation and extensive institutional investigation, and it prompted new programs of research and development in the aviation and automobile industries. Numerous new "techniques and procedures" were employed to discover the accident's truth, to make it speak its secrets, and, significantly, many of those techniques and procedures directly involved accident technologies.

The flight-data recorder was used to keep an automatic graphic log of an airplane's performance, tracking exactly how the plane behaved until the moment of impact, explosion, or breakdown. The cockpit-voice recorder was used to pick up and preserve the voices of airplane pilots, to store on steel wire or magnetic tape what often were the pilots' last linguistic and paralinguistic utterances. It was hoped that these graphic and sonic records of human tragedy and technological catastrophe would help accident investigators ascertain the

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[47] Michel Foucault, Power/Knowledge: Selected Interviews and Other Writings 1972-1977, trans. Colin Gordon, et al., ed. Colin Gordon (New York: Pantheon, 1980) 131.

cause of the plane crash. Such information could then be used to discipline pilots and to redesign planes for safety, thereby preventing crashes in the future. High-speed motion-picture photography, for its part, was used in scientifically rigorous, technologically sophisticated automobile crash tests in order to magnify and map the accident's every move. The crash's split-second chaos, destruction, and extreme force impacts (automotive and anthropometric) were mediatized so that they might be subjected to scientific scrutiny and "micromotion" analysis. Such information could then be used to discipline drivers and to redesign vehicles for safety, thereby reducing injuries and fatalities in the future. Each of these forensic media promised to socially and affectively <u>contain</u> the accident by scientifically and institutionally <u>explaining</u> the accident. Each rearticulated, in the context of mid-twentieth-century America, what Robert Castel calls modernity's "grandiose technocratic rationalizing dream of absolute control of the accidental."[48]

Outline of the Chapters

Chapter One sets the stage for the analyses offered in subsequent chapters by focusing on what was probably the earliest articulation of accident-technology desire and forensic imagination: Charles Babbage's self-registering apparatus for railroad trains in 1839. My purpose in this chapter, generally, is to establish Babbage's apparatus's precursory relationship to twentieth-century accident technologies and techniques. In the first main section, I analyze the apparatus's cultural and technological conditions of possibility, paying particular attention to its epistemological linkages with other automatic graphic-recording devices of the period, such as those used in the fields of acoustics and experimental

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[48] Robert Castel, "From Dangerousness to Risk," <u>The Foucault Effect: Studies in Governmentality</u>, ed. Graham Burchell, Colin Gordon and Peter Miller (Chicago: U of Chicago P, 1991) 289.

physiology. I argue that Babbage's apparatus, like these other devices, instantiated the cultural and institutional desire to make "the movement of a body" an object of knowledge for scientific theory and practice in the nineteenth century. The second section critically examines the railroad-accident anxieties and railroad-safety desires that Babbage's apparatus crystallized. The third section draws on the works of Leo Marx, John F. Kasson, and David E. Nye in order to demonstrate the apparatus's connection to the nineteenth-century aesthetic/rhetoric of the "technological sublime." The chapter concludes with a discussion of how Babbage's apparatus embodied the belief in reason, enlightenment, and progress, as well as how it brought together, for the first time, recording instrumentation, mechanized transportation, and the forensic imagination.

Chapter Two looks at the emergence and institutionalization of the twin technologies that compose the aviation "black box": the flight-data recorder and the cockpit-voice recorder. The first half of the chapter analyzes the early history of flight-data recorders. In addition to noting their ties to agendas of surveillance and national security, I point out the ways in which flight-data recorders articulated and were articulated by dreams and discourses of epistemological certainty, media survivability/machinic indestructibility, and social and technological progress. The third and fourth sections focus on early, and in some cases rather obscure, attempts to use sound-reproduction technology to achieve both retrospective certainty (truth) and prospective security (progress) in relation to modern transportation accidents. Toward the end of the chapter, I examine the development of David Warren's "device for assisting investigation into aircraft accidents," the first cockpit-voice recorder.

Chapter Three, the centerpiece of this study, analyzes discourses of automobile accidentality in the first half of the twentieth century. Additionally, it studies the development of scientifically controlled automotive crash-testing after the Second World War. The first section shows how dominant prewar discourses deployed a juridical logic of responsibility, constructing a morally culpable driving subject (“the reckless driver”) on whom blame for accidents could be readily placed. I contend that this discourse was conditioned by liberal humanist ideologies, instrumentalist rationalities of technology, scientific-rationalist epistemologies, and cultural narratives of progress and perfectibility. In the second and third sections, I chart what I argue was a major discursive shift that began in the 1940s, with the emergence of crash-injury research, and culminated in the scientifically controlled automobile crash tests of the 1950s. The conclusion considers the privileged position occupied by high-speed motion-picture photography in the transformation of the automobile accident into an object of scientific and institutional analysis, knowledge, and control during the postwar period.

Chapter Four undertakes close critical readings of postwar industrial and educational films that incorporated scientific crash-test footage into their audiovisual discourse. I read these collision-experiment films, as I call them, for the ways in which they scientistically reimagined and popularly reimaged the relationship between agency, automobility, and accident in the 1950s and ’60s. I show how the films appropriated iconographies of both laboratory science and destructive spectacle in order to make emergent logics and practices of crash-injury prevention popularly meaningful and socially useful to the American citizenry. The parable of “Civilization Redeemed” and the trope of the “safely packaged passenger” are examined in this chapter, as is the discursive construction of a safe driving subject more generally.

The Conclusion discusses this dissertation's origins as well as what I take to be its contributions to the fields of cultural studies, communication studies, and media studies. Mainly, though, its purpose is to point the way to further research on accident technologies and techniques. On the one hand, I begin to argue for another way of contextualizing the postwar emergence of accident technologies: namely, through the lens of atomic anxieties. I speculate that the fear of the car crash and the fear of the atomic blast might be articulations of a shared structure of feeling. I also observe marked similarities in the sorts of institutional response such anxieties engendered, from an insistence on everyday preparedness to the deployment of educational/propagandistic films. On the other hand, I begin to think about how my research might engage accident technologies in the contemporary context. I pay particular attention to three present-day accident technologies: the car black box, the cockpit-video recorder, and computer-animated reconstructions. The Conclusion also contains a brief postscript on the subject of "risk."

CHAPTER ONE

BABBAGE'S APPARATUS

Introduction

"At the commencement of the railway system I naturally took a great interest in the subject, from its bearings upon mechanisms as well as upon political economy."[49] So proclaimed nineteenth-century British mathematician and inventor Charles Babbage in "Railways," the twenty-fifth chapter of his autobiography, Passages from the Life of a Philosopher. Today, Babbage is best remembered for his contributions to the prehistory of the digital computer, particularly his innovative calculating and tabulating machines, the Difference Engine and the Analytical Engine. As a result, he is sometimes referred to as "The Father of the Computer," an honorific appellation that conforms to the modern mythology of the inventor-hero, or what Jonathan Sterne calls "the male-birth model of technological history."[50] What is less often remembered or remarked on, however, is that in 1839, Babbage commenced a "long series of experiments" in which he designed, built, and tested what he called a "self-registering apparatus" for railroad trains.[51] Were this contribution to the prehistory of the flight-data recorder better known to inventor-hero mythologists and male-

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[49] Charles Babbage, Passages from the Life of a Philosopher, ed. Martin Campbell-Kelly (London: Pickering & Chatto, 1991) 234.

[50] Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham: Duke UP, 2003) 181.

[51] Babbage 245.

birth historians of technology, Babbage might have earned another honorific appellation: “The Father of the Black Box.”

Fastening to the internal framework of a passenger coach, Babbage’s apparatus consisted of an independently suspended table, across which slowly scrolled a thousand-foot-long sheet of paper, upon which “several inking pens traced curves.”[52] These curvilinear tracings registered and represented several of the train car’s performance parameters, including its rate of speed, force of traction, and vertical, lateral, and terminal vibrations. Babbage biographer Anthony Hyman explains:

> A powerful spring-driven clock . . . was adapted to raise and lower a special pen which made a dot on the paper every half second. Thus from the spacing of these dots the speed of the train could immediately be determined. The main inking pens and the ink feed gave Babbage a good deal of difficulty but ultimately the pens worked well, tracing out their curves, followed closely by a roller faced with blotting-paper. The pens were connected mechanically to different parts of the carriage or to some special piece of apparatus. Thus was formed a multi-channel pen-recorder with mechanical linkage.[53]

Babbage implied that his “great interest” in obtaining such technical data exceeded that of the railroad enthusiast or gentleman scientist (both of which he was). To be sure, something weightier was at stake in his self-initiated, self-enacted experiments of 1839, something encoded in those automatically generated, ink-stained inscriptions. For Babbage, that something involved the financial viability (“political economy”) and, above all, the fundamental safety, of railway travel. “I have a very strong opinion that the adoption of such mechanical registrations would add greatly to the security of railway travelling,” he insisted, “because they would become the unerring record of facts, the incorruptible witnesses of the

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[52] Babbage 239.

[53] Anthony Hyman, Charles Babbage: Pioneer of the Computer (Princeton: Princeton UP, 1982) 160.

immediate antecedents of any catastrophe."[54] Hyman puts it this way: "So impressed was Babbage with the value of the permanent records which he obtained with his apparatus, that he suggested that similar equipment should be installed on railway trains as a matter of routine, so that in the event of an accident it should be possible to determine the causes."[55]

This chapter provides a critical history and theory of Babbage's self-registering apparatus, in order to demonstrate its precursory relationship to twentieth-century accident technologies and forensic media. As part of my examination of the apparatus's technical and cultural conditions of possibility, I consider its multiple and complex articulations to other nineteenth-century mechanical inscriptors and, more abstractly, to the epistemology of the graphic method. In addition, I explore its invention in the context of contemporaneous railroad-accident anxieties, railroad-safety desires, and the aesthetic/rhetoric of the technological sublime, particularly its mythologies of reason and progress. I argue that Babbage's apparatus constitutes the earliest articulation of the desire to read the transportation accident forensically — which is to say, to master it rationally, to contain it culturally, and to manage it institutionally.

The Epistemology of the Graphic Method

Automatic graphic-recording instruments of the nineteenth century were many and varied. Most of them, as Thomas L. Hankins and Robert J. Silverman observe, were integrally involved in the modernization of one of two scientific fields: acoustics or

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[54] Babbage 248.

[55] Hyman 160.

experimental physiology.[56] In the field of acoustics, Thomas Young, a British natural philosopher and "undulatory optical theorist," developed a device that utilized a small pencil, a vibrating rod, and a sheet of paper to create "permanent inscriptions of sonic vibrations."[57] Wilhelm Weber and Guillaume Wertheim, among others, "devised related ways to preserve the traces of styluses attached to sounding bodies, such as rods and tuning forks."[58] A forerunner of Thomas Edison's phonograph, Édouard-Léon Scott de Martinville's

> phonautograph consisted of a paraboloid collecting chamber, one end of which was open, while the other was covered with a thin elastic membrane. . . . The acoustic stimulation of this diaphragm activated a system of ossicle-like levers and a stylus whose motion would be traced on a steadily moving paper, wood, or glass surface coated with lampblack.[59]

In the field of experimental physiology, Carl Ludwig designed an instrument — the first kymograph — that, when surgically attached to an artery, measured and graphically registered blood pressure. Karl Vierordt's and Étienne-Jules Marey's sphygmographs did the same, only non-invasively. Compact enough to strap onto a human arm, Marey's version featured "a spring that rested on the radial artery and transmitted movements to a light recording arm, which inscribed the motion on a moving glass plate."[60] Marey later adapted this technology to study a wide variety of human and animal movement, refining and extending the peculiar approach to scientific experiment that he called "the graphic method."

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[56] Thomas L. Hankins and Robert J. Silverman, Instruments and the Imagination (Princeton: Princeton UP, 1995) 128.

[57] Hankins and Silverman 132.

[58] Hankins and Silverman 133.

[59] Hankins and Silverman 135.

[60] Hankins and Silverman 137.

Also employing auto-inscription apparatus during this period were Carlo Matteucci and Hermann von Helmholtz, each of whom conducted experiments on muscular contractions.

Hankins and Silverman are keen to point out that these nineteenth-century automatic recording devices were qualitatively different from earlier instruments of graphic inscription, such as James Watt's indicator diagram, which mechanically plotted steam-engine cylinder pressure in relation to piston position.[61] Devices in the latter category reduced or eliminated human labor (and tedium) by automating the process of accumulating data; they were "better" because they were easier and more efficient. Devices in the former category, by contrast, yielded the sort of information that no amount of direct observation or manual notation ever could; they were "better" not because they substantially reduced something deemed undesirable (the exertions of the researcher/record-keeper), but because they positively produced something otherwise unobtainable, something inaccessible to the naked eye and to the other modalities of human perception: namely, detailed knowledge about the nature of physical and physiological processes. Second-generation mechanical inscriptors were regarded as revolutionary, in other words, because, to reflexively invoke the masculinist and ocularist metaphorics of heroic science, they penetrated, peered into, and produced a picture of Nature's secret spaces in a way hitherto impossible.

Babbage's self-registering apparatus was technically comparable — and culturally and historically connected — to other nineteenth-century auto-inscription technologies in a couple of key respects. First, all were designed and utilized to measure the motions of phenomenal reality — vibratory, undulatory, circulatory, oscillatory, and so on. All simultaneously incarnated, animated, and serviced nineteenth-century experimental science's

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[61] Hankins and Silverman 128.

fascination with duration and dynamic processes, with transferences of energy (and their temporalities) actualized in and as waves, flows, pulsations, contractions, “rhythms” (Marey), “shakes” (Babbage). This fascination was manifest in the drive to discover the “laws” governing — or, to use Marey’s preferred terminology, to decipher the “language” encoded in — the relationship between time, space, force, and movement. “All movement is the product of two factors: time and space,” Marey wrote in 1878. “To know the movement of a body is to know the series of positions which it occupies in space during a series of successive instants.”[62] Conceived as a means to register the inconstant velocities and multiple vibrations of a locomotive in motion, and to do so as a function of time, Babbage’s apparatus, no less than Marey’s armamentarium of mechanical inscriptors, instantiated the cultural and institutional desire to make “the movement of a body” an object of knowledge for scientific theory and practice in the nineteenth century.

The second respect in which Babbage’s self-registering apparatus was bound up with the phonautograph, the kymograph, the sphygmograph, the myograph (muscular contractions), the cardiograph (heartbeat), the pneumongraph (respiration), the thermograph (heat), and the like is essentially epistemological. Simply stated, all of these technologies materialized and operationalized a bedrock belief in both the scientific legitimacy and the superior reliability (as compared to the unaided human sensorium) of the graphic method. These twin claims of legitimacy and reliability, in turn, were predicated on the epistemological promise of the inscriptional apparatus: namely, the promise of indexicality, along with its corollaries, automaticity and authenticity. For Babbage, the promise of machinic indexicality was the promise of “the unerring record,” of “the incorruptible

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[62] Quoted in Anson Rabinbach, The Human Motor: Energy, Fatigue, and the Origins of Modernity (New York: Basic, 1990) 94.

witness." It was the promise of intrinsic impartiality and evidentiary trustworthiness: "Even the best and most unbiassed judgement [sic] ought not to be trusted when mechanical evidence can be produced."[63]

In Charles Sanders Peirce's theory of signs, indexicality is defined by the non-arbitrary relationship between the signifier and the signified. Immediately inferable or observable, this relationship is not primarily based on either convention (as with the symbolic sign) or resemblance (as with the iconic sign). Instead, according to Peirce, the indexical sign is causally or physically connected to its object, to an object that necessarily exists "objectively," in the material world, as opposed to one that only exists "subjectively," in the mental world. Mary Ann Doane notes that "indexicality was the major stake of Marey's representational practices. It was crucial that the body whose movement was being measured be the direct source for the tracing."[64]

The requirement that the body originate its own tracings, that the phenomenon author its own inscriptions — a requirement that represents the cornerstone of the graphic method — assumes and implies both the automaticity of the recording process and the authenticity of its products. According to Marey, "it is of immense importance that the graphic record should be automatically registered, in fact, that the phenomenon should give on paper its own record of duration, and of the moment of production."[65]

Here, the apparatus and its texts are implicitly naturalized: the former's automaticity is conceptualized as a form of bodily reflex; the latter's authenticity as a function of what

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[63] Babbage 245.

[64] Mary Ann Doane, The Emergence of Cinematic Time: Modernity, Contingency, the Archive (Cambridge: Harvard UP, 2002) 47.

[65] Quoted in Doane, The Emergence of Cinematic Time 48.

Scott referred to as “natural stenography.”[66] “Automatic,” in other words, means that the apparatus responds to stimuli just like a living body responds to stimuli — just like the nerve impulses and muscular contractions it was enlisted to record — while “authentic” means that its texts are written in what Marey called “the true universal language,” the mother of all mother tongues, the lingua franca of Nature.[67] Modern science reconceives Nature in light of recently discovered forms of physical and physiological motion, while modern society remakes it through recently developed forms of transportational and communicational mobility. Under the sign of this new natural order, automaticity comes to designate the convergence of the machine body and the animal/human body, while authenticity comes to designate the equivalence of machinic writing and natural writing. Just as the graphic method makes the machine responsive to stimulus through bodily incorporation (the body assimilates the machine), so it makes the body communicative through machinic excorporation (the machine writes the body).

Accident Anxieties, Safety-Device Desires

Thus far I have been concerned to call attention to the technical and conceptual features that Babbage’s self-registering apparatus shared with other nineteenth-century automatic recording devices, in order to begin to illuminate its material, social, and historical conditions of possibility. I noted that these technologies were designed to mechanically detect, continually monitor, and graphically trace particular qualities and quantities of physical or physiological movement, thereby translating ephemeral, often obscure motions

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[66] Quoted in Hankins and Silverman, Instruments and the Imagination 135.

[67] Quoted in Hankins and Silverman, Instruments and the Imagination 139.

into “permanent,” readily readable inscriptions. I suggested, additionally, that they reflected and contributed to nineteenth-century experimental science’s will to know the complex relations between time, space, force, and movement. Finally, I argued that, in mobilizing the graphic method, they assumed and evinced an epistemology of indexicality organized around tropes and discourses of automaticity and authenticity, themselves tied to notions of naturality, bodily reflexes, and universal legibility.

New technologies neither appear ex nihilo nor exist in a vacuum, and Babbage’s apparatus is, of course, no exception. Its technical form, scientific rationale, and epistemological underpinnings were conditioned by and consonant with the devices — in every sense of the word — of Young, Weber, Wertheim, Scott, Ludwig, Vierordt, Marey, Matteucci, and Helmholtz.

Crucial as these technical, scientific, and epistemological conditions and consonances were to the invention of Babbage’s self-registering apparatus, they do not tell the whole story. For Babbage’s apparatus, as idea and as artifact, in theory and in practice, also articulated and was articulated by quite different cultural and institutional concerns and contexts — concerns and contexts that not only distinguished it from other nineteenth-century instantiations of the graphic method but also prepared the ground for, and, in a sense, pointed the way toward, twentieth-century accident technologies and forensic media, particularly the flight-data recorder, or “black box.” What made Babbage’s apparatus a “new” technology in the 1800s, and what made it a precursor of accident technologies of the 1900s, were not so much its technical form and function, since, as we have seen, it strongly resembled, in its material thingness and manner of operation, instruments of automatic graphic inscription developed for and deployed in research experiments in the natural sciences. Rather, what made it "new," and what made it a precursory accident technology (and therefore pertinent to the present study) were the ways in which it was implicated in and expressive of particular cultural and institutional anxieties and desires. On the one hand, Babbage's apparatus embodied anxieties concerning the risks of mechanized transportation; specifically, risks to person and property realized in and as crashes and accidents. On the other hand, it embodied the desire to know and ultimately ameliorate those risks through techniques and technologies of crash analysis and accident investigation.[68]

Babbage gives voice to these anxieties and desires, directly and indirectly, throughout "Railways." He expresses solicitude for "the safety of all [railway] travellers."[69] He recounts his participation in several formal and informal conversations with merchants, politicians, bureaucrats, industrialists, and other prominent personages, in which the railroad's "various difficulties and dangers were suggested and discussed."[70] He writes of "having a great wish to diminish [these] dangers" and of "studying the evidence given upon the enquiries into the various lamentable accidents which have occurred upon railways."[71] He describes the impetus, design, and purpose of railroad-safety devices of his invention besides the self-registering apparatus, including a contrivance for dispatching obstructions on the tracks (which came to be called a "cowcatcher") as well as a contrivance for preventing passenger-coach derailment in the event of engine derailment. And, as one who publicly participated in Britain's legendary "Battle of the Gauges" — surely one of the greatest technology-standards

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[68] Babbage's apparatus, in other words, was <u>discursively</u> precursory.

[69] Babbage 241.

[70] Babbage 237.

[71] Babbage 238, 245.

debates of the industrial era — he defends his early endorsement of, and continuing preference for, broad- rather than narrow-gauge track in the name of safety, economy, and efficiency.[72]

Yet perhaps the most intriguing expression of accident anxieties and safety-device desires comes at the beginning of the chapter, which comprises not a triumphant account of the mighty and majestic locomotive, as might be expected from an accomplished inventor and lifelong champion of science and industry, but a personal anecdote about an unsettling, ill-omened, almost abortive train ride. Recalling his experience at the ceremonious opening of the Manchester and Liverpool Railway on September 15, 1830, Babbage writes that "we had not proceeded a mile before the whole of our trains came to a standstill without any ostensible cause." After several motionless minutes, "A certain amount of alarm now began to pervade the trains, and various conjectures were afloat of some serious accident."[73] The conjectures would soon be confirmed: Member of Parliament William Huskisson, whom Babbage "had seen but a few minutes before standing at the door of the carriage conversing with the Duke of Wellington," had been accidentally run over and killed.[74] Hyman observes that, as the first-recorded railroad tragedy in history, "The death cast a shadow over the railways which was not easily lifted. . . . [It] was a reminder of the awesome power of the machinery and was to be followed by many railway deaths in fiction."[75] Babbage was so

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[72] Babbage writes: "The result of my experiments convinced me that the broad gauge was most convenient and safest for the public" (239). For more on the question of track gauge, see page 243 and pages 249-250.

[73] Babbage 234.

[74] Babbage 235.

[75] Hyman 144.

shaken by the tragedy, his imagination so infected with the accident, that trackside scenes of salutation took on a surreal and sinister air:

> For several miles before we reached our destination the sides of the railroad were crowded by a highly excited populace shouting and yelling. I feared each moment that some still greater sacrifice of life might occur from the people madly attempting to stop by their feeble arms the momentum of our enormous trains.[76]

The “serious accident”: it turns high-spirited spectators into wild-eyed suicides, a wondrous machine into a relentless monster, a momentous maiden voyage into a veritable Grand Guignol, a communal celebration of social and technological progress into a bloody sacrifice of person and proxy of state.

Babbage’s phantasm offers a glimpse into the cultural imagination of technology — and of the technological accident — in the early years of the railroad. Juxtaposing vivid images of excitement, fear, sacrifice, madness, sheer power, and utter powerlessness, it bespeaks a profound ambivalence toward the new mode of transportation and, by extension, toward the new machinery of industrialization. On the one hand, there is the marvel of the machine: its breathtaking spectacle, its inexorable momentum, its astonishing enormity. On the other hand, there is the madness of the machine: the pandemonium it engenders, the futile resistance it elicits, the brutal sacrifices it demands. Peculiarities of content notwithstanding, this hallucinatory expression of ambivalence toward technology is not reducible to the realm of the psychological; that is to say, it should not be seen as merely the product of one man’s mind. Instead, Babbage’s phantasm, considered more properly as a cultural text, articulates aspects of what Leo Marx calls “the technological sublime.”[77]

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[76] Babbage 235.

The Technological Sublime

The technological sublime was at once a powerful aesthetic and a prevalent rhetoric during the nineteenth century, as Marx, John F. Kasson, and David E. Nye all have shown.[78] Adapting the eighteenth-century theories of Edmund Burke and Immanuel Kant to the nineteenth-century materialities of science and industry, these authors define the technological sublime as a subjective experience of, as well as a cultural discourse about, modern machinery and technology, combining elements of wonder, fascination, reverence, incredulity, and dread.

Burke contrasted the essence of the beautiful to the essence of the sublime. Whereas the beautiful inspires "sentiments of tenderness and affection," the sublime excites "an idea of pain and danger, without being in such circumstances."[79] "The strongest emotion which the mind is capable of feeling," the sublime specifies the complex of affective energies and sensuous intensities provoked by encounters with objects exhibiting one of more of the following characteristics: power, obscurity, vastness, magnitude, suddenness, vacuity, silence, magnificence, darkness, infinity.[80] Burke's name for the singular "state of the soul" associated with sublimity is "astonishment":

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[77] Leo Marx, The Machine in the Garden: Technology and the Pastoral Ideal in America (New York: Oxford UP, 1964/2000) 195.

[78] It should be pointed out that Marx's, Kasson's, and Nye's work focuses on the American context. Still, I would suggest that there is plenty in their analyses that is applicable to the concurrent British context.

[79] First phrase quoted in Terry Eagleton, The Ideology of the Aesthetic (Oxford: Blackwell, 1990) 52. Second phrase quoted in John F. Kasson, Civilizing the Machine: Technology and Republican Values in America, 1776-1900 (New York: Hill and Wang, 1976/1999) 166.

[80] Quoted in Kasson, Civilizing the Machine 166. See also David E. Nye, American Technological Sublime (Cambridge: MIT, 1994) 6.

> The passion caused by the great and sublime in nature, when those causes operate most powerfully, is Astonishment; and astonishment is that state of the soul, in which all its motions are suspended, with some degree of horror. In this case the mind is so entirely filled with its object, that it cannot entertain any other, nor by consequence reason on that object which employs it.[81]

Nye asserts that, for Burke, the sublime experience "grew out of an ecstasy of terror that filled the mind completely. The encounter with a sublime object was a healthy shock, a temporary dislocation of sensibilities that forced the observer into mental action."[82] Accentuating the political and ideological (as opposed to the purely psychological or phenomenological) dimensions of the Burkean sublime, Terry Eagleton contends that, "As a kind of terror, the sublime crushes us into admiring submission; it thus resembles a coercive rather than a consensual power, engaging our respect but not, as with beauty, our love."[83]

Kant reconceived Burke's theory of the sublime in at least two fundamental respects. First, he challenged the mutual exclusivity of the beautiful and the sublime, arguing that, since pleasure is produced by sublime no less than beautiful objects, the two are not, in fact, absolutely antithetical.[84] This is not to say, however, that the pleasure of the beautiful and the pleasure of the sublime are identical. Rather, for Kant, they are inversely charged: the former is positive; the latter, because it is tinged with terror, is negative: "as the mind is alternately attracted and repelled by the object, the satisfaction in the sublime implies not so much

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[81] Quoted in Nye, American Technological Sublime 9.

[82] Nye 6.

[83] Eagleton 54.

[84] Nye 6. Although Nye does not mention it, Burke, too, claims that the sublime experience is, in part, pleasurable. His name for this type of pleasure is "delight." See Edmund Burke, A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful, ed. Adam Phillips (Oxford: Oxford UP, 1990).

positive pleasure as wonder or reverential awe, and may be called a negative pleasure."[85] Second, he divided the experience of the sublime into two categories: "the mathematical sublime" and "the dynamic sublime." The mathematical sublime denotes the encounter with superhuman size or scale, overwhelming enormity or immensity, incomparable vastness or greatness. The dynamic sublime, by contrast, designates the subject's confrontation with terrifying Nature: its menacing features and implacable forces and devastating furies. Kant offers a few examples:

> Bold, overhanging and as it were threatening cliffs, masses of cloud piled up in the heavens and alive with lightning and peals of thunder, volcanoes in all their destructive force, hurricanes bearing destruction in their path, the boundless ocean in the fury of a tempest, the lofty waterfall of a mighty river; these by their tremendous force dwarf our power of resistance into insignificance. But we are all the more attracted by their aspect the more fearful they are, when we are in a state of security; and we at once pronounce them sublime, because they call out unwonted strength of soul and reveal in us a power of resistance of an entirely different kind, which gives us courage to measure ourselves against the apparent omnipotence of nature.[86]

Like Burke, Kant claims that the sublime experience is characterized by fear — or, more precisely, by a certain kind of fear, a double-coded fear, a feeling of fear coupled with an awareness of the absence of danger, a fear that in Sartrean terms is simultaneously pre-reflective and reflective, a real fear that nonetheless knows not to be really afraid. Unlike Burke, however, Kant contends that this fear ultimately mutates, by means of an operation interior to the sovereign subject, into its opposite: courage. Exposed to the elements, naked before Nature, whether instantiated as an infinity of expanse (mathematics) or as an infinity of energy (dynamics), the subject initially and instinctively cowers, flooded as he is with feelings of impotence and insignificance. But then, according to Kant, the subject

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[85] Quoted in Nye, American Technological Sublime 7.

[86] Quoted in Nye, American Technological Sublime 7.

experiences an awakening from within, an empowerment from Reason, which, by reaching out to grasp the totality and potency of things — of sublime things — restores his sense of moral strength and superiority. Reason, indomitable as ever, more infinite than the phenomena it apprehends, comes to the rescue.

For both Burke and Kant, the sublime object is necessarily a natural one.[87] With the onset of industrialization, however, technical apparatus became articulated to the sublime in the cultural imagination. To paraphrase Jeffrey T. Schnapp, the sublime's supernaturality became secularized and assimilated to the realm of everyday life.[88] Kasson notes that

> in the second half of the eighteenth century in England, George Robertson, Joseph Wright of Derby, and other artists soon broadened the field of the sublime beyond the natural landscape and discovered new sources of sublime emotion in industrial processes. By the mid-nineteenth century, both in England and America, this aesthetic of the technological sublime had achieved a broad following, as the reactions to the Corliss engine dramatically illustrate. The desire to "see sublimity . . . in the magnificent totality of the great Corliss engine," to shiver with awe and dread before it, had become a popular passion.[89]

Those who wished to "shiver with awe and dread" before the Corliss steam engine had to visit Machinery Hall at the Philadelphia Centennial Exposition of 1876. For most Englishmen and Americans, though, there was a much easier way to experience the technological sublime: stand alongside the railroad tracks and take in the train as it rushed by — just like the "highly excited populace" in Babbage's phantasm. "Perhaps the most

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[87] Kasson writes that Burke "nowhere mentions machine technology as a source of the sublime; the closest he comes is to cite artillery as among those noises which awaken 'a great and aweful sensation in the mind'" (166).

[88] Jeffrey T. Schnapp, "Crash (Speed as Engine of Individuation)," Modernism/Modernity 6.1 (1999): 4.

[89] Kasson 166-167.

common vehicle of the technological sublime in the nineteenth century was the railroad," Kasson avers.

> Viewers not only thrilled to the elaborate ornamentation of locomotives such as the "America," which reached its height around midcentury; they were still more fascinated by the sight of the railroad in motion. Universally accessible, a rushing train possessed almost all the Burkean attributes and symbolized the beneficent new technological order. Observed at close range, particularly at night, it possessed an irresistible appeal.[90]

Kasson's point about the train symbolizing "the beneficent new technological order" is significant, as it highlights the link between the aesthetic/rhetoric of technological sublime and the ideology of progress. Marx argues that

> The idea that history is a record of more or less continuous progress had become popular during the eighteenth century, but chiefly among the educated. Associated with achievements of Newtonian mechanics, the idea remained abstract and relatively inaccessible. But with rapid industrialization, the notion of progress became palpable; "improvements" were visible to everyone. During the nineteenth century, accordingly, the awe and reverence once reserved for the Deity and later bestowed upon the visible landscape is directed toward technology or, rather, the technological conquest of matter.[91]

Here, Marx indicates three historically successive (re)articulations of sublimity: from fear and trembling before the Almighty, to fear and trembling before Nature, to fear and trembling before the Machine. In the last articulation, the sublime is implicated in a progressivist ideology of history, according to which "awe and reverence" for technology serve as an index of man's achievement and advancement. The technological sublime, then, unlike earlier articulations of sublimity, is more than an aesthetic and a rhetoric; it is also a form of historical consciousness — linearist, ameliorist, teleological.

My purpose in taking this detour through theories of the sublime is to suggest that, as a popular nineteenth-century aesthetic, rhetoric, and form of historical consciousness, the

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[90] Kasson 172.

[91] Marx 197.

technological sublime informed not only the discursive content of Babbage’s phantasm (its mood, its imagery, its symbolism) but also the discursive context of his apparatus’s invention. I am proposing, in other words, that the sublimity of the locomotive, its status as an object of public fascination and fear during the nineteenth century, pervaded Babbage’s phantasm as a cultural text, even as it provided a background against which Babbage’s apparatus emerged as a cultural technology. Entwined as it was with crash and accident, tragedy and catastrophe, violence and destruction, Babbage’s apparatus embodied and indicated the technological sublime’s aspect of dread and terror, of “pain and danger.” In anticipating the awful possibility of the train wreck, it accentuated the actual sublimity of the train.

The Triumph of Reason and the Ideology of Progress

Babbage’s apparatus embodied and indicated two other aspects of the technological sublime as well: the triumph of reason and the ideology of progress. For Kant, it will be recalled, the sublime experience consists of two qualitatively distinct moments. At first, the subject, seized by something bigger, loses his bearings. Stunned and amazed by the sublime object’s unfathomable infinity, ungraspable alterity, and unassimilable exteriority, his rational faculties fail him.[92] He is perfectly mortified and practically immobilized. But then, just when he seems weakest and most vulnerable, Reason returns in force and with a vengeance, rides in on a white stallion, so to speak. Suddenly, the subject comes to his senses and comes to grips with the situation, takes hold and takes charge. For he now realizes that the power of the sublime is no match for his power of reason. Secure in his ability to outthink

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[92] Only because I am mimicking Kant’s language in this passage do I universalize the male pronoun.

that which initially terrorized him, the subject reclaims his dignity and his sovereignty, and with them, his sense of certainty: the certainty of Truth.

Implicit in the idea of Babbage's apparatus — and, indeed, in the idea of accident technologies more generally — is, I submit, something of this story about the triumph of reason. In fact, the parable of the Kantian sublime and the "purpose" of Babbage's apparatus draw on and contribute to essentially the same cultural narrative. In the former, the subject is shaken to his core and shocked into submission by something that is, initially, beyond the bounds of his comprehension. By the end of the parable, however, Reason reigns supreme. Terrifying Nature, the source of the subject's awe and astonishment, the cause of his fear and trembling, has been effectively neutralized by a rationality that transcends it. The same basic storyline is built into Babbage's apparatus. The specifics of the scenario are different, of course, and the setting has shifted from the plane of the psycho-phenomenological to that of the technocultural, but the structure of the drama, the logic of the plot, the essence of the conflict, the identity of the hero, and the moral of the story all conform to the Kantian parable. The action unfolds as follows:

Act One. The locomotive steams down the line. Its iron grip on the rails provides stability and security. It moves with great momentum in a forward direction. It is a marvel of modern science and engineering. It is a testament to the power of reason and a token of moral and material progress.

Act Two. Disaster strikes! Whether due to human error or mechanical failure, the train derails or collides. Its forward motion is abruptly interrupted; its smooth operation is violently disrupted. The accident unleashes the forces of chaos. All around there is carnage and wreckage, death and disorder. Panic ensues. This, the scene of unreason.

Act Three. Railroad experts examine the wreckage for evidence as to the cause of the accident. Babbage's apparatus is retrieved and its scrolls are scrutinized. Across their paper surface, mechanical tracings encode the tale — the truth — of the train wreck. The cause of the accident is thereby ascertained. Order is restored. The locomotive, marvel and testament and token, once again steams down the line, stably and securely, with great momentum, in a forward direction.

This play in three acts is obviously contrived, but I use it here to illustrate an important point. Embedded in the intended purpose of every technology lies a cultural ideal and narrative, a fantasy about what the technology is good at and good for, a fairytale about how human ends will be achieved, and the conditions of human life improved, through its agency and application. Babbage's self-registering apparatus is built around a story of human tragedy and fallibility, of technological failure and its traumatic costs (human, social, economic, symbolic). Such fallibility and failure, dramatized in the occurrence of the accident, constitute the apparatus's raison d'être. While its design is predicated on the accident's unpredictability, its "necessity" is predicated on the accident's inevitability. Disaster must strike in order for it to fulfill its designated function; otherwise or until such time, it is practically useless. Its technical efficacy and social and economic utility are inversely related to those of the locomotive that carries and contains it. The possibility of its working as planned ("normal" operation) is tied to the eventuality of its host's not working as planned (crash, breakdown). Its machinic productivity is a function of the greater machine's (self-)destructivity. It only "makes sense," rationally and operationally, in the context of the train wreck's seeming senselessness. To be sure, this twice-twisted sense-making — its comprehensibility as an intentional artifact and its ostensible ability to "comprehend" the accident — lies at the very heart of the matter. For, as a “purposeful” mechanism, Babbage’s apparatus only makes sense in connection with the coming to pass of a catastrophe of which it is presumed capable of making sense. Its technological rationale, in other words, is contingent on its capacity to retroactively rationalize the technological accident.

Act Three portrays this process of retroactive rationalization. The cultural narrative encoded in Babbage’s apparatus climaxes in the crash, but the enactment of its cultural ideal comes in the crash’s aftermath. That ideal involves the technicized writing and, above all, the scientized reading of the accident. The accident’s rationalization is at once the condition and the consequence of this reading. What is at issue here is a complex process of textualization, narrativization, and mythologization, an intricate assemblage of relays and relations between technical reproducibility, historical intelligibility, and ideological necessity. The dream designed into Babbage’s apparatus, its technological “magic,” is also its institutional imperative: on the one hand, to write the accident “faithfully” — indexically, automatically, authentically, immediately — and, on the other hand, to read it forensically.

To read the accident forensically is to perform a meticulous exegesis on what is simultaneously a book of revelation (about what happened) and a book of judgment (about what went wrong). Such a book, moreover, is at once open and esoteric — open because, according to the graphic methodologists, it is inscribed in the universal language of Nature, and esoteric because those “natural” inscriptions can be revealed (and, indeed, can be registered in the first place) only by means of specialized techniques and technologies. To read the book of the accident is, ideally, to retrace a previous sequence of events; it is to recover a prior course of action and, through this very process of retracing and recovering, to render the awful culmination of that course of action not only coolly inevitable (“knowing what we know now, we can see that the accident had to happen") but psychically innocuous. Or, more exactly, it is to render its specter less ominous on account of its legibility, less threatening in the abstract for being scientifically readable and less threatening in actuality for having been so read. To read the book of the accident is to (vainly) attempt to exorcise the demons of chance and contingency from its dramaturgy, from its official account and explanation — and, in a sense, from the official accounts and explanations of all such "accidents," past, present, and future. For, if accidents can be accounted for and explained, so the logic goes, they are not "accidents" at all; they are, rather, events with determinate and determinable causes. To read the book of the accident in this way, therefore, is to write not only the authorized history of a particular accident but also the prolegomena to any future history of accidents. What is significant, in any case, is that it is a history neatly expunged of messy indeterminacy, a history of the accident immaculately evacuated of true accidentality.

Both the Kantian sublime and Babbage's apparatus tell the story of a settled and sophisticated rationality in Act One (the sovereign subject, the industrial order in general and the railroad in particular), the terrifying unsettling of that rationality in Act Two (the sublime encounter, the train wreck), and the reprisal and resettling of that rationality in Act Three (the transcendence of the subject, the technoscientific explanation of the accident). I am not claiming, of course, that there was a causal or empirically demonstrable relationship between Kant's theory of the sublime and Babbage's invention of the self-registering apparatus. Rather, I am pointing to the saliency, versatility, and persistence of a cultural mythology in which fear-inducing disruptions of, and formidable challenges to, prevailing conditions and expressions of a normative rationality are confronted, negotiated, and ultimately surmounted — surmounted, in fact, by the very rationality (now reinvigorated) whose agency and authority had been under assault. It might even be said that, in one version or another, this cultural mythology, this story of the triumph of reason, constitutes one of the defining mythologies of Western modernity.

Although bound up with human fallibility and technological failure, what Babbage's apparatus is really about, as it were, is the rational recuperation of such fallibility and failure. More pointedly, it is about the redemption of human fallibility and technological failure in the name of moral and material progress. "The moment of redemption, however secularized, cannot be erased from the concept" of progress, Theodor W. Adorno declares. "For the enlightened moment in it, which terminates in reconciliation with nature by calming nature's terror, is sibling to the enlightened moment of nature domination."[93] Babbage's apparatus is about man's deployment of the tools of reason and enlightenment to overcome the disaster of reason and enlightenment's own device, thereby and thereafter resuming his movement in a forward direction, with stability and security and even greater momentum. It is, to borrow Ernst Jünger's idiom, about the "drying up" and derealization of dangerousness, about the reduction of bewildering senselessness to understandable erroneousness:

> The supreme power through which the bourgeois sees security guaranteed is reason. The closer he finds himself to the center of reason, the more the dark shadows in which danger conceals itself disperse, and the ideal condition which it is the task of progress to achieve consists of the world domination of reason through which the wellsprings of the dangerous are not merely to be minimized but ultimately to be dried up altogether. The dangerous reveals itself in the light of reason to be senseless and relinquishes its claim on reality. In this world all depends on the perception of the dangerous as the senseless; then in the same moment it is overcome, it appears in the mirror of reason as an error.[94]

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[93] Theodor W. Adorno, "Progress," <u>Benjamin: Philosophy, History, Aesthetics</u>, ed. Gary Smith (Chicago: U of Chicago P, 1989) 89.

[94] Ernst Jünger, "On Danger," <u>The Weimar Republic Sourcebook</u>, ed. Anton Kaes, Martin Jay, and Edward Dimendberg (Berkeley: U of California P, 1994) 370.

Earlier I said that to read Babbage's book of the accident forensically is to read it simultaneously as a book of revelation and as a book of judgment. Yet it is also to read it as a book of prophecy. This is because, "in the mirror of reason," discovering what happened (revelation) and deciding what went wrong (judgment) are conceived not so much as ends in themselves as means to an end. Specifically, they are conceived as means by which to build a "better mousetrap" and, by extension, a "brighter tomorrow."[95] This progressivist ideology penetrates to the core of Babbage's apparatus, as it does to those of all accident technologies.

Let us here recall Babbage's summary statement concerning the value and utility of his apparatus: "I have a very strong opinion that the adoption of such mechanical registrations would add greatly to the security of railway travelling, because they would become the unerring record of facts, the incorruptible witnesses of the immediate antecedents of any catastrophe." The self-registering apparatus differed from the other railroad-safety devices Babbage conceived or championed in at least one crucial respect. Whereas the cowcatcher, the anti-derailment contrivance, and broad-gauge track were designed to protect the lives and limbs of railway passengers as they rode (that is, for the duration of their journey), the self-registering apparatus was designed to protect the lives and limbs of other, anonymous railway passengers in the future. The latter device did not and could not enhance the security of railway travel in the same manner as the former devices. The kind, degree, and sense of security provided by the one was altogether different from the kind, degree, and sense of security provided by the others.

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[95] There is, of course, a variety of ends such discovering and deciding might serve — civil, legal, political, financial, psychological — in other contexts. My chief concern here, however, is the ideological work performed by Babbage's apparatus as a precursory accident technology.

We are dealing here with two distinct scales as well as two distinct temporalities of "security": one macrological and future-directed, the other micrological and present-directed. The self-registering apparatus promised to secure the greater railway system later on, while the other devices promised to secure a single, specific train right now.

These distinctions, moreover, imply and are imbricated with another significant distinction. Whereas Babbage's other railroad-safety devices, once installed, provided security entirely mechanically and practically immediately, the self-registering apparatus by itself provided no security to speak of. Indeed, without the considerable subsequent expenditure of industrial and institutional resources, including the time, labor, capital, and expertise needed to retrieve the "mechanical registrations," decipher them, and implement the systemic changes they are thought to prescribe, Babbage's apparatus cannot be considered a railroad-safety device in any meaningful sense of the term "safety." With the expenditure of those resources, however, it becomes a means by which to project "security" into the future, to pass it onto posterity in effect, as well as a mechanism, literal and figurative, for the sublime production of social and technological progress.

Conclusion

In "The Horrors of Travel," a chapter in his book on the history of train wrecks, Robert C. Reed writes:

> Throughout the nineteenth century America was horrified by a series of railroad catastrophes as boilers burst, bridges crumbled, and engines derailed. Wreck reports appeared frequently after 1853 in the national journals — Harper's Weekly, Leslie's, and Ballou's — publicizing the frightful cost of life and property. Every volume of these weekly magazines illustrated blood chilling artist's sketches of demolished passenger cars, twisted locomotives, and human debris. Daily newspapers also gave wide coverage by spreading

> gore across their front pages. It is no wonder that railroad accidents captured the imagination of the American public.[96]

Reed is commenting on the American context here, but, as Wolfgang Schivelbusch observes, the horrors of railroad accidents were no less anxiously imagined or intensely perceived in Western Europe during the same period:

> The fear of derailment was ever present on train journeys in the early days. The greater ease and speed with which the train "flew" (a typical nineteenth-century term for rail travel) the more acute the feat of catastrophe became: we have already quoted [English politician] Thomas Creevy's statement made in 1829, that the railroad journey was "really flying, and it is impossible to divest yourself of the notion of instant death to all upon the least accident happening." A German text of 1845 speaks of "a certain constriction of the spirit that never quite leaves one no matter how comfortable the rail journeys have become." It was the fear of derailment, of catastrophe, of "not being able to influence the motion of the carriages in any way."[97]

Babbage's self-registering apparatus was born of and into this discursive context, menaced as it was by the morbid shadow of the accident.

Schnapp points out that, contrary to received wisdom, widespread fears and deep-seated reservations concerning the speed and safety of new modes of transportation antedate the rise of the railroad train. By the mid-eighteenth century, for example, the coach, whether a two-wheeled cabriolet, a four-wheeled phaeton, or some other lightweight, horse-drawn vehicle, had become a source of exhilaration for the privileged driver and, at the same time, of exasperation for the general public. According to Schnapp, "The spread of this 'epidemic' of mobile self-display, thanks to which individuality became identified with administration of one's own speed, terrified rural populations and transformed cities like Paris and London into

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[96] Robert C. Reed, Train Wrecks: A Pictorial History of Accidents on the Main Line (New York: Bonanza, 1968) 25.

[97] Wolfgang Schivelbusch, The Railway Journey: The Industrialization of Time and Space in the 19th Century (Berkeley: U of California P, 1986) 78.

nightmarish killing fields in the eyes of many observers."[98] Schnapp's work is important, in part, because it sheds light on an often overlooked chapter in the historical "anthropology of speed and thrill," as he calls it, demonstrating that the modernist cult of accelerated mobility began to crystallize a century or so earlier than is usually supposed.[99]

That said, Schnapp is less attentive to (and, to be fair, less expressly concerned with) the many qualitative disparities between the perils and perceptions of eighteenth-century coach accidents and those of nineteenth-century railroad accidents. As the reference to "nightmarish killing fields" suggests, the private coach represented a hostile takeover of, or at least a dangerous incursion into, public space, insofar as it posed a threat to the safety and security (not to mention the rights and rights-of-way) of pedestrians, bystanders, and others deprived of the new means of accelerated mobility. The railroad, by contrast, was seen as posing a threat to the safety and security not, by and large, to persons and publics deprived of accelerated mobility but, rather, to those who enjoyed its prerogatives. The Schivelbusch quotation illustrates that, for the nineteenth-century public, the horror of the train wreck was the horror of riding — or imagining oneself riding — the train as it wrecked. (Whereas the coachman "administered his own speed" and so experienced the illusion of control and security, the rail rider could not "influence the motion of the carriages in any way" and so experienced the anxiety of helplessness and vulnerability.) Thus, in terms of their spatial, social, and affective relationship to the destructive conveyance, most coach-accident victims differed categorically from most railroad-accident victims.

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[98] Schnapp 14.

[99] Schnapp 3.

In addition to this disparity in categories of victimhood, there existed a disparity in accident intensities and magnitudes. Simply stated, the intensity and magnitude of devastation caused by a serious coach accident did not hold a candle to the intensity and magnitude of devastation caused by a serious railroad accident. Whether reckoned in mortal, material, or social-psychic units of damage, the nineteenth-century train wreck typically dwarfed the eighteenth-century coach crash. This disparity in degrees of damage, moreover, was largely a function of a disparity in degrees of technological complexity, or what Schivelbusch terms "the falling height" of a technical artifact or system:

> It is obvious how closely such a feeling of safety is joined to the technology upon which it is based. The technology has created an artificial environment which people become used to as second nature. If the technological base collapses, the feeling of habituation and security collapses with it. What we called the "falling height" of technological constructs (destructivity of accident proportionate to technical level of construct) can also be applied to the human consequences of the technological accident. The web of perceptual and behavioral forms that came into being due to the technological construct is torn to the degree that the construct itself collapses. The higher its technological level, the more denaturalized the consciousness that has become used to it, and the more destructive the collapse of both.[100]

The steam locomotive, being of a "higher technological level" than any mode of transportation that came before it, including the horse-drawn coach, "collapsed" with unprecedented force and ferocity. And so did "the feeling of habituation and security" that attended it.

This last point leads us back to the claim I made earlier about the discursive context of Babbage's apparatus. The 1830s and '40s, in Great Britain and the United States, were decades of emerging and rapidly expanding industrialization. They were also, not incidentally, decades that witnessed the flowering of an extraordinary faith in the principles

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[100] Schivelbush 162.

and products of science, industry, and technology — expressions of "enlightenment" each and all. This faith had as its chief corollary the ideology of progress. Siegfried Giedion writes: "Eighteenth-century faith in progress as formulated by Condorcet started from science; that of the nineteenth century, from mechanization. Industry, which brought about this mechanization with its unceasing flow of inventions, had something of the miracle that roused the fantasy of the masses."[101] No mechanized invention of the nineteenth century materialized the ideology of progress or "roused the fantasy of the masses" more than the railroad. Yet, at the same time, as Alan Trachtenberg remarks,

> the railroad was never free of some note of menace, some undercurrent of fear. The popular images of the "mechanical horse" manifest fear in the very act of seeming to bury it in a domesticating metaphor: fear of displacement of familiar nature by a fire-snorting machine with its own internal source of power.[102]

Despite the reassuring figure of speech, "the mechanical horse" was not a docile or domesticated animal; despite the continuities between eighteenth- and nineteenth-century "anthropologies of speed and thrill," the railway journey was experientially unlike a ride in a cabriolet or phaeton; and despite the fact that both the train wreck and the coach crash were transportation accidents, the latter did not enact or emblematize the trauma and tragedy of accelerated mobility with the same acuity, intensity, or extremity as did the former.

Fashioned and experimentally deployed in 1839, Babbage's apparatus at once reflected and attempted to reconcile the opposing sides of the early railroad's discursivity, the yin and yang of its technological sublimity: its masterful harnessing of the forces of Nature

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[101] Siegfried Giedion, Mechanization Takes Command: A Contribution to Anonymous History (New York: Norton, 1969) 31.

[102] Alan Trachtenberg, foreword, The Railway Journey: The Industrialization of Time and Space in the 19th Century, by Wolfgang Schivelbusch (Berkeley: U of California P, 1986) xiii.

and its disastrous inability to completely contain them, its status as an icon of reason and its reputation for “erratic behavior,” its rhetoric of progress and its spectacle of catastrophe. On the one hand, Babbage’s apparatus indicated the imperfection of the train’s technological achievement; on the other hand, it implied that that achievement was perfectible, that it could and would be perfected in the future, so long as the accident was made amenable to technical transcription and subjected to scientific investigation. That it pointed toward the future is significant. For unlike other transportation-safety devices of its day, which were designed to operate within tightly circumscribed spatial and temporal parameters (right here, right now, this and only this conveyance), Babbage’s apparatus implicated three distinct temporalities: the accident in the present (as it happens), the accident in the past (as it happened), and the non-accident in the future (so it will not happen again). Writing the accident, reading the accident, and erasing the accident. An inscription in the present tense, a description in the past tense, and a prescription in the future tense: it is precisely this triple-tensing of the accident that made Babbage’s apparatus a precursory accident technology as opposed to simply another single-tense safety device.

Babbage’s apparatus is historically noteworthy, as well as thematically and theoretically central to this dissertation, because it brought together, for the first time, recording instrumentation, mechanized transportation, and the forensic imagination. It crystallized the then-nascent cultural and institutional desire to transform the irregular rhythms of the transportation accident into the regularized data of technoscience, to transmute the dross of technological failure into the gold of scientific knowledge. It constituted a singular socio-technical convergence, articulating together widely and keenly felt anxieties regarding the extreme yet increasingly everyday risks of accelerated mobility, state-of-the-art techniques and technologies of inscription (the graphic method), and an incipient program for decrypting and disciplining the transportation accident by means of those techniques and technologies.

Whereas other nineteenth-century automatic recording devices were conceived with the intention of monitoring and measuring the moments and movements of Nature herself, a pure nature uncontaminated by culture (natural waves of sound, natural pulsations of blood, natural contractions of muscle), Babbage's apparatus was conceived with the intention of registering and recording hybrid vibrations — shakes that straddled the line or blurred the distinction between nature and culture, emanations of energy from a zone of liminality. Were its curvilinear tracings the product of natural forces, or were they the product of mechanical processes? Were the rhythms of the transportation accident — was the accident itself — naturally engendered or anthropogenically engineered? Unlike other graphic-method machines, Babbage's apparatus did not belong to either the "natural science" of acoustics or that of experimental physiology, and it was not designed to transcribe "normal" transferences of energy and their temporalities. Instead, it belonged to the prehistory of fields of scientific endeavor that would not come into being until the twentieth century — forensic engineering and failure analysis — and it was designed to transcribe the decidedly "abnormal" energy transferences and temporalities of technological breakdown. It is for these reasons that Babbage's apparatus represented the first glimmerings of the forensic imagination.

So what happened to those glimmerings? What became of Babbage's self-registering apparatus after 1839? As certain as Babbage was that, if widely adopted, his apparatus would make the railroad safer for the traveling public, he was equally certain that its wide adoption was unlikely, "unless directors can be convinced that the knowledge derived from [it] would, by pointing out incipient defects, and by acting as a check upon the vigilance of all their officers, considerably diminish the repairs and working expenses both of the engine and of the rail."[103] The railroad was a capitalist enterprise, and Babbage suspected that his apparatus's economic value would not be obvious to those empowered to authorize and administer its adoption. Compounding the problem, Babbage conjectured, was the issue of his credibility, or, more exactly, his lack of credentials:

> Since the long series of experiments I made in 1839, I have had no experience either official or professional upon the subject. My opinions, therefore, must be taken only at what they are worth, and will probably be regarded as the dreams of an amateur. I have indeed formed very decided opinions upon certain measures relative to railroads; but my hesitation to make them public arises from the circumstance, that by publishing them I may possibly delay their adoption.[104]

Babbage's hesitation proved prescient. In fact, it would take another century before an auto-inscription instrument would be utilized to record transportation data for the express purpose of ascertaining the cause of an accident. Interestingly, Babbage predicted that his apparatus probably would "be allowed to go to sleep for years, until some official person, casually hearing of it, or perhaps re-inventing it, shall have <u>interest</u> with the higher powers to get it quietly adopted as his own invention."[105]

A historically rigorous account of why Babbage's apparatus was "allowed to go to sleep for years" is beyond the scope of this study. Suffice it say that the history of technology is not a Rip Van Winkle fairytale, and a technical artifact does not become widely adopted simply because of one person's interest or influence with "the higher powers." Contrary Babbage's simplistic speculation, the reasons for any given technology's adoption or, in this

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[103] Babbage 249.

[104] Babbage 245.

[105] Babbage 245.

case, non-adoption are no doubt overdetermined. That is to say, they are multiple, contingent, heterogeneous, and frequently contradictory, and they cut across the domains of the social, cultural, political, and economic. The next chapter considers several of these complex determinations in relation to the twentieth-century emergence and institutionalization of the "black box."

CHAPTER TWO

THE EMERGENCE OF FLIGHT RECORDERS

Introduction

In 1937, The New York Times and Science each reported on the development of a new aviation technology: the flight recorder, or, as Science dubbed it, “the flight analyzer.”[106] Introduced by engineers of the Bureau of Air Commerce during a three-day air-safety conference summoned by the Department of Commerce, the device consisted of a barometric altimeter, three automatic indelible-ink pens, and a three-by-five-inch card attached to a revolving cylinder, all encased in a three-pound, roughly six-by-eight-inch duralumin shell. One pen continuously traced the plane’s altitude from takeoff to landing; one registered the time and number of radiotelephone communications from pilot to ground stations; and one recorded information about the operation of the automatic pilot.[107] Installed in the tail section of the aircraft prior to takeoff and removed for inspection “immediately upon landing,” the

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[106] “New Device Gives Check-up on Fliers,” New York Times 4 Feb. 1937: 15. “Flight Recorders for Commercial Transport Planes,” Science 27 Aug. 1937: supp. 7. In contemporary usage, the term “flight recorder,” like the term “black box,” can designate either the flight-data recorder or the cockpit-voice recorder. In this section and the next, “flight recorder” refers only to the former.

[107] There is some ambiguity in the historical record as to the function of the latter pen. The New York Times article, which carries a February 3, 1937, dateline, makes no mention of an automatic-pilot pen. Instead, it claims that “the third [pen] will set down the record of the radio beacon receiver whether it functions or not and for how long” (“New Device Gives Check-up on Fliers” 15). The Science article, on the other hand, makes no mention of a radio-beacon-receiver pen. Assuming that each article was factually accurate at the time of its publication, it is reasonable to infer that the device’s design was modified, if perhaps only slightly, at some point after the appearance of the Times piece and before the August 27, 1937, appearance of the Science piece.

flight recorder was designed to function for eight hours at a stretch, which, as Science observed, was "much longer than any scheduled non-stop flight" in 1937.[108] Its intended purpose was to improve the efficiency and safety of commercial-transport aviation by making it "possible for the pilot himself, the dispatchers and the chief pilots to reconstruct completely the story of the plane's flight."[109]

Framing the question in terms of pilot consciousness/conscientiousness, the Times article stressed the device's utility as an instrument of discipline and deterrence:

> For a long time operators and government officials have been trying to devise ways and means to make the pilots "altitude conscious." Low flying, they believe, has been responsible for a number of serious accidents, and the accident reports of the bureau have pointed this out. While there is a government regulation requiring an altitude of at least 500 feet above all ground obstacles in the best of weather and higher flying when the weather is bad, there hitherto has been no way of checking exactly how high the planes stay, save when a disastrous crash reveals the fact that the pilot has been too close to the ground. "This instrument should make the pilots 'altitude conscious,'" one official said today, "and should go a long way toward making flying safer."[110]

Published six months later, the Science article, too, indicated the flight recorder's surveillant possibilities, noting that "Company officials will also be able to check on whether safety regulations with regard to altitudes at which the planes fly have been carefully observed. A check is also provided on the airways' traffic control scheme enforced in major airline services." At the very end of the article, a rather more ominous potential use for the machine was mentioned:

> The analyzer will also aid future safety work by providing a permanent record of what went on in the plane before any accident that might occur. Analysis of

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[108] "Flight Recorders for Commercial Transport Planes" 7.

[109] "Flight Recorders for Commercial Transport Planes" 7.

[110] "New Device Gives Check-up on Fliers" 15.

> accident causes has frequently been hampered in the past by the fact that little was known of the plane's behavior immediately before disaster overtook it.[111]

In the previous chapter, I showed how Charles Babbage's self-registering apparatus for railroad trains served as a nineteenth-century precursor to the twentieth-century accident technology commonly known as the "black box." This chapter continues to explore the conceptual, cultural, and discursive origins of the black box by focusing on the early histories of the twin technologies that compose it: the flight-data recorder and the cockpit-voice recorder. Throughout, I analyze the peculiar ways in which early flight-data and cockpit-voice recorders articulated and were articulated by dreams of epistemological certainty, media survivability/machinic indestructibility, and social and technological progress. I also consider their imbrication with discourses and practices of surveillance/deterrence, national security, and transportation safety. Particular attention is paid to the origins and implications of two models of flight recorder: the General Mills Ryan Flight Recorder (a data recorder) and the ARL Flight Memory Unit (a voice recorder), both of which emerged during the mid-1950s. I argue that these technologies reflected and expressed the postwar crystallization of the cultural impulse to turn the transportation accident into an object of scientific and institutional analysis, knowledge, and control.

Early Flight Recorders

In 1937, <u>Science</u> stated that sixty United Air Lines planes had been equipped with the flight analyzer, and that all commercial airliners in the United States would be so equipped in the near future. Instead, the near future brought World War II and, consequently, a reordering

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[111] "Flight Recorders for Commercial Transport Planes" 7.

of military and civilian priorities, along with a reallocation of social, economic, and technological resources.

During the war, flight recorders of one sort or another, through their utilization in military flight-testing, were implicated in the problem of national security. Aviation announced in 1942 that “a corps of electronic and mechanical design engineers” at Brown Instrument Company, a subsidiary of Minneapolis-Honeywell Regulator Company, had developed “a new type of self-balancing electronic potentiometer” (an instrument for measuring electromotive forces) specifically for the Douglas B-19, then the largest airplane in operation.[112] The device, which automatically generated a graph-paper printout of motor, carburetor, exhaust, and oil-line temperatures, as well as wing-strut, bulkhead, and tail-surface pressures, relieved the flight-test engineer of his manual note-taking duties. According to Aviation,

> with an instrument of this type installed in the plane, readings will be made regularly and automatically and the pilot may devote his entire attention to the proper manipulation of the airplane controls. Another advantage of the flight recorder is that many more readings may be obtained in a given time interval so that much more complete and detailed information of the flight is available than has heretofore been the case where readings were recorded manually.[113]

During the same period, Vultee Aircraft Corporation manufactured and marketed its own flight recorder. More sophisticated than Brown Instrument’s potentiometer, the Vultee Radio-Recorder, or “test-flight stenographer,” as it was informally called, electronically registered a wide range of strains, motions, pressures, and temperatures by means of specially designed pickups, and instantaneously telemetered the information by frequency-modulation

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[112] “Flight Recorder to Ease Test Pilot’s Job,” Aviation Nov. 1942: 149. See also “Flight Recorder Takes Over Some Flight Engineer’s Duties,” Scientific American Jan. 1943: 41.

[113] “Flight Recorder to Ease Test Pilot’s Job” 149.

radio to a ground station where it was simultaneously recorded on several different media — wax disks, sound film, and paper charts.[114]

Like the Brown Instrument flight recorder, the Vultee Radio-Recorder was designed to increase the accuracy, reliability, and efficiency of data collection through automation. The Vultee technology, however, enjoyed a distinct advantage over not only Brown Instrument's potentiometer but also the military's previous data-collecting system, in which cockpit-mounted high-speed motion-picture cameras filmed the airplane's instrument panel. Since the test-flight stenographer's airborne registering apparatus was spatially separated from its terrestrial recording apparatus, the data it yielded would not be damaged or destroyed in the event of a flight-related accident (unless, of course, the plane crashed into the ground station, an improbable circumstance to be sure). In 1943, <u>Radio News</u> called attention to precisely this advantage:

> Pilots testing warplanes are faced with the necessity of controlling their planes during severe gyrations, and cannot be expected to record faithfully the many instrumental readings. Because the many factors of atmospheric conditions, vibrations, fuel flow, etc., are often variables, frequently changing by split-seconds, readings and recordings must be taken very rapidly. One reason alone is adequate to provide radio transmission for these readings. Should the plane crash, valuable data would otherwise be lost. What caused the failure? Very likely we never would learn the answer. As it is, however, those records are safely in the keeping of engineers on the ground at the very moment those in the plane are lost.[115]

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[114] "Wing Talk," <u>Collier's</u> 26 Dec. 1942: 8+. Harvey D. Giffen, "A Flight Recorder for Aircraft," <u>Radio News</u> Apr. 1943: 14-17+. Lynn C. Thomas, "Flight Test Recorder," <u>Flying</u> May 1943: 60-61+. Thomas B. Thomson and Willard C. North, "Electronic Flight Recorder," <u>Radio News</u> Feb. 1945: 25-27+.

[115] Giffen 15. <u>Flying</u> put it this way in an article published one month later: "The advantages of using radio transmission is [sic] obvious, for in testing new type airplanes it is not unusual to lose a ship in a crash and too often the cause of the failure cannot be determined. With flight test data transmitted to the ground by radio, a permanent record of what transpired is available and in all probability would prevent a duplication of the accident" (Thomas 61).

Two years later, in another article on the Vultee flight recorder, Radio News reiterated this point in a way that explicitly emphasized its potential as an accident technology as well as its association with technoscientific progress:

> [The Vultee Radio-Recorder gives] us the composite picture of the airplane, instantaneously and accurately. Once we relied upon motion pictures and "magic eye" cameras to record instrument indications. If an experimental airplane crashed, odds favored the records being mutilated. Now, thanks to electronic recording, we can know what took place up to the instant of the crash, and perhaps find from those records how to avoid a repetition. In any event, electronic recording marks great progress in flight-testing of aircraft.[116]

The electrical liveness and indestructible ethereality of radio promised the post-crash survivability of flight-test data — and with it, both the safety of aviation through the avoidance of catastrophic repetition and, as Collier's suggested in 1942, the security of the nation through debugging and diagnostic auscultation:

> The most important result of the new apparatus is that it should shorten the development period of new bombers and fighters considerably. Vultee engineers declare that, in effect, it enables them to put a stethoscope on new planes and get at their defects more quickly. "Bugs" in very hot new airplanes have often delayed their appearance on the fighting fronts by many months due to a lack of exact performance data. The new development is to be made available to the entire aviation industry.[117]

The aviation industry, however, remained unimpressed, or at least unmoved. Indeed, interest in radiotelemetric flight recorders waned in the postwar years, perhaps because of the various costs and complexities involved in establishing, operating, and maintaining the apparatus's ground-station component. By contrast, mechanical-inscriptional flight recorders, after a wartime hiatus, became objects of considerable technical innovation, commercial investment, and governmental attention.

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[116] Thomson and North 82.

[117] "Wing Talk" 53.

In June 1940, the Air Safety Board, which had been created two years earlier with the passage of the Civil Aeronautics Act, was abolished at the behest of President Franklin D. Roosevelt, and its accident-investigating duties were transferred to the newly established Civil Aeronautics Board (CAB).[118] Responding to a series of airline crashes in the early 1940s, the CAB called for the installation of some sort of airborne record-keeping mechanism that would remain intact in the event of an accident: a crash-protected flight recorder. Wartime shortages delayed the development of a such a device, and, according to Dennis R. Grossi, National Resource Specialist for Flight-Data Recorders at the National Transportation Safety Board, “after extending the compliance date three times, the CAB rescinded the requirement in 1944.”[119]

Three years later, in September, the CAB revisited the issue, adopting Civil Air Regulation amendments that required the installation of flight recorders by June 30, 1948, on all cargo and passenger planes. In March 1948, the requirement was relaxed so as to make it “applicable only to planes with a certificated maximum takeoff weight of 10,000 lb. or over,” and a few months later, it was rescinded altogether.[120] Aviation Week covered the story in July 1948:

> The Board’s Safety Bureau now has announced that delays in producing adequate flight recorders made it impossible for the airlines to comply with the requirement by June 30. It also said that because all of the flight recorders available are of new design, some operational experience is desirable to prove

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[118] Robert Burkhardt, The Federal Aviation Administration (New York: Frederick A. Praeger, 1967) 16.

[119] Dennis R. Grossi, “Aviation Recorder Overview,” International Symposium on Transportation Recorders, May 3-5, 1999, Arlington, VA <http://www.ntsb.gov/events/symp_rec/proceedings/authors/grossi.htm>. See also Vanda Sendzimir, “Black Box,” American Heritage of Invention & Technology Fall 1996: 28.

[120] “Board Is Cautious on Flight Recorders,” Aviation Week 12 July 1948: 53.

> the serviceability and dependability of each type before requiring that all transport aircraft be equipped with the device.[121]

Vacillations in governmental regulation throughout the 1940s did not dissuade some manufacturers from attempting to answer the CAB's call for a state-of-the-art flight recorder. Science Digest reported in 1947 that General Electric Company had been working on an "automatic flight recorder, designed to provide recorded data which will help determine the cause of aircraft mishaps."[122] The device had two distinctive characteristics. First, it recorded the plane's altitude, vertical acceleration, airspeed, compass-heading, and other parameters by means of an inkless mechanism. A stylus etched a groove, two-hundredths of an inch in width, into black paper coated with a thin layer of white lacquer, thus avoiding the difficulties that sometimes vexed inking instruments at high altitudes, such as blotting, clogging, and freezing.[123] Second, it used a system of "selsyns," tiny electrical signaling devices, to instantaneously transmit readings from the aircraft's instruments to the flight recorder.

Engineers at General Electric claimed that "the new instrument promotes safety . . . by furnishing recorded data which may later determine the cause of an accident to the plane."[124] The utility of such data, of course, depended on the durability of the medium that manifested it. Yet, apart from the fact that it was designed to be placed in the plane's tail

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[121] "Board Is Cautious on Flight Recorders" 53.

[122] "Flight Recorder," Science Digest July 1947: 95. See also "Device Aids Plane Safety," New York Times 28 Jan. 1947: 3.

[123] Sendzimir 28.

[124] "Flight Recorder," Science Digest 96.

section, General Electric's automatic flight recorder possessed little in the way of crash protection.

The General Mills Ryan Flight Recorder

A few years later, a less likely corporate "General" — General Mills, the cereal company — debuted its own flight recorder.[125] The General Mills Ryan Flight Recorder, so named for James J. Ryan, the General Mills employee and University of Minnesota professor credited with its invention, was designed to provide what Flying in 1954 called "an absolute and permanent record of an aircraft's air speed, altitude, vertical acceleration, time and heading."[126] Self-contained save for its connections to the plane's gyrocompass, General Mills' flight recorder, unlike General Electric's, was entirely mechanical, requiring no internal electronics or remote pickups. Driven by a battery-powered spring motor and capable of operating for up to 300 hours without reloading, the oscillographic device fed a sheet of aluminum foil, one millimeter thick and two-and-a-quarter inches wide, through an escapement mechanism that controlled its rate of speed, between three-and-a-half and five-and-a-half inches per hour. Each of four styli inscribed a discrete data parameter: velocity, g-force, altitude, and time. (An early incarnation of the instrument bore the name Ryan VGA

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[125] By the 1940s, Minneapolis-based General Mills had become much more than a cereal company. During World War II, the company's Mechanical Division developed and manufactured gunsights, bombsights, torpedoes, and other precision-control instruments for the U.S. Army, Navy, and Air Force. Shortly after the war, it worked on a number of government-sponsored hot-air-balloon projects, some of which concerned the atmospheric effects and implications of atomic radiation. See "General Mills: Seventy-five Years of Innovation, Invention, Food, and Fun" <http://www.generalmills.com/corporate/company/hist_decades.pdf>.

[126] Page Shamburger, "Flight Recorder," Flying Mar. 1954: 42. See also "Flight Data Recorder Uses No Electronics," Aviation Week 14 Sept. 1953: 84; "Flight Recorder," Time 9 May 1955: 105; "Instrument Records Flight Performance," National Safety News June 1955: 64; and Sendzimir 28-29.

Flight Recorder, the initials “VGA” standing for the first three of these parameters.) In 1955, National Safety News noted that “The instrument makes it possible to preserve records for evaluation of aircraft performance, stresses encountered in flight, . . . severe atmospheric disturbances, landing shocks, and other flight conditions.”[127]

To a greater degree than any previous mechanical-inscriptional flight recorder, Ryan’s contrivance was designed — and tested — for data indestructibility. As such, it represented the clearest, most compelling response to the CAB’s call for a crash-protected graphic-recording mechanism during the postwar period. In a technical paper presented in April 1955 at The American Society of Mechanical Engineers Diamond Jubilee Spring Meeting in Baltimore, Ryan specified the device’s protective features and preservative functionalities:

> [The flight recorder] is spherical in shape to maintain the greatest rigidity against impacts due to aircraft crash. Between an internal and external sphere is a 1 in.-thickness of perlite insulation which is sufficient to prevent melting of the aluminum foil inside the recorder after 1/2-hr exposure to an intense heat of a fuel fire.[128]

Elaborating further, Ryan highlighted the flight recorder’s herculean ability to withstand tremendous forces and to survive hostile environments:

> The instrument functions over the range of ambient temperatures from –30 to +50 C and is not affected by extreme exposure of –65 C to +70 C. The recording medium . . . is not subject to deterioration or distortion. . . . The unit functions properly, and is not adversely affected, when exposed to extreme conditions of humidity as normally specified. The recording medium remains intact so that the intelligence can be analyzed when the instrument is subjected to a 100-g impact shock, and when exposed to flames at 1100 C for a period

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[127] “Instrument Records Flight Performance” 64.

[128] J. J. Ryan, “The General Mills Ryan Flight Recorder,” The American Society of Mechanical Engineers Diamond Jubilee Spring Meeting, April 18-21, 1955, Baltimore, MD (New York: The American Society of Mechanical Engineers, 1955) 1.

> of 30 mins. It also is capable of remaining permanent and reproducible after exposure to a 36-hr period of immersion in sea water.[129]

Ryan could wax authoritative about his invention's extraordinary tolerances and endurances because it had been subjected to a battery of scientific tests, both in the laboratory and in the field. Three kinds of test were conducted: calibration, environment, and flight. The calibration tests microscopically measured the precision, "the displacement and the true position," of the recording styli as a function of time.[130] The environment tests, carried out by the Civil Aeronautics Administration Technical Development and Evaluation Center in Indianapolis, analyzed the apparatus's capacity to endure extremes of temperature, vibration, and humidity. According to Ryan, "the instrument survived a crash of 97 g, immediately followed by insertion in a large gasoline-fired torch for ½ hr. The record, although annealed, remained permanent and reproducible after these tests."[131] The flight tests, in contrast to the environment tests, examined the recorder's accuracy and reliability under "normal" conditions of operation (that is, during routine flights). By July 15, 1954, prototypes of the device had logged a total of 732 flying hours aboard commercial aircraft (DC-3s, DC-6Bs, Martin 202s, Convair 340s), as well as another 1,200 or so aboard non-commercial aircraft, without malfunction.

As we have seen, the technoscientific dream of, and industrial and governmental desire for, an automatic graphic-recording instrument capable of generating "an absolute and permanent record" of an airplane accident dates back to at least the 1930s. Before then, essentially the same impulse underlay the invention, in the late 1830s, of Charles Babbage's

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[129] Ryan 3-4.

[130] Ryan 4.

[131] Ryan 5.

self-registering apparatus for railroad trains, which promised to produce an "unerring record of facts" regarding "the immediate antecedents of any catastrophe."[132] Whether designed for planes or for trains, it was thought that such a device would help the experts crack the catastrophe's code by preserving a record of "absolute" and "unerring" facts; in turn, that cracked code would be employed by the authorities to make the system of conveyance safer in the future.

The General Mills Ryan Flight Recorder rearticulated these dreams and desires, as well as the cultural fears and phantasms that underlay them, in the context of postwar America. On the one hand, it pointed to the perils of speed and the problem of the accident, embodying the anxieties and uncertainties of an accelerated citizenry increasingly accustomed to, and dependent on, mechanized means of transportation. On the other hand, it signaled the future possibility of epistemological certainty, bodily safety, and existential security through the purposeful acquisition, progressive accumulation, and positivist analysis of technical "intelligence." In this respect, the institutionalization of the flight recorder in the 1940s and 1950s mirrored the Cold War era's massive and multifarious investment — economic, institutional, psychological, ideological — in the protective possibilities of high-tech surveillance, electronic data processing, and communications interception and decryption, undertaken in the name of national security.

In his paper's concluding section, Ryan enumerated eleven of his contrivance's potential applications. Taken together, the first of these ("Provide a reliable means for analyzing and studying air failures") and the last of these ("Make all flying safer by the accumulation of this measured knowledge") strongly suggest that the new and improved

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[132] Charles Babbage, Passages from the Life of a Philosopher, ed. Martin Campbell-Kelly (London: Pickering & Chatto, 1991) 248.

flight recorder of the 1950s, like all accident technologies, represented a response to technocultural fear and, and the same time, a remedy through technoscientific faith.[133] Crucially, that remedy was predicated on the notion that a single catastrophic accident, if mechanically measured and scientifically studied, could prevent similar accidents in the future. "Thus an attempt is made to insure that an air failure need only occur one [sic] to prevent its reoccurrence," Ryan insisted. "As Lord Kelvin so aptly pointed out, 'To measure is to know!'"[134] The implication here is fascinating: the accident is not an irredeemable failure but a <u>sacrifice</u> for posterity. Evidence of error in the present, so stark and terrifying, is made to feed a fantasy of future infallibility. The tools of technoscience have the power to break the cycle of violent and destructive accidentality.

The notion that "failure need only occur once to prevent its reoccurrence," that the accident can be technically monitored, scientifically measured, and institutionally mobilized to prevent its virulent replication, constitutes one of the pillars of accident-technology mythology. This notion follows the logic of what Roland Barthes calls "the inoculation." For Barthes, the figure of the inoculation "consists in admitting the accidental evil . . . the better to conceal its principal evil. One immunizes the contents of the collective imagination by means of a small inoculation of acknowledged evil; one thus protects it against the risk of a generalized subversion."[135] In other words, when something bad happens that threatens to

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[133] Ryan 8.

[134] Ryan 8. In his paper's introduction, Ryan stated: "The cause of aircraft crashes and operational failures may be determined from an analysis of the history of the flight immediately preceding and following the difficulty. From this knowledge, corrective measures to prevent reoccurrence may be instituted. Such statistical information is necessary to safely fly air vehicle[s], and to predict the development needs of the future; thus, since only a small per cent encounter difficulty, all aircraft should carry recorders" (Ryan 1).

destabilize the social order, the stability and sustainability of the social order is served when the existence of that bad something is conceded and confessed, rather than ignored or denied. It must, however, be conceded and confessed in a very particular way. The social order itself must not be subjected to searching inquiry and analysis, much less condemned outright. Its fundamental illogicalities and inadequacies must not be called into question, as doing so might precipitate a mass revolt. Instead, a "bad apple" must be singled out, made an exception. This "small inoculation" ensures the survival of the system and the preservation of the status quo.

We can begin to appreciate some of accident technologies' (in this case, the flight recorder's) ideological operations and sociopolitical implications by using Barthes' concept of inoculation. Accident-technology mythology admits "the accidental evil" of the technological accident. But it does so strategically. Consider how flight recorders are discursively constructed and contextualized in the journals, magazines, and newspapers cited in this chapter. The flight recorder is an instrument that, by its very being, acknowledges the "evil" existence of the aviation accident. Its ostensible necessity calls attention to the distressing presence and nagging possibility of human error and mechanical failure (the latter conceived as a variant of the former, since, in this formulation, machines are only as good as their makers). Thus, accounts of the flight recorder in the press — trade, hobbyist, popular — are effectively compelled, if only for the purposes of expository clarity and referential coherence, to evoke a world in which disaster strikes, things fall apart, and humans suffer and die. This compulsory evocation, however, in no way challenges the cultural common sense; it neither serves as an incisive critique of technoscientific logics and technocapitalist relations,

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[135] Roland Barthes, Mythologies, trans. Annette Lavers (New York: Noonday-Farrar, Straus and Giroux, 1972) 150.

nor runs the risk of inciting “a generalized subversion” against them. On the contrary, it administers an ideological inoculation on their behalf, delivering the disease, but only in a small dose; exposing “the collective imagination” to trauma, but not too much trauma; shocking the system, but in a way that renders it more shock-resistant thereafter. This rhetoric evokes a disastrous, disintegrative, and dangerous world, to be sure, but only and always in terms of a problem to be solved, a malfunction to be fixed. Or rather, it evokes that world only and always in terms of a problem that <u>can</u> and <u>will</u> be solved, a malfunction that <u>can</u> and <u>will</u> be fixed, with the help of technoscientific knowledge and technocapitalist product, here instantiated in the form of the flight recorder. In the end, the “principal evil” this discourse “conceals” — conceals precisely (and paradoxically) in the act of <u>singling it out</u>, understood in the double sense of identifying it and excepting it, of nominating it and anomalizing it — is the inevitability, the ineradicability, and, despite Ryan’s dream of a machine that would prevent the reoccurrence of failure, the necessary iterability of transportation crash and technological catastrophe.

In addition to rearticulating key elements of accident-technology mythology, dominant discourses concerning the General Mills Ryan Flight Recorder rehearsed and reinscribed what might be called the cultural fantasy or trope of the indestructible machine, or, alternately, the invulnerable technology. In the West, this fantasy extends at least as far back as 1482, when Leonardo da Vinci, in a letter to Ludovico il Moro, Duke of Milan, wrote of having prepared plans for bridges that are “secure and indestructible by fire and battle,” for “vessels which will resist the fire of the largest cannon, and powder and smoke,” and for “covered cars, safe and unassailable, which will enter among the enemy with their artillery, and there is no company of men at arms so great that they will not break it."[136] Beyond Leonardo and the Italian Renaissance, the notional nexus between machinic unassailability and military vehicles/vessels expanded and intensified with developments in battlefield technology during the twentieth century. From World War I tanks such as the British Mark I ("Big Willie," "Mother") to World War II airplanes such as the American B-17 "Flying Fortress" to post-Cold War submarines such as the Russian Kursk, the idea of the mobile, heavily armored, virtually invincible war machine has continually exercised the modern military-industrial imagination, even as it has continually exacted substantial sums from the coffers of the modern military-industrial state.[137]

Apart from its martial incarnations, the indestructible machine has been a popular topos in news and entertainment media throughout the twentieth century.[138] For instance, prior to its fatal collision with an iceberg on April 14, 1912, the Royal Mail Steamer Titanic was widely hailed as "unsinkable," a mechanical marvel of unparalleled size, strength, and security. However devastating its short-term social-psychic effects, the sinking of the "unsinkable" ocean liner did not destroy the currency of the trope of the invulnerable technology, as even a cursory inspection of science-fiction thematics and iconography attests. Indeed, across the entire spectrum of science-fiction forms (novels, comic books, movies,

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[136] Leonardo da Vinci, The Notebooks of Leonardo da Vinci, ed. Irma A. Richter (Oxford: Oxford UP, 1952) 294, 295. I am indebted to Tyler Curtain for pointing me to Leonardo.

[137] Surely no military vehicle or vessel, over the course of its history, has more potently or prominently embodied the idea of machinic indestructibility than the tank. For a cultural history of the tank, see Patrick Wright, Tank: The Progress of a Monstrous War Machine (London: Faber and Faber, 2000).

[138] Although my research has not been able to confirm this, I would speculate that the fantasy of the indestructible machine enjoyed some measure of popular-media currency in the nineteenth century as well, perhaps in connection with the steamship, the railroad train, or the industrial engine.

radio programs, television shows, videogames), the android, “replicant,” or spaceship that proves impervious to all manner of attack, thanks to its impenetrable armor, electromagnetic force field, or other means of fortified protection, has been a hallmark of the genre. Probably the most famous, and certainly the most spectacular, examples have come from Hollywood films: Gort, the towering robot in The Day the Earth Stood Still (1951), and the Terminator, the unstoppable cyborg from the 1984 blockbuster (and its 1991 and 2003 sequels) of the same name.

The discursive history of the phonograph offers a different kind of example. During the period of its emergence, phonography was frequently invested with fantasies of preservation and permanence.[139] Jonathan Sterne writes: “From the moment of its public introduction, sound recording was understood to have great possibilities as an archival medium. Its potential to preserve sound indefinitely into the future was immediately grasped by users and publicists alike.”[140] Thomas A. Edison attested to his invention’s durability thus: “Repeated experiments have proved that the [record’s] indentations possess wonderful enduring power, even when the reproduction has been effected by the comparatively rigid plate used for their production.”[141] Pushing the promise of permanence to its logical limit,

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[139] Preservation and permanence are intimately interrelated but differently inflected concepts. While each addresses the issue of archivability, the former accentuates the informational indelibility of the archival medium (the fact of having been recorded), the latter the physical durability of the archival medium (the form of the record). All recording media, by definition, have the capacity to preserve information. My concern here is with the imagined possibility of permanence, specifically in relation to the fantasy of indestructibility.

[140] Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham: Duke UP, 2003) 288. See also Carolyn Marvin, When Old Technologies Were New: Thinking About Electric Communication in the Late Nineteenth Century (New York: Oxford UP, 1988) 203-205.

[141] Thomas A. Edison, “The Phonograph and Its Future,” North American Review May-June 1878: 529.

one Albany, New York-based company went so far as to name itself the Indestructible Phonographic Record Company. Sterne notes that

> The company's advertisements emphasized the durability of the cylinders and played on the idea of indestructibility with pictures of a child putting a stick of dynamite into a cylinder or polar bears rolling around on Arctic ice with one in a cylinder, although the process or the material composition of the cylinders was never explained.[142]

Here is a recording medium that can withstand an explosion of dynamite, that can survive immersion in frigid water (in the advertisement, the two polar bears are in the process of rolling a third bear, encased in an oversized phonographic cylinder, off the edge of an ice sheet and into what is presumably the Arctic Ocean). Although directed at a very different audience, these promotional images from 1908 strikingly anticipate Ryan's contention, advanced forty-seven years later, that his flight recorder's medium is analyzable after being subjected to "a 100-g impact shock," "flames at 1100 C for a period of 30 mins," and "a 36-hr period of immersion in sea water."

Whereas the Indestructible Phonographic Record Company's advertisements were to be taken with a grain of salt, claims of indestructibility made for Ryan's contrivance, whether proffered in technical papers or publicized in the press, were to be taken at face value. Humorous and obviously hyperbolic, the former could not have convinced a reasonable reader that the company's cylinders were really dynamite-proof, frost-proof, or seawater-proof. Clearly, the ads' point — their pitch — was that, compared to other commercially available sound-recording media, made of inferior materials (wax, tinfoil, paraffin), Indestructible's cylinders, made of celluloid, were sturdier, more durable, lasted longer. Something like "creative license" allowed the company to associate its product with a child

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[142] Sterne 299.

setting off a stick of dynamite or a trio of polar bears playing on an Arctic ice sheet. General Mills and James J. Ryan, by contrast, were neither in need of, nor entitled to, any such license, any allowance for "puffery," when describing their product's properties and capacities. Their descriptions, precise and propositional, were to be taken literally, issuing as they did from authoritative social actors (a major food corporation with research-and-development ties to the U.S. military, a senior corporate engineer and university professor), and predicated as they were on scientific evidence and experiment.

Throughout their history, recording media, from clay tablets to phonographic cylinders to compact discs to the latest digital-storage software, have been imagined as being imperishable and/or indestructible.[143] The General Mills Ryan Flight Recorder at once radicalized and recontextualized these imaginings. Not only did it hold up under extremely adverse conditions (high-speed impact, blazing fire, freezing cold, seawater immersion), it was literally built for them. Equipped for every conceivable calamity, its mission was to go to hell and back, as it were, and to faithfully report on what it had "sensed" and "experienced." No longer was preservation merely a matter of duration and functional longevity, or permanence merely a matter of ordinary wear and tear ("normal use"). Now those concepts designated the ability of the mechanism's hardware to withstand the severest of trials, the most excruciating of ordeals, as well as the ability of its software to remain not only "permanent and reproducible" but also free from "deterioration or distortion" in the

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[143] For a brief but interesting piece on the compact disc's mythos of indestructibility, see Steve Knopper, "Are CDs Rotting Away? 'Indestructible' Technology Shows Its Age," Rolling Stone 25 June 2004 <http://www.rollingstone.com/artists/thebarkays/articles/story/6209257/are_cds_rotting_away?rnd=1142782584234&has-player=true&version=6.0.11.847>.

aftermath of those trials and ordeals.[144] In the economies of private entertainment and popular consumption, the ideal of recording-media indestructibility revolved around the promise of repeated listenings, of undamaged medium-form and undiminished medium-content (“fidelity”), day after day, play after play. In the wider economies of science, industry, and government, on the other hand, it pointed to the nested possibilities of forensic discovery through mechanical reliability and reproducibility, and social betterment — more certainty and security, less apprehension and anxiety, increased efficiency and productivity — through technological improvement and advancement.

By the late 1950s, General Mills had sold the design for its flight recorder to Lockheed Corporation, which “produced it as Model 109-C until 1969.”[145] Meanwhile, the Civil Aeronautics Board issued another round of regulations in 1957, this time mandating that all aircraft weighing more than 12,500 pounds and carrying passengers above 25,000 feet be equipped with a crash-protected, five-parameter, foil-oscillographic flight recorder by July 1, 1958. The regulations demanded compliance with Technical Standards Order TSO-C51, which specified the device’s recording parameters (time, altitude, airspeed, compass heading, and vertical acceleration), sampling interval, range of accuracy, and survivability

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[144] The technical distinction between hardware and software is important to keep in mind when considering claims of recording-media indestructibility. What made the General Mills Ryan Flight Recorder “indestructible” was not, by and large, its software — the medium per se — but its hardware: the spherical shape of the case, the one-inch-thick perlite insulation, and so on. It could be argued, in view of this fact, that to compare the indestructibility of Ryan’s contrivance to that of phonographic cylinders, as I have done, or to that of any commercially available recording medium for that matter, is specious because it exploits a conceptual slippage, perpetrates a “category mistake.” According to this line of reasoning, it would be more apposite to compare the case or container of the one to the case or container of the other. My response to this hypothetical objection would be that we are dealing here with dreams and discourses of recording-media indestructibility, and that it is precisely this slippage, this blurring of the distinction between hardware and software, that operates in the discursive construction of the General Mills Ryan Flight Recorder’s indestructibility.

[145] Sendzimir 29. Lockheed also produced a rectangular version, Model 109-D, shaped so as to fit into the cockpit’s radio rack.

thresholds.[146] Even more than in the previous decade, the issuance of new CAB regulations invited commercial innovation and market competition, and within a few years several companies besides Lockheed were manufacturing TSO-compliant flight recorders, including Sundstrand, Waste King, Allied Signal, Fairchild Aviation, and Minneapolis-Honeywell.[147]

In August 1958, President Dwight D. Eisenhower signed into law the Federal Aviation Act, transferring from the CAB to the newly created Federal Aviation Administration (FAA) the responsibility for issuing safety rules and regulations. Issued by the FAA in 1966, Technical Standards Order TSO-C51a, in addition to requiring that an aircraft's flight recorder be located as far aft as feasible, appreciably increased two of the performance standards specified in TSO-C51 — impact shock (from 100 Gs to 1000 Gs for five milliseconds) and seawater immersion (from thirty-six hours to thirty days) — and added three more for good measure: static crush (5,000 pounds for five minutes on each axis), impact penetration (500 pounds dropped from ten feet with a quarter-inch-diameter contact point), and corrosive fluids (immersion in oil, fuel, and other aircraft fluids for a period of twenty-four hours).[148]

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[146] Significantly, the survivability thresholds specified in TSO-C51 — 100-g impact shock, 1100° C fire for thirty minutes, immersion in seawater for thirty-six hours — exactly matched the tolerances and endurances Ryan claimed for his invention. Its engineering and design details, its subjection to scientifically controlled destructive testing, its role as regulatory standard-bearer — all support the proposition that the General Mills Ryan Flight Recorder marked an important break, a genealogical rupture of sorts, with previous flight recorders. In this sense, it represented the first truly modern flight-data recorder.

[147] Sendzimir 29. See also "Flight Recorder Competition Grows as ATA Asks Deadline Extension," Aviation Week 6 June 1960: 38.

[148] See Grossi's "Aviation Recorder Overview" for more on the technical and regulatory history of flight recorders in the United States.

The Military/Maritime Phonograph

Reporting on military affairs in England in 1888, a foreign correspondent for The New York Times recounted his recent conversation with a British officer concerning the naval and military possibilities of Thomas A. Edison's "talking machine":

> A distinguished officer said to me, after we had inspected Edison's phonograph . . . , "I wonder can that be adapted to naval and military use?" Subsequent conversation with him developed these ideas. There is hardly a campaign of which we have a complete record; there is hardly an accident at sea of which we have ever heard, or that did not give rise to the question of the exact wording and precise emphasis on the wording of an order. . . . Now, if there were a portable form of the phonograph there could be a record of the orders given, whether in case of an action ashore or an accident afloat. Perhaps Mr. Edison will condescend to give the subject his attention. . . . But in applying the phonograph to military and naval purposes it does seem to be necessary that there should be found some more durable, even if less sensitive, material than the wax cylinder as the receiver of the vibrations.[149]

Five years later, The Phonogram, a short-lived periodical focusing on the phonograph's business applications, ran an article titled "The Phonograph at Sea," which speculated as to the medium's maritime utility:

> We know that if several records of the condition of the disabled vessel had been made by someone on board capable of accomplishing this — before the danger became imminent, and these waxen cylinders had been placed in tin cases constructed so as to be corked like a bottle or jar, and sealed with rosin or any other preparation that would render them water-proof, these cases floating along in the path followed by nearly all the steamers crossing the Atlantic, would by this time have been discovered, and we should now be in possession of some meager details of the terrible catastrophe; or at any rate might gather from the record of those looking their doom in the face, facts going to suggest alterations in the equipment or arrangement of other transatlantic liners that would save them from similar casualty.[150]

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[149] "Army Talk in England," New York Times 16 Sept. 1888: 11. Although the article does not carry a byline, it was probably written by William Drysdale, whose byline appears beneath a subsequent article on the same page. Drysdale was a foreign correspondent for the Times during this period.

[150] "The Phonograph at Sea," The Phonogram Mar.-Apr. 1893. I am grateful to Jonathan Sterne for generously sending me this citation.

New media and communication technologies do not spring forth fully formed like Athena from the forehead of Zeus. Their material configurations are no more naturally preordained than their meanings are Platonically predefined or their functions are technically predetermined. Their "purposes" and practical utilities, modes of perception and rituals of consumption, institutional protocols and accompanying ideologies, are neither handed down from on high nor carved into granite. As Geoffrey B. Pingree and Lisa Gitelman observe,

> when new media emerge in a society, their place is at first ill defined, and their ultimate meanings or functions are shaped over time by that society's existing habits of media use (which, of course, derive from experience with other, established media), by shared desires for new uses, and by the slow process of adaptation between the two. The "crisis" of a new medium will be resolved when the perceptions of the medium, as well as its practical uses, are somehow adapted to existing categories of public understanding about what the medium does for whom and why.[151]

Written and disseminated within the first two decades of the phonograph's invention, the Times and Phonogram articles suggest the extent to which phonography's cultural meanings, social functions, and contexts of use were still more or less open to interpretation, subject to revision, and amenable to imaginative leaps toward the end of the nineteenth century. Not yet wholly hemmed in by social custom, industrial standardization, or institutional regulation, proper phonographic attitudes, practices, and circumstances were still being hammered out through debate, discussion, and competing attempts to satisfy (or maybe just specify) "shared desires." Simply stated, the phonograph as a cultural technology was, to use Gitelman and Pingree's term, in crisis.[152]

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[151] Geoffrey B. Pingree and Lisa Gitelman, "Introduction: What's New About New Media?," New Media, 1740-1915, ed. Lisa Gitelman and Geoffrey B. Pingree (Cambridge: MIT, 2003) xii.

[152] Pingree and Gitelman themselves borrow the term from Rick Altman's notion of "crisis historiography."

Edison initially conceived the phonograph as a machine for recording telephone messages. In 1878, in an article published in North American Review (and ghostwritten by his business associate, Edward H. Johnson), Edison amended and greatly expanded his initial conception to encompass a number of other "actual" and "probable" uses for the sound-reproduction technology, such as letter writing, dictation, books for the blind or infirm, elocutionary instruction, the reproduction of music, the "family record" (a phonographic album of family members' voices, sayings, and dying words), music boxes and toys, clocks that announce the hour of the day, commercial advertising, and the preservation of political speeches.[153] "In other words," David Morton writes, "what Edison had first conceived narrowly as a telephone recorder for business he now predicted would become a more general-purpose enhancement or even replacement for many kinds of oral and written communication for business and personal purposes."[154]

The ideas put forward in the Times and Phonogram articles at once resonated with and reached beyond the hodgepodge of conceits, conjectures, and prophecies that Edison had enumerated in the pages of North American Review some years prior. On the most basic level, those ideas echoed what Edison called "the almost universal applicability of the [phonograph's] foundation principle, namely, the gathering up and retaining of sounds hitherto fugitive, and their reproduction at will."[155] The underlying reasoning was straightforward and sound: theaters of modern war and bridges of sinking ships each resound

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[153] Edison, "The Phonograph and Its Future"; see especially pages 531-534. The reference to the phonograph's "actual" and "probable" uses appears on page 528.

[154] David Morton, Off the Record: The Technology and Culture of Sound Recording in America (New Brunswick: Rutgers UP, 2000) 3.

[155] Edison 527.

with vocal expressions (military "orders given," oral "records of the condition of the disabled vessel"), and those expressions, like all hitherto fugitive sounds, are capable of being phonographically gathered up, retained, and reproduced at will. For the Times and Phonogram, the apparatus's capacity to capture and control the re-release of a variety of vocal expressions was axiomatic, as it was for Edison, who insisted that phonography made possible "the captivity of all manner of sound-waves," especially those emanating from or identified with the human voice.[156] In this sense, the articles endorsed, if only implicitly, the phonograph's "foundation principle."

It is one thing for an apparatus to be able to record and reproduce sound waves, and another for it to be able to do so faithfully, unimpeachably, and infallibly. Edison claimed both for his invention, averring that it was "practically perfected in so far as the faithful reproduction of sound is concerned," that it provided "an unimpeachable record," and that it functioned as a sort of "conscientious and infallible scribe."[157] The Times and Phonogram articles shared and further circulated Edison's epistemological assumptions. The Times promised that the phonograph, were it to be brought either into battle or aboard a vessel, would provide "a complete record" of important oral communications such as military commands. Its mechanical ear — an "ear" that "heard" by means of a mouthpiece — would pick up and perfectly preserve the syntax and inflections of human speech, the "exact wording and precise emphasis" of spoken utterances. Phonogram proposed much the same, equating a phonographic "record of those looking their doom in the face" with an oral registry of "details" and "facts." Such truth-claims were in sync with Edison's contention that the talking machine not only accurately reproduced a wide range of speech forms, including

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[156] Edison 530.

[157] Edison 530-531, 533, 536.

"interjections, explanations, emphasis, exclamations, etc.," but also occasionally improved their articulacy and intelligibility:

> the writer has at various times during the past weeks reproduced [sound] waves with such degree of accuracy in each and every detail as to enable his assistants to read, without the loss of a word, one or more columns of a newspaper article unfamiliar to them, and which were spoken into the apparatus when they were not present. . . . Indeed, the articulation of some individuals has been very perceptibly improved by passage through the phonograph, the original utterance being mutilated by imperfection of lip and mouth formation, and these mutilations eliminated or corrected by the mechanism of the phonograph.[158]

Yet as much as the Times and Phonogram articles reinforced normative epistemologies of phonography — epistemologies authorized by Edison from the very beginning — they also, crucially, pushed the envelope by recommending for the medium an alternative matrix of rationales, instrumentalities, and spheres of application. During the period in which the articles appeared, Edison's phonograph and its competitor, Alexander Graham Bell and Charles Sumner Tainter's "graphophone," were manufactured and marketed primarily as machines for dictation and record-keeping, and secondarily (albeit increasingly with each passing year) as machines for popular amusement. Phonographic dictation was done in business offices and, for some well-to-do consumers, in private homes; "nickel-in-the-slot" phonographic amusement was had in barrooms and, as David Nasaw notes, "on fair midways, in train stations, in hotel lobbies, and at summer resorts."[159] The Times and Phonogram articles asked the phonograph to undertake obligations, execute functions, and operate under conditions of entirely different sorts. What they asked of it, in

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[158] Edison 532, 528-529.

[159] David Nasaw, Going Out: The Rise and Fall of Public Amusements (New York: Basic, 1993) 123.

fact, was so fundamentally unlike its use as a means of popular amusement as to be all but antithetical. And what they asked of it also differed in key respects from its commercially promoted, culturally predominant use as an office dictation device. As if attempting to test the proposition of "universal applicability," the articles advocated the extension of the phonograph's reach — practical and political — into realms untried, uncertain, and heretofore unimagined.

Those realms, as we have seen, were military and maritime, and the call to render phonography serviceable to the interests and institutions that governed them is significant. Exemplifying what Edison had referred to as "the imaginative work of pointing and commenting upon the possible," the Times and Phonogram articles represented early attempts to envisage and publicly articulate how sound-reproduction technology might be mobilized to meet the many and sundry security needs of a modern, industrialized society, culture, and nation.[160] In a military setting, so the logic went, the phonograph could be counted on to keep an objective log of orally communicated orders issued by commanding officers, thereby eradicating after-the-fact ambiguity and ensuring historical accuracy (who said what, when, and to whom). Similarly, in a maritime setting, the phonograph could be employed by the captain or a crewman to chronicle the circumstances and vicissitudes of an unfolding tragedy, and that chronicle, in turn, could be employed by naval architects or shipbuilding experts "to suggest alterations in the equipment or arrangement of other transatlantic liners that would save them from similar casualty." Each of these imaginings, so remarkable for its day, implicated the medium in social relations and cultural constructions of risk, safety, and protection: the one by installing it at the primal scene of national security,

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[160] Edison 528.

the battlefield; the other by instrumentalizing it for the prevention of similar nautical disasters. Liberated from its utilitarian applications in the worlds of machine-mediated labor (office dictation) and leisure (popular amusement), the phonograph here becomes something far more extraordinary and exciting, and at the same time far more essential: namely, a means by which to defend the nation, guard against danger, protect bodies from harm, save lives. It becomes a medium to be used both forensically, as a technoscientific mechanism for the production of historical veracity, and preemptively, as an institutional mechanism for the prevention of future catastrophe. It becomes, in short, an accident technology.

The New York Times and Phonogram articles are pertinent to the present study because they show that the history of the idea of using sound-reproduction technology to achieve both retrospective certainty (truth) and prospective security (progress) vis-à-vis modern transportation accidents — an achievement predicated on the medium's presumed capacity to capture and preserve the voices and explanatory utterances of "those looking their doom in the face" — can be traced back to the first decades of Edisonian phonography, even if the practical and institutional realization of that idea had to wait until the development of the cockpit-voice recorder in the mid-twentieth century.

Also significant is the suggestion in the articles that the phonographic apparatus, in order for it to achieve such ends, would require some measure of technical modification, some degree of redesign. Specifically, it would need to be ruggedized. When Edison claimed in 1878 that the phonographic record possessed "wonderful enduring power," he was referring to the record's ability to continue to function properly — that is, to reproduce sounds "faithfully" — after repeated plays. He did not, however, have in mind conditions of operation as harsh or inhospitable as those specified in the Times and Phonogram articles.

Regarding such conditions, the Times was concerned about the robustness of the recording medium, concluding that "it does seem to be necessary that there should be found some more durable, even if less sensitive, material than the wax cylinder as the receiver of the vibrations." Phonogram, for its part, was concerned about the preservative efficacy of the medium's container, rather than that of the medium itself, recommending that the "waxen cylinders [be] placed in tin cases constructed so as to be corked like a bottle or jar, and sealed with rosin or any other preparation that would render them water-proof."

Here we glimpse perhaps the earliest publicly articulated intimations of what would come to be commonly regarded as a mandatory requirement for all transportation recorders, including the cockpit-voice recorder: survivability. (Charles Babbage made no mention in his autobiography of having so much as considered survivability criteria or the question of crash protection when building and testing his self-registering apparatus for railroad trains in 1839.) Since, in this view, nothing less than the veracity of the past and the security of the future are at stake, the proper precautions must be taken to make sure that the data emerge from the ordeal practically unscathed. Indeed, according to what might be called the survivability imperative, the destructive violence of the accident must be accounted for ahead of time and accommodated in the apparatus's design. The consequences of catastrophic failure must be preemptively neutralized, either by making the recording medium sturdier (the Times) or by ensuring the impermeability of its outer shell (Phonogram). Not only, then, do these articles anticipate the problem of forensic-media survivability, of accident-technology crash protection, they also anticipate its twin solutions: strengthen the software or hermetically seal the hardware, render more robust either the carrier of information or its carapace, immunize the interior or armorize the exterior.

The notion, explicitly expressed in the Phonogram article, that a firsthand account of a maritime accident could be preserved by encasing it in something "like a bottle or jar," which, having been cast into the ocean, might later be found "floating along in the path" of a ship or washed up on a shore, was nothing new. On the contrary, the proverbial practice to which it pointed — sending a message in a bottle — is hundreds, if not thousands, of years old. As the Bulletin of the International Oceanographic Foundation explains in an article titled "Neptune's Sea-Mail Service,"

> Seaborne bottles bearing notes have often been associated with shipwrecked seamen cast ashore on some uninhabited island, launching a last empty bottle in the hopes of a rescue. Drift bottles have been used for centuries, however, to shed light on nautical mysteries, to convey secret messages, or to seek contact with an anonymous pen pal in a faraway country.[161]

For Phonogram, the invention of Edisonian phonography offered an opportunity to modernize the practice of sending a message in a bottle, to make it more efficient through mechanization. Before, the interested parties had to rely on fragments of information scrawled on scraps of paper for an indication of what caused the ship to sink. Hastily written, overly abbreviated, and sometimes barely legible, this sort of scribble was of limited value to those who wished to "reconstruct" the accident. On the other hand, a message recorded at the speed of speech and "bottle[d] up for posterity," as Edison put it, would be capable of carrying considerably more information than a handwritten note, and would be clearer and more comprehensible to boot.[162] Reliably transcribed by a mechanical stenographer and securely sealed in a watertight container, such a message promised "to shed light on nautical mysteries" in a manner hitherto impossible.

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[161] Wilmon Menard, "Neptune's Sea-Mail Service," Sea Frontiers: Bulletin of the International Oceanographic Foundation Nov.-Dec. 1980: 337.

[162] Edison 536.

As it turned out, the phonographic message in a bottle did not become a reality. In the mid-1950s, however, something like it did: the cockpit-voice recorder.

David Warren's Device

In April 1954, David Warren, an Australian chemist specializing in aircraft fuels, prepared a technical memorandum for Aeronautical Research Laboratories in Melbourne, Australia. The four-page report, titled A Device for Assisting Investigation into Aircraft Accidents, did not deal with issues pertaining to aviation chemistry, as might be expected given its author's area of specialization. Instead, it succinctly stated the case for an onboard contrivance that would continuously record the voices of a pilot and a copilot as they operated an aircraft. Should tragedy strike, the record of those voices would be of "inestimable value" to accident investigators, according to Warren, because it would contain otherwise unobtainable evidence as to the cause of the crash:

> It may be assumed that in almost all accidents the pilot receives some pre-indication either by sight, feel of controls, automatic alarm or instrument reading. In most cases this would evoke a complaint of difficulty or a shout of warning to attract the attention of the co-pilot. Unless radio contact is actually in progress there is often not time to get any information through before the crash. . . . In the case of fire [there] would almost certainly [be] a shout from the first crew-member to detect it, followed by verbal instructions. Careless control or error-of-judgment (as is often suspected in landing and take-off accidents) would probably elicit criticism, suggestion or warning from the co-pilot. An unexpected fuel-tank explosion would be recorded as an interruption of normal conversation by the first part of the explosion noise followed by immediate cut-out.[163]

Warren proposed that a fine steel wire be utilized as the recording medium. The wire would run across an erasing head and a recording head in a continuous loop, and new data

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[163] D. R. Warren, A Device for Assisting Investigation into Aircraft Accidents (Melbourne: Aeronautical Research Laboratories, 1954) 2-3.

would be recorded over old every two or so minutes. The moving mechanism would switch off automatically in the event of an accident, providing “a permanent ‘memory’ of the conversation in the control cabin” during the final moments of flight.[164] The device would be small (occupying less than 0.1 cubic feet of space), lightweight (less than five pounds), and inexpensive (£60 per dozen). It could be powered in part by the airplane’s radio receiver, and would be easy to maintain, needing only “an occasional check that it was in working order.”[165] Warren claimed, moreover, that the steel-wire medium “would not be greatly harmed by impact nor by suffering moderate heating,” though he conceded that “the extent of the latter would need to be checked by experiment.”[166] To ensure its intact recovery after a crash, the contrivance could be installed in the tail section of the aircraft, where it would likely sustain the least amount of damage. A method could even be devised to automatically eject the device at some point prior to impact, so as to sever its fate from the presumably worse one awaiting the craft that carried it. “If the containing box were reasonably robust,” Warren added, “no parachute would be required, as only the wire need be salvaged. An attached marker streamer, however, would greatly help in finding the unit.”[167]

Warren foresaw only one potential problem in all of this: cockpit-voice recording, as it would come to be called, might have a negative “psychological effect” on the pilots. Oral exchanges between pilot and copilot would no longer be private or effectively privileged; they would, instead, be subject to external scrutiny, to the surveillance of anonymous others.

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[164] Warren 2.

[165] Warren 4.

[166] Warren 3.

[167] Warren 4.

Making a virtue of necessity, Warren found a remedy for this difficulty in the machine's technical limitations: "The possible objection by crew to having their [sic] conversation continually recorded is countered by the fact that the device has such a short memory. If no accident occurs, anything said during flight is obliterated during the time taken to taxi in."[168]

It is unlikely that Warren was aware of the fact that something very much like the idea he was proposing in 1954 had been proposed some six decades earlier in connection with the phonograph. Nevertheless, the similarities are significant, as they indicate the emergence and eventual crystallization of an identifiable cultural and institutional impulse: that is, the impulse to use forensic techniques and technologies to turn the transportation accident into an object of knowledge and control. Broadly, both proposals, those in The New York Times and Phonogram and that in Warren's technical memorandum, sought to introduce sound-reproduction technology into the sphere of mechanized transportation, to adapt it to the ends and exigencies of modern mobility. More specifically, both wanted to exploit advances in the science and technology of audio recording for the purpose of providing critical information about the causes and circumstances of catastrophes, be they nautical or aeronautical. And both presumed that such information — orally communicated by an on-the-spot observer, faithfully recorded by a mechanical stenographer, and formidably protected in a ruggedized container — could then be used to write the definitive history of the tragedy and to enable improvements in transportation safety.

Yet Warren's report did not simply echo relatively obscure late-nineteenth-century ideas about the possibilities of sound-reproduction technology for accident investigation; it also reworked them in crucial ways. Most obviously, it replaced the wax cylinder with the

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[168] Warren 4.

steel wire, mechanical inscription with electrical magnetization. Apart from mentioning that it might be necessary to somehow reinforce the recording medium or its container, the Times and Phonogram articles, being essentially fanciful inquiries addressed to nonexpert audiences, were unconcerned with technical details and practical realities. A Device for Assisting Investigation into Aircraft Accidents, by contrast, was written by a research scientist in conformity with the codes and conventions of scientific thought and expression, and therefore had to be concerned with precisely such details and realities. Hence the attention paid in the report to the device's economic and operational efficiencies:

> The instrument would be much less in size, weight and cost than a normal wire recorder since neither high fidelity nor play-back facilities are required, and the amount of wire needed is very small (e g 30 ft.). Power supply requirements would be low and could possibly be taken to some extent from the existing radio system.

Warren's advocacy of a compact, inexpensive, low-maintenance wire recorder was rational rather than fanciful, the product of hard-headed science rather than wild-eyed speculation, and his technical memorandum marked the first formal attempt to bring the vast and varied resources of institutionalized technoscience to bear on the dream of deploying sound-reproduction technology to discover and discipline the transportation accident.

The Times and Phonogram articles implied that the voice to be recorded by the military/maritime phonograph belonged to a speaking subject who affirmatively wished to be recorded, willfully initiated the recording process, and thus consciously knew he or she was being recorded. This way of thinking was very much in keeping with the then-normative conception of the phonograph as a device for taking dictation. According to this conception, the origin of the voice and the operator of the machine, recordee and recordist, are most often one and the same. The user engages the apparatus on his or her own terms, for his or her own purposes. The user possesses the power to switch the machine on and off, controls the recording process from start to finish. The user is the dictator.

Warren’s report sketched a decidedly different recording scenario. In it, the wire recorder does not function as a dictation device. It is neither directly nor deliberately spoken into by an intentional agent. It is not operated manually, and the way it works has nothing to do with the recordee’s will or wishes. Literally and figuratively out of reach, it cannot be switched on or off by those whose voices it captures. Instead, it is always on, running by itself, “in the background,” monitoring and storing “the conversation in the control cabin” automatically, incessantly, until there is no conversation left to record. (And when there is no conversation left to record, when all the voices have been silenced, it stops as automatically as it had operated.) It does not so much hear oral exchanges as overhear them, does not so much listen as listen in. It is an inconspicuous interloper with an open, indiscriminating ear, an electrical eavesdropper that picks up and preserves complaints of difficulty, shouts of warning, and, perhaps, explosions of fuel tank. It is there but not there, like a fly on the wall. It is a bug.

Unlike the Times and Phonogram articles, A Device for Assisting Investigation into Aircraft Accidents conjured the specter of surveillance. In its final two sentences (quoted above), it acknowledged that flight crews might take umbrage at an officially mandated, automatically operated, inaccessibly located sound-reproduction technology. It considered the possibility that pilots might feel as if they were being bugged, and resent it. It recognized that they might balk at what they took to be an invasion of their privacy, an incursion of Big Brother into their place of work or, in some cases, of leisure. Would the presence of the device undermine morale? Would it elicit indignation? Would it diminish performance or productivity? Worst of all, would it work to discourage inter-pilot communication, perhaps leading to a decrease in operational safety and, consequently, an increase in accidents — accidents whose elimination, ironically, it had been put there precisely to achieve? By taking such questions into consideration, if only implicitly, the report forged a discursive link between concepts, practices, and contexts associated with aviation surveillance and those associated with audio surveillance.

The concept and practice of using flight recorders to surveil airplane pilots preexisted the appearance of Warren's technical memorandum of 1954. Indeed, as we have seen, flight-recorder surveillance had been around since at least 1937, when The New York Times and Science each reported on the development of a device designed, in part, to deter dangerous flying and reduce the risk of accidents by supplying authorities with a means by which to monitor, and in effect enforce, pilots' compliance with safety rules and regulations. But this was surveillance of an auto-inscriptional sort, involving the use of inking pens and squiggly lines and scrolling paper, all mechanically operated or engendered. Warren's report, too, took up the issue of surveillance but did so in relation to sonic, not graphic, recording. It proposed a device whose medium would be magnetic not mechanical, and whose form of data would be verbal not visual, audible not tangible, reproductive of human speech not representative of nonhuman behavior (the plane's performance). It also suggested, in contrast to the Times and Science articles, that flight-recorder surveillance might be a matter of some concern, even controversy. In 1937, surveillance could be promoted as one of the principal benefits of flight recorders, but in 1954 it was viewed as a potential problem.

Doubtless part of the reason for this discrepancy lay in the differing cultural assessments of and attitudes toward the recorders' respective technological capacities and applications. The flight recorder of the 1930s and ’40s was an early version of the flight-<u>data</u> recorder. Its task was to register the various motions and varying conditions of an inanimate object, and to represent the results as curvilinear tracings on paper. Humans, in this scheme of things, do not immediately figure into the equation: no intentional subjects, no interposing bodies, no one to throw a spanner in the works. Just one machine monitoring the functioning of another. Automated operations, automated output. Flight recording is conceived as a fundamentally impersonal process.

Warren’s device, however, came with an alternative set of associations and, crucially, an additional set of obligations. Its task was to snatch sounds from out of the air and save them to steel wire. And as a cockpit-<u>voice</u> recorder, this task was necessarily tied to human subjects and bodies — the voice being traditionally regarded as the supreme expression of human agency and intentionality, as that which stands metonymically for human identity. According to this scenario, the introduction of intentional subjects and interposing bodies alters the equation. Using a mechanical device to monitor and measure the plane’s performance is one thing; using a electromagnetic device to “steal” and store the pilots’ speech is quite another. When flight recording is machine on machine, when its operations and output are entirely automated, it can be construed as amoral and purely physical. But as soon as the human voice enters the drama, as soon as the soul signs on, it becomes freighted with moral questions and imbued with metaphysical connotations. By seizing hold of someone’s voice — someone who has no say in the matter — flight recording threatens to become an affront to dignity, a breach of privacy, an assault on liberty, even a theft of identity. What was once a fundamentally impersonal process turns disturbingly personal.

In Warren's report, then, the recording of cockpit conversations was viewed as a potential problem in part because of the moral and metaphysical baggage borne by the human voice. Insofar as it problematized the involuntary and indiscriminate recording of human speech, the report participated in a long line of thinking about the ethical and political implications of audio surveillance. It also effectively articulated the emergent practice of cockpit-voice recording to earlier, established practices of electrical eavesdropping such as telegraphic and telephonic wiretapping (the former of which was regularly employed by both the North and the South during the American Civil War), as well as "the making of secret or surveillance records," which, as David Morton notes, dates back to "the early days of the phonograph, although it required a considerable amount of naiveté on the part of others."[169]

It is noteworthy, in this connection, that Warren maintained that his device's design was modeled on the Minifon, an ultraminiaturized, battery-operated wire recorder developed in 1952 by Monske GMBH of Hanover, Germany. Initially marketed as a portable dictation device, the Minifon, which Warren chanced upon at an Australian trade fair shortly after World War II, soon found other, less "legitimate" applications, including spying and surveillance, as Morton explains:

> The idea of offering a pocket dictating machine was novel, since dictation had previously been done in the office. However, it was thought that people like salesmen could take the machine "on the road" with them. Once on the market, the Minifon's promoters discovered that many people took advantage of the recorder's small size to make secret recordings to be used as evidence, as in court.[170]

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[169] Morton 145. For a concise history of audio surveillance, see David Morton, "Recording and the 'Surveillance Society'" <http://www.recording-history.org/HTML/surveillance1.htm>.

[170] David Morton, "The Minifon: An Early Portable Dictating Machine" <http://www.acmi.net.au/AIC/MINIFON.html>.

By the time Warren wrote his report in 1954, the model for his device's design was already articulated to audio surveillance through the "illegitimate" practices of its users.

A Device for Assisting Investigation into Aircraft Accidents circulated throughout the Australian aviation industry in 1954 but was greeted mostly with indifference. It was then sent out "to airlines, aviation authorities and research establishments throughout the rest of the world. Still no responses were elicited. It was therefore decided that what was needed was a demonstration unit."[171] With the support of his superintendent, Tom Keeble, and the assistance of T. Mirfield, an instrument engineer, Warren built a prototype using Minifon components. More sophisticated than the device described in his technical memorandum, the "ARL Flight Memory Unit," as it was dubbed (the initials standing for Aeronautical Research Laboratories), could record four hours, rather than two minutes, of cockpit conversation. In addition, it could store readings from eight flight instruments every two seconds, making it not just the first cockpit-voice recorder, but the first combination cockpit-voice and flight-data recorder.

The official responses to Warren and Mirfield's prototype were less than enthusiastic — this despite the fact that it had performed admirably during its flight tests. "We finished developing this to this stage and found that people weren't interested," Warren said in an interview for an Australian television program, broadcast in November 2002. "We wrote to the Department of Civil Aviation and the letter we got back said, 'Dr Warren's instrument

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[171] Royal Society for the Encouragement of Arts, Manufactures, and Commerce, "The Story of Invention: Dr. David Warren" <http://www.thersa.org/australia/Documents/Hartnett%20Medal%20Information/story_of_invention.pdf>.

has little immediate, direct use in civil aviation.'"[172] The Royal Australian Air Force concluded that "such a device is not required," since in all probability it "would yield more expletives than explanations."[173] The Australian Federation of Air Pilots complained: "It would be like having a spy on board — no crew would take off with Big Brother listening." (Warren's suggestion that his device might have a negative "psychological effect" on pilots proved prescient.) And the Aeronautical Research Council decided that, in view of the difficulties involved, "no further action should be taken."[174] The Defence Science and Technology Organisation, a division of Australia's Department of Defence, speculates that the reason for such reluctance "may well have been that Australia had not experienced a major air accident for many years and, indeed, was recognized as having the world's best safety standard at that time."[175]

Sir Robert Hardingham, Secretary of the U.K. Air Registration Board, responded a good deal more favorably to Warren's device. Having taken notice of it during a visit to Aeronautical Research Laboratories in 1958, Hardingham arranged for it to be brought to England for a formal demonstration. According to <u>Air Disaster</u> author Macarthur Job, the demonstration was a success by any standard: "the BBC reported on it, aircraft manufacturers were supportive, aviation authorities considered making flight recorders mandatory, and the

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[172] "Black Box," <u>New Dimensions</u>, Australian Broadcasting Corporation, 27 Nov. 2002 <http://www.abc.net.au/dimensions/dimensions_future/Transcripts/s736952.htm>.

[173] Defence Science and Technology Organisation, "The Black Box: An Australian Contribution to Air Safety" <http://www.dsto.defence.gov.au/attachments/The%20Black%20Box.pdf>.

[174] Macarthur Job, "David Warren," <u>Time</u> 25 Oct. 1999 <http://205.188.238.109/time/magazine/intl/article/0,9171,1107991025-33686,00.html>.

[175] The Defence Science and Technology Organisation.

firm of S. Davall & Son bought production rights, subsequently developing a crash recorder that won a major share of the British market."[176] The design for S. Davall & Son's "Red Egg" recorder, so nicknamed for its red-painted exterior, was modeled not on Warren and Mirfield's original demonstration unit, but on its more sophisticated successor, the "Pre-production Prototype ARL Flight Memory Unit," developed by Warren along with Aeronautical Research Laboratories associates Lane Sear, Ken Fraser, and Walter Boswell.[177]

In the United States, meanwhile, the Federal Aviation Administration, in response to Civil Aeronautics Board recommendations, conducted a study in 1960 to determine the feasibility of recording flight-crew conversations for the purpose of accident investigation.[178] Two years later, the FAA carried out tests a new model of magnetic-tape flight recorder manufactured by El Monte, California-based United Data Control, Inc. — the same company, as it happens, that had been commissioned two years earlier to develop a similar device for the Australian market (much to the chagrin of Warren and his colleagues). The FAA had high hopes for the new machine. In April 1962, The New York Times quoted an unnamed FAA official as saying: "The flight [data] recorder can tell us at the most what did not cause an accident. It is not likely to reveal the cause itself — as we hope a cockpit voice recorder will."[179]

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[176] Job.

[177] For a technical description of the Pre-production Prototype ARL Flight Memory Unit, see "Addendum for the Technically Minded" in The Defence Science and Technology Organisation, "The Black Box: An Australian Contribution to Air Safety."

[178] Grossi.

[179] "F. A. A. Spurs Hunt for Device to Preserve Cockpit Messages," New York Times 6 Apr. 1962: 50.

FAA historian Robert Burkhardt writes that "the FAA in 1965 ordered the installation and use of cockpit voice recorders in large transport airplanes operated by air carriers and commercial operators."[180] The compliance date for all turbine-powered aircraft was July 1, 1966, and for all pressurized aircraft with four reciprocating engines, January 1, 1967.[181]

Conclusion

In November 1943, Life magazine ran a story in its Science section about the use of a recently developed "magnetic wire recorder" for military observation flights. Just as the Brown Instrument potentiometer and the Vultee Radio-Recorder promised to make the tracking and transcribing of aircraft instrument readings easier, more efficient, and less prone to error, so the wire recorder promised to increase the ease, efficiency, and accuracy of aerial reconnaissance. All three wartime aviation technologies, in other words, promised improvements in record-keeping through automation. Only, in the case of the wire recorder, the means of improvement involved sonic reproduction, not mechanical inscription:

> Instead of making notes in a pad strapped to their right knee they speak their observations into a microphone which fits in the palm of the hand like a stop watch. Their words are magnetically recorded on a thin steel wire uncoiling between doughnut-size spools mounted in a compact case. The resultant spool of magnetized wire when played back into sound provides a fresh, on-the-spot account, far better than notebook reports.[182]

The article went on to say that the wire recorder might also find application in the battlefield, not just above it: "Highly portable, the recorder could be used for on-the-spot transcriptions of tank, artillery and naval actions. The War Department is already encouraging war

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[180] Burkhardt 95.

[181] Grossi.

[182] "Magnetic Wire Recorder," Life 1 Nov. 1943: 49.

correspondents to use it for dictating battle descriptions for subsequent broadcasts or transcription into written accounts."[183]

The wire recorder described in the pages of Life in 1943 constitutes a kind of "missing link" between the late-nineteenth-century military/maritime phonograph and the mid-twentieth-century ARL Flight Memory Unit.[184] On the one hand, it rearticulated the decades-old dream of using sound-reproduction technology as something like a war-zone Dictaphone; on the other hand, it introduced magnetic-wire recording into the aircraft control cabin eleven years before David Warren wrote his technical memorandum. Interestingly, it also hooked up with the early history of the flight-data recorder, insofar as its aeronautical instrumentalization paralleled the prescribed functions of the Brown Instrument and Vultee flight recorders.

Contrary to what might be called the moment-of-eureka mythology informing most accounts of the invention of the cockpit-voice recorder, Warren's report was not the first printed source to imagine that audio technology might be mobilized for accident investigation (the Times and Phonogram beat it to the punch). Neither was his device the first wire recorder to be utilized in the cockpit of an airplane (as the Life article demonstrates). Wherein, then, lay the import of Warren's device? And, by way of conclusion, let us also inquire as to the import of James J. Ryan's contrivance, that other mid-'50s flight recorder to which claims of historical primacy have tended to cling, despite the fact that, as we have seen, it was far from being the first onboard apparatus to automatically graphically register information concerning an aircraft's performance.

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[183] "Magnetic Wire Recorder" 49.

[184] I want to stress that I am using the term "missing link" purely figuratively. It is not my intention to imply the existence of a history somehow restored to linearity, integrity, or coherency through the recovery of that which was previously "lost."

While not the first wire recorder to be used by a flight crew, Warren's device was the first to be imagined and constructed as a permanent piece of aircraft apparatus, as well as the first to be expressly intended as an aid to accident investigation. Similarly, while not the first flight-data recorder, Ryan's contrivance was the first to really emphasize in its engineering and design the concept of crash protection, as well as the first to be put through a rigorous program of scientifically controlled destructive testing (see also footnote 41). Warren's device and Ryan's contrivance were not just flight recorders, then, but flight recorders designed and deployed above all as accident technologies. Herein lay their import for the present study.

Warren wrote A Device for Assisting Investigation into Aircraft Accidents in April 1954 in Melbourne, Australia. One year to the month later, at a meeting of the American Society of Mechanical Engineers in Baltimore, Maryland, Ryan presented a paper on the subject of his new invention, the General Mills Ryan Flight Recorder. One scientific paper outlined an idea for a soon-to-built cockpit-voice recorder; the other described the technical features and practical functions of a recently built flight-data recorder. While there is no indication in the historical record that Warren and Ryan knew of each other or of each other's research, I want to suggest that their respective ideas and inventions were inextricably intertwined, not only nominally (each carrying the name "flight recorder" and, later, "black box"), but socially, culturally, and discursively as well. In each of these technical artifacts from the mid-1950s we see the crystallization of the cultural desire to know the accident forensically, to make it speak its truth by means of its mechanical reproduction (voices) or representation (graphs). We see, as well, the crystallization of the cultural dream of making the accident productive of a safer and more secure future. The two flight recorders promised progress through the technoscientifically assured non-recurrence of crash and catastrophe.

The ARL Flight Memory Unit and the General Mills Ryan Flight Recorder served as twin emblems and embodiments of a specific conjuncture. They represented a socially and historically contingent response (forensic media) to socially and historically contingent problem (the hazards of mechanized mobility). As I suggested in the Introduction to this study, they were integrally involved in the construction of a new regime of accident that gained ascendancy in the United States in the decades following World War II. Under that new regime — itself a key element of an emergent control society obsessed with the surveillance of state enemies and the deterrence of technological disasters — the transportation accident became an object of scientific and institutional analysis, knowledge, and control.

CHAPTER THREE

ACCIDENT DISCOURSE AND THE DEVELOPMENT OF SCIENTIFIC CRASH-TESTING

Introduction

There is a moment early in the history of every modern transportation technology when the terror of the accident has not yet reached critical mass in the collective consciousness. At such times the new conveyance is often said to be more secure than the mode of transportation it effectively replaces or renders obsolete. Over the course of the nineteenth and early-twentieth centuries, it was the beast of burden that was effectively replaced and rendered obsolete (albeit neither immediately nor universally), first by steam and railway, then by internal combustion and roadway. In each case, the mechanical technology was initially believed to be superior to the animal technology in terms of safety, regularity, and reliability.

“The promoters of the railroad regarded steam power’s ability to do away with animal unreliability and unpredictability as its main asset,” writes Wolfgang Schivelbusch. “Mechanical uniformity became the ‘natural’ state of affairs, compared to which the ‘nature’ of draught animals appeared as dangerous and chaotic.”[185] Schivelbusch quotes an anonymous text published in 1825:

> It is reasonable to conclude, that the nervous man will ere long, take his place in a carriage, drawn or impelled by a Locomotive Engine, with more

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[185] Wolfgang Schivelbusch, The Railway Journey: The Industrialization of Time and Space in the 19th Century (Berkeley: U of California P, 1986) 14.

> unconcern and with far better assurance of safety, than he now disposes of himself in one drawn by four horses of unequal powers and speed, endued with passions, that acknowledge no control but superior force, and each separately momentarily liable to all the calamities that flesh is heir to. Surely an inanimate power, that can be started, stopped, and guided at pleasure by the finger or foot of man, must promise greater personal security to the traveller than a power derivable from animal life, whose infirmities and passions require the constant exercise of other passions, united with muscular exertion to remedy and control them.[186]

Similar claims were made on behalf of the automobile at the end of the nineteenth century. In 1896, Horseless Age magazine stated: "The motor vehicle will not shy or run away. . . . These frightful accidents can be prevented. The motor vehicle will do it."[187] Pioneering automaker J. Frank Duryea put it this way in 1897:

> The horse is a willful, unreliable brute. The ever recurring accidents due to horses which are daily set forth in the papers prove that the horse is a dangerous motor and not the docile pet of the poet. The mechanical motor is his superior in many respects, and when its superiority has become better known his inferiority will be more apparent.[188]

Here is Horseless Age again, this time in 1899: The "truth is, we are just beginning to realize what a fractious, unreliable animal the horse is. . . . The animal is treacherous and dangerous, and his gradual elimination from the centers of civilization is not only much to be desired, but . . . a necessity."[189] Finally, that same year, Harper's Weekly had this to say on the subject: "a good many folks to whom every horse is a wild beast feel much safer on a

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[186] Schivelbusch 14.

[187] Joel W. Eastman, Styling vs. Safety: The American Automobile Industry and the Development of Automotive Safety, 1900-1966 (Lanham: UP of America, 1984) 115.

[188] Quoted in Joel W. Eastman, Styling vs. Safety 115.

[189] Quoted in Sarah S. Lochlann Jain, "'Dangerous Instrumentality': The Bystander as Subject in Automobility," Cultural Anthropology 19.1 (2004): 87, n. 16.

machine than behind a quadruped, who has a mind of his own, and emotions which may not always be forestalled or controlled."[190]

Underlying such assertions is the notion that accidents result from the impossibility of ever fully domesticating the animal, on whom the efficient movement of people depends. Harm comes to the person because the passions of the creature can neither be accurately anticipated nor completely curbed, because its every move cannot be minutely managed by its master. Injury to the human body and insecurity in the human psyche are the inevitable consequences of the natural infirmities and intractabilities of less noble life-forms. Animals "bite and buck and act in ways that often cannot be controlled by humans. They hurt people and as such can be described as vicious and bad."[191] The brute can be beaten into provisional submission, perhaps, but its basic instincts can never be beaten out of it. Its flesh is calamitously fickle, and its inclinations and actions are treacherously unpredictable. And so when things go amiss, when equestrian travel turns traumatic, blame falls with the beast.

Man, by contrast, is above reproach in this formulation. Accidents are visited upon him, not engendered by him; they occur in spite of him, not because of him. His innocence and integrity are not in question. Neither are the reliability and predictability of his machines, locomotive and motorcar. Products of reason and enlightenment, these technological marvels promise to rid the transportation process of its perils. No more irregularities of motion or paroxysms of passion. No more strenuous struggles with the source of motive power. No more shying or running away, biting and bucking. No more willful misbehavior or uncontrollable emotions. No more danger or chaos. No more frightful accidents.

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[190] Quoted in James J. Flink, The Automobile Age (Cambridge: MIT, 1988) 138-139.

[191] Jain 71.

Such claims are soon enough shown to be specious. As accidents accumulate, one after the other, each seemingly more violent and destructive than the last, it becomes increasingly difficult to sustain the aura of safety that initially surrounded the new transportation technology. As the death toll continues to climb, day after day and with no end in sight, the rhetoric of reliability that the greeted the mechanical conveyance begins to ring hollow. The idea, once so luminous, that the machine is substantially more secure than the animal, loses its luster a little more with each new railroad "concussion" or automobile collision. And once the luster wears off completely, the idea is liable to undergo inversion: the machine may be feared and condemned for the scale, suddenness, and sheer violence of its accidents, while the animal may be remembered fondly for the peace of mind it provided the pre-industrial traveler, who took comfort in the creature's gentle carriage and closeness to nature.

By the first decade of the twentieth century, institutional data suggested that the motorcar was more menacing than the horse-drawn coach:

> Automobile accident statistics released at the 1909 meeting of the International Association of Accident Underwriters revealed that the motor vehicle was not safer than the horse, for the record was much worse than what had been considered normal for horse-drawn vehicles. In the same year, Horseless Age admitted that "the 'automobile hazard' is not likely to decline in frequency." Not only did the accident rate seem very high given the number of automobiles in use, but automobile accidents usually involved more serious bodily injury and higher property damage claims than accidents involving only horse-drawn vehicles.[192]

Thus arose a new dilemma: With the beast no longer there to bear the blame, who or what is responsible for the automobile accident? According to Joel W. Eastman, author of Styling vs. Safety: The American Automobile Industry and the Development of Automotive Safety,

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[192] Eastman 116.

1900-1966, "because the automobile, unlike the horse, was an inanimate object, it was natural for the blame for accidents to be laid on the human operator."[193] And there it lay, by and large, for the first half of the twentieth century.

This chapter critically examines discourses of automobile accidentality from the turn of the twentieth century through the 1950s, as well as the development of scientifically controlled automotive crash-testing after World War II. I argue that prewar discourses, informed by liberal humanist ideologies, tended to construct a morally responsible driving subject upon whom blame for accidents could be, and was, readily placed. I argue, in addition, that such blame-placing strategies and practices were crucially conditioned by instrumentalist rationalities of technology, scientific-rationalist epistemologies, and cultural narratives of progress and perfectibility. In the second and third sections of this chapter, I chart what I contend was a major discursive shift, a disciplinary rupture and realignment, that began in the 1940s with the emergence of crash-injury research, culminating in the precisely controlled, highly technologized, rigorously analyzed, institutionally underwritten automobile crash tests of the 1950s. Finally, the conclusion focuses on the role played by motion-picture photography and other crash-test apparatus in the transformation of the automobile accident into an object of scientific and institutional analysis, knowledge, and control during the postwar period.

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[193] Eastman 118.

“The Reckless Driver”: Accident Discourse in the Early Decades of Automobility

From the earliest days of automobility in the United States, the notion held sway that road accidents were almost always the product of driver negligence. A newspaper reporter in 1902 wrote:

> For the automobile has not, like a horse, a will of its own, which may act uncertainly. It is sensitive and responsive — acting in exact accordance with the principles upon which it is constructed. The accident which happens to the automobile is seldom due to the machine itself, but almost wholly to the loss of control or presence of mind of the operator.[194]

Note the peculiar phrasing here: it is the automobile, not the operator, to which the accident happens. Man, once the innocent victim of the animal’s unreliability, has himself become the unreliable animal, while the machine, once and still the embodiment of safety, has become the innocent victim. The beast is still to blame, but now the beast is human.

The law courts generally adhered to this “driver negligence paradigm,” to borrow Sarah S. Lochlann Jain’s term.[195] A precedent-setting judicial opinion issued in 1907 states: “It is not the ferocity of automobiles that is to be feared, but the ferocity of those who drive them. Until human agency intervenes, they are usually harmless.”[196] Francois Ewald, writing in a Foucaultian vein, critiques this “juridical logic of responsibility”:

> the judge takes as the point of departure the reality of the accident or the damage, so as to infer the existence of its cause in a fault of conduct. The judge supposes that there would have been no accident without a fault. . . . Juridical reason springs from a moral vision of the world: the judge supposes that if a certain individual had not behaved as he or she actually did, the

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[194] Quoted in Jain, “‘Dangerous Instrumentality’” 87, n. 16.

[195] Jain 70. “The outcome of these cases ultimately determined that automobiles would be considered as fundamentally benign products that were harmful only when driven negligently, and by the second decade of the 20th century, safety bureaucrats concentrated their attention exclusively on driver education and traffic engineering” (Jain 65).

[196] Quoted in Jain, “‘Dangerous Instrumentality’” 70.

> accident would not have happened; that if people conducted themselves as they ought, the world would be in harmony.[197]

If only the man behind the wheel would be more careful and conscientious, pay more attention and play by the rules. . . . If only he wouldn't behave so ignorantly, so irresponsibly. Accidents, according to this regime of juridical responsibility, are avoidable and preventable, and their occurrence is attributable to the abnormal actions — the "reckless" behavior — of motorists. The problem is defined as a criminal lack of driver discipline. The driver who gets into an accident is undisciplined socially (unadjusted) or perceptually (unfocused) or mentally and manually (untutored, untrained). But, above all, as Ewald suggests, he is undisciplined morally (unredeemed). His recklessness is a sign of his vanity and selfishness, an expression of his disregard for the rights, interests, and welfare of others. He is a wrongdoer, a malefactor. A "bad" driver.[198]

The automobile industry long and loudly endorsed this line of reasoning. It had an obvious interest in doing so, as such reasoning served a threefold purpose: to absolve it of moral responsibility; to exempt it from legal liability; and to ward off the specter of government regulation.[199] Pointing the finger at the reckless driver made the industry appear inculpable, as did pointing the finger at poor road conditions, the industry's other official explanation of why accidents happened. Significantly, these strategies of blaming implied the

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[197] Francois Ewald, "Insurance and Risk," The Foucault Effect: Studies in Governmentality, ed. Graham Burchell, Colin Gordon and Peter Miller (Chicago: U of Chicago P, 1991) 202.

[198] Jain notes that in the early twentieth century, injuries inflicted on bystanders "were used by automobile associations, courts, and an emerging safety network to make moral claims on drivers" (Jain 66).

[199] By "government regulation," I mean regulation of the automobile industry. The industry was actually in favor of governmental regulation of drivers and roads. This position was consistent with how it framed the problem of the accident and with what it understood to be its economic self-interest.

needlessness of redesigning the vehicle and of all the exertions and expenditures such redesigning entailed, from drawing board to finished product. After all, why should automakers waste (or be compelled to waste) their time, effort, and resources on elaborate and expensive safety research and development when accidents were not their fault? Besides, what good would redesigning the vehicle do if, in the end, the driver remained unredeemed?

> The industry argued that automobiles almost never cause accidents and that it was not normal for one to be involved in a crash — thus, there was no obligation to design a car with this possibility in mind. It was vociferously maintained that even the "perfect vehicle" could not prevent driver error or poor road conditions, and that, thus, the solution to the safety problem lay in improving the driver and the highway.[200]

Fortunately for the automobile industry, the highway-safety movement, a loose aggregation of public and private organizations that emerged around 1914, the most important of which was the National Safety Council, institutionalized and helped to popularize the idea that accidents are caused by bad drivers and bad roads, not bad cars. As Eastman observes, "The rationale for the Council's approach to accidents was based on the assumption that all accidents had causes; as one author put it: 'Human misbehavior, human frailty, human ignorance, human laziness all cause accidents. Remove them and accidents cease.'"[201]

The guiding philosophy of the highway-safety movement was sloganized as "The Three E's: Engineering, Enforcement, and Education." The problem of the accident was to be solved through a strategy of triangulation, with each term signifying a distinct approach and angle of attack. The first called for improvements in roadways and related infrastructure; the second, for the enactment of new traffic laws and the establishment of new traffic courts; and

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[200] Eastman 119.

[201] Eastman 120-121.

the third, for the mass inculcation and dissemination of "safety-first principles." According to Eastman, "The safety professionals concluded that, since almost all accidents could be attributed to some human action — which was usually in violation of at least one traffic ordinance — the solution was to educate drivers and pedestrians to behave 'safely' and legally and to enforce the laws against those who misbehaved."[202] Interestingly, those same safety professionals had little to say about the automobile, other than to praise it as "a nearly perfect mechanism which caused few, if any, accidents."[203]

The combined efforts of the automobile industry and the highway-safety movement to infix and naturalize a particular understanding of the relationship between driver (reckless, bad), vehicle (nearly perfect), and accident (avoidable, preventable) proved remarkably successful throughout the early 1900s. Eastman offers a few examples of how this carefully crafted understanding tended to be uncritically accepted and further circulated by the popular press:

> An editorial in Collier's in 1925 stated, "Automobiles are now nearly fool-proof. Streets are not and some drivers are fools," and the magazine repeated six years later, "Automobiles are built for safety but we throw caution to the wind and reap the harvest of recklessness." Another journal summed it up less colorfully a year later when it reported: "Death and injury are to be attributed in the main to the predominance of inefficient but otherwise well meaning drivers. . . ."[204]

The single most widely read and culturally significant article on the subject of automobile accidents to appear during this period was J. C. Furnas's "— And Sudden Death." Originally published in Reader's Digest in August 1935, the article describes the car-

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[202] Eastman 122.

[203] Eastman 122.

[204] Eastman 124.

crash experience — and especially its traumatic effects on the human body — in literally excruciating detail. "Like the gruesome spectacle of a bad automobile accident itself," Furnas writes by way of preface, "the realistic details of this article will nauseate some readers. Those who find themselves thus affected at the outset are cautioned against reading the article in its entirety, since there is no letdown in the author's outspoken treatment of sickening facts."[205]

No letdown, indeed. Even today Furnas's article is notable for its lurid language, gory imagery, and macabre tone. Throughout, the motorcar comes across as something like a medieval instrument of torture, one equipped with a "lethal array of gleaming metal knobs and edges and glass."[206] "Lethal" because, during an accident, "every surface and angle of the car's interior immediately becomes a battering, tearing projectile, aimed squarely at you — inescapable. . . . It's like going over Niagara Falls in a steel barrel full of railroad spikes."[207] Paragraph after paragraph of Furnas's article is littered with moaning voices, mutilated bodies, and mangled corpses. In relentless succession, the reader is told of Z-twisted legs and blood-dripping eyes; "bones protruding through flesh in compound fractures" and "dark red, oozing surfaces where clothes and skin were flayed off"; brains pierced by wooden fragments and skulls shattered by dashboards; abdomens impaled by steering columns and bodies decapitated by windshields; internal injuries and hemorrhages, smashed hips and knees, cracked ribs and collarbones, broken pelvises and spines.[208]

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[205] J. C. Furnas, "— And Sudden Death," Reader's Digest Aug. 1935: 21.

[206] Furnas 23.

[207] Furnas 22-23.

[208] Furnas 22.

"— And Sudden Death" immediately aroused a great deal of public interest and concern, and its didactic possibilities were not lost on civic authorities. In the months following its publication, millions of reprints were ordered and distributed by schools, churches, social clubs, safety organizations, police departments, and traffic courts. Additionally, the article was republished in some two thousand newspapers and magazines. Eastman notes that "The total printed circulation of '— And Sudden Death' in the last few months of 1935 was estimated at over 35,000,000 copies."[209]

At the outset of the article, Furnas claimed that he wanted to move beyond the impersonal abstractions of injury and fatality statistics in order to bring "the pain and horror" of motor-vehicle mishaps "closer home."[210] But why, and to what end? That is, why did Furnas think it necessary to bring home such pain and horror to the readership of Reader's Digest, that metonym for white, conservative, middle-class America? What did he hope to accomplish by doing so? And, for that matter, why did Reader's Digest editor DeWitt Wallace commission Furnas to write the piece in first place? After all, Reader's Digest wasn't exactly known for its sensationalist stories, much less for its morbid fascinations.

Furnas explained that his purpose was to jar "the motorist into a realization of the appalling risks of motoring."[211] For such a realization to be effective, he added, it must be more than momentary: "what is needed is a vivid and sustained realization that every time you step on the throttle, death gets in beside you, hopefully waiting for his chance."[212]

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[209] Eastman 138.

[210] Furnas 21.

[211] Furnas 21.

[212] Furnas 21.

Wallace, for his part, “immediately realized that if more people knew what an accident was really like it might bring some of the reckless drivers and speed maniacs to their senses.”[213] Hence the editor’s addendum that appeared on the last page of the article:

> Convinced that widespread reading of this article will help curb reckless driving, reprints in leaflet form are offered at cost. . . . To business men’s organizations, women’s clubs, churches, schools, automobile clubs, or other groups interested in public welfare, we suggest the idea of distributing these reprints broadcast. The cover of the leaflet provides space for any message or announcement of your own that you may wish to add.[214]

Furnas’s and Wallace’s stated intentions suggest the extent to which the figure of the reckless driver, causer of accidents, had achieved the status of cultural common sense by the mid-1930s. One might even say that the reckless driver had become a cultural archetype of sorts, a new kind of outlaw for a new kind of society and structure of feeling, a troublemaker all the more treacherous on account of his ordinariness. Furnas’s and Wallace’s comments also suggest the extent to which driver education, the third of the so-called Three E’s, was thought to be an effective, if partial, remedy for recklessness.

“— And Sudden Death” was commissioned, written, and edited with the express purpose of reforming reckless drivers and dissuading those who, in a moment of rashness, might be tempted to join their ranks. Accordingly, it continually addresses the reader, assumed to be a motorist, in the second person. The tone is unremittingly urgent and admonitory as well as unabashedly didactic: If you do not want to end up like these victims, then you must drive carefully and conscientiously at all times. When you mix “gasoline with speed and bad judgment,” this is the sudden death, or, worse, the protracted agony, that

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[213] Eastman 137.

[214] Furnas 26.

awaits you.[215] “If you customarily pass without clear vision a long way ahead, make sure that every member of the party carries identification papers — it’s difficult to identify a body with its whole face bashed in or torn off.”[216]

And so on. Nowhere in the article is the automobile itself indicted, only its imprudent operator. Drivers exercise “bad judgment,” Furnas insists, not the designers, engineers, manufacturers, or marketers of the vehicles drivers use — or rather, misuse. Therefore, the way to prevent mishaps is to educate motorists as to the high risks and horrible realities of behaving badly behind the wheel. Wallace and Furnas hoped and believed that “— And Sudden Death,” with its shocking and sickening images of human carnage, would serve as a key lesson in just such an education. And so did the schools, churches, social clubs, safety organizations, police departments, and traffic courts that bulk-ordered and mass-distributed reprints of the article.

I want to propose that the particular configuration of driver, vehicle, and accident I have been discussing in this section constituted and operated as a powerful social and institutional discourse in the United States in the first five decades of the twentieth century. Casting a wide net, this discourse attempted to fix certain meanings, cultivate certain attitudes, inculcate certain behaviors, and assign certain obligations in relation to automobility, and thus was integrally involved in the material and symbolic normalization and regulation of the emergent car culture. Its power and particularity lay in the semantic specificity of each of its three terms, on the one hand, and in the conjunctural specificity of the assemblage, or inter-articulation, of those terms, on the other. Each term — driver,

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[215] Furnas 22.

[216] Furnas 23.

vehicle, accident — was itself a normative construction, in other words, and their consolidation and cultural effectivity marked a discursively distinctive moment the history of mechanized mobility.

In the logic of this complex discourse, (1) the driver is an autonomous subject who freely chooses to act either responsibly or recklessly and who, because he is essentially rational, can be trained to choose the former; (2) the vehicle is an intrinsically safe and reliable technology without agency of its own; and (3) the accident is an entirely unnecessary occurrence, possessing what is often a simple and singular cause: the reckless driver.[217] What we have, then, is a macro-discourse of automobility composed of three mutually informing micro-discourses: a discourse of subjectivity articulated to a discourse of technology articulated to a discourse of accidentality. I will briefly consider each of these micro-discourses.

Subjectivity. The driver is an intentional agent, a rational being, and a sovereign individual. He assesses, decides, and acts accordingly, for better or for worse. His behavior is self-determined and self-directed, and it holds both material consequences and social implications. Because driving is an expression of individual volition, reckless driving is amenable to moral reform: it can be corrected through a combination of instruction (the third E, education) and punishment (the second E, enforcement).

The discursive construction of the reckless driver echoed longstanding, deeply entrenched liberal humanist values, which N. Katherine Hayles defines as “a coherent, rational self, the right of that self to autonomy and freedom, and a sense of agency linked

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[217] For the purposes of the present discussion, I am leaving aside the question of roadway conditions. The idea that accidents were caused by bad roads was not invoked nearly as often or as insistently as the idea that they were caused by bad drivers.

with a belief in enlightened self-interest."[218] Insofar as he was presumed to be endowed with intentionality, reason, self-sovereignty, and a seemingly infinite capacity for self-improvement, the driving subject of the early and mid-twentieth century recalled and recontextualized the liberal humanist subject of the Enlightenment. He also recycled distinctly American fantasies of personal mobility, themselves rooted in liberal humanism's valorization of self-movement and self-regulation, together with democracy and decentralized control.[219]

Technology. In legal parlance, the term "dangerous instrumentality" refers to a category of objects considered to be inherently harmful or hazardous, such as firearms, explosives, and ferocious animals. Under the law, "the owner of a dangerous instrumentality [has] a special obligation to keep it with care."[220] Jain has shown how the judicial system repeatedly refused to recognize the motor vehicle as a dangerous instrumentality in the early decades of automobility. Instead, the courts typically regarded it as an ordinary object, a consumer product like any other, a thing that "merely extend[s] a driver's will," and they codified and reified this way of regarding in their rulings.[221] Such rulings paralleled and literally legitimated the conception of the car as "a nearly perfect mechanism" — a conception that, as we have seen, informed the reasoning and inflected the rhetoric of the popular press, the automobile industry, the highway-safety movement, and the civic

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[218] N. Katherine Hayles, How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics (Chicago: U of Chicago P, 1999) 85-86.

[219] Hayles 86.

[220] Jain 70.

[221] Jain 71.

authorities. Thus did the notion that the automobile was not inherently harmful or hazardous become the cultural common sense.

To leave the explanation here, however, would be to ignore the ways in which the kind of common sense advocated and propagated by the aforementioned industries and institutions was itself conditioned by a broader, already established and effective rationality of technology. It would be to ignore, as well, the ways in which that rationality, because of its historical embeddedness and cultural currency, predisposed the public to accept and adopt, rather than contest or refuse, that "common sense." Just as the eighteenth-century liberal humanist subject prepared the ground for the twentieth-century driving subject, so a prevailing rationality of technology provided the conceptual framework for understanding the "true nature" of the automobile.

This rationality contains two key moves. First, it reduces a sophisticated technology to the status of a simple tool; second, it takes for granted the social, political, and ethical neutrality of that tool. In this way, it exemplifies what Andrew Feenberg calls the "instrumental theory" of technology. According to Feenberg, instrumental theory makes a technology into a "pure instrumentality," a means "indifferent to the variety of ends it can be employed to achieve," a mechanism "without valuative content of its own."[222] Technologies are things — benign, unbiased, and devoid of agency — that stand "ready to serve the purposes of their users."[223]

Other critically minded philosophers of technology have made similar points. Langdon Winner, for instance, argues:

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[222] Andrew Feenberg, Critical Theory of Technology (New York: Oxford UP, 1991) 5.

[223] Feenberg 5.

> According to conventional views, the human relationship to technical things is too obvious to merit serious reflection. . . . Once things have been made, we interact with them on occasion to achieve specific purposes. One picks up a tool, uses it, and puts it down. One picks up a telephone, talks on it, and then does not use it for a time. A person gets on an airplane, flies from point A to point B, and then gets off. The proper interpretation of the meaning of technology in the mode of use seems to be nothing more complicated than an occasional, limited, and nonproblematic interaction.[224]

Accompanying this conventional "meaning of technology in the mode of use" is a correspondingly conventional morality of technology:

> Tools can be 'used well or poorly' and for 'good or bad purposes'; I can use my knife to slice a loaf of bread or to stab the next person that walks by. Because technological objects and processes have a promiscuous utility, they are taken to be fundamentally neutral as regards their moral standing.[225]

Feenberg's and Winner's critiques help us to see how an ideologically dominant instrumentalist rationality of technology could have conditioned the possibility of the automobile's social, political, and ethical neutralization — of its tendentious reduction to the status of an ordinary object — in and across a number of public, popular, and institutional sites during the first half of the twentieth century. As "the most widely accepted view of technology," instrumental theory lent credence to the concept that cars are tools to be used for good or for ill, that they are ethically empty machines for modern living, no different in principle from electric toasters, automatic dishwashers, or any other consumer technology.[226] At the same time, it worked to deflect attention from what Ralph Nader famously dubbed "the designed-in dangers of the American automobile," obscuring the social agencies of the

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[224] Langdon Winner, The Whale and the Reactor: A Search for Limits in an Age of High Technology (Chicago: U of Chicago P, 1986) 5-6.

[225] Winner 6.

[226] Feenberg 5.

vehicle engineer, the vehicle manufacturer, and the vehicle itself.[227] In short, the cultural predominance of the instrumental theory of technology facilitated the naturalization of the notion that cars don't kill people, people kill people, including themselves.

Accidentality. Let us recall what Eastman said about the National Safety Council: "The rationale for the Council's approach to accidents was based on the assumption that all accidents had causes; as one author put it: 'Human misbehavior, human frailty, human ignorance, human laziness all cause accidents. Remove them and accidents cease.'" These statements perfectly encapsulate the dominant discourse of accidentality in the early decades of automobility. There are three interrelated claims or assumptions here. The first is that automobile accidents have mundane causes and, therefore, are susceptible to rational explanation. The second is that automobile accidents are anthropogenic, the direct results of human actions. The third is that automobile accidents can be "removed" or "ceased"; that is, they are eradicable. As Jain observes, "The obvious corollary of assuming that the car is an ordinary object was that accidents would be understood as the result of driver negligence. Perfect driving was assumed to be humanly possible and legally obligatory."[228] What made this particular reading of the automobile accident seem reasonable and right to most people at the time? First and foremost, I would answer, the prevalence of a broader and more basic conceptualization of the nature of "the accidental."

Karl Figlio, in his essay "What Is an Accident?," writes: "So deeply rooted in our cosmology as an ordinary accident may be, it remains a feature of an historically constituted

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[227] Ralph Nader, Unsafe at Any Speed: The Designed-in Dangers of the American Automobile (New York: Grossman, 1965).

[228] Jain 66.

way of understanding events."[229] Automobile accidents, by definition, compose a specific subset of a more encompassing class of phenomena called "accidents," and what a given society or culture includes (and does not include) in that more encompassing class — indeed, whether it recognizes such a class in the first place — tells us something significant about what Figlio calls its cosmology. The converse is true as well: a society's or culture's cosmology — its conception of the natural order — determines not only what counts (and does not count) as an accident but also how accidents are normally or customarily interpreted, valued/devalued, and represented. What we are talking about, then, to put it in Foucaultian terms, is a certain <u>regime</u> of accident.

The discursive construction of automobile accidents as mundanely caused/rationally explainable, anthropogenic, and eradicable was contingent on a particular conceptualization of accidents in general, which, in turn, was an essential part of a socially and "historically constituted way of understanding events" in the universe. To define a car crash or other unexpected event involving a motor vehicle as an accident is a gesture neither arbitrary nor innocent, for the term "accident" always already implies a whole worldview, a whole politics of reality. The question then becomes, What kind of worldview preconditioned this particular regime of accident?

In the same sense that liberal humanism set the stage for the reckless driver and instrumental theory laid the groundwork for the depoliticization of the automobile, modern scientific rationalism, together with an equally modern belief in progress and human perfectibility, conditioned the possibility of the mundanely caused/rationally explainable, anthropogenic, and eradicable accident. Having already examined, in this dissertation's

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[229] Karl Figlio, "What Is an Accident?," <u>The Social History of Occupational Health</u>, ed. Paul Weindling (London: Croom Helm, 1985) 180.

Introduction, the conceptual, historical, and discursive relations between modernity, accidentality, technology, and "progress," I will not repeat that analysis here. Suffice it to reiterate a few key points.

First, with post-Enlightenment modernity comes that category of misfortune called "the accidental." Secular reason makes accidents classifiable and comprehensible — which is to say that it makes them possible per se. Otherwise, "accidents" are not really accidents at all: they are events willed and motivated by the gods, by God, or by some other magical force or supernatural entity. They are divine interventions into human affairs, and their meanings and purposes are to be apprehended in light of extramundane intentions, actions, and arrangements. Accidents, by contrast, are not orchestrated by the hand of a "disposing" deity; they can only occur in a disenchanted world.

Second, and closely connected to the first point, scientific-rationalist epistemologies look for and locate causes and their "chains" in the world, not beyond it. Accidents are seen as logical outcomes of linear progressions of physical phenomena, terminal links in chains of causality existing in time and space. Every worldly event has a worldly cause, and, crucially, every worldly cause can be explained rationally and scientifically. And in the dominant discourse of accidentality in the early decades of automobility, the worldly cause of motor-vehicle mishaps was that most human of prime movers, the reckless driver.

Finally, a foundational faith in moral and material progress, inherited from the eighteenth century and allied with scientific rationalism, supported the view that accidents were errors that could be eradicated. "Rationalism goes hand in hand with the idea of progress," writes Siegfried Giedion. "The eighteenth century all but identified the advance of science with social progress and the perfectibility of man."[230] Individually and cumulatively, automobile accidents were thought to be nothing more than the manifestations of human mistakes, ignorant or imprudent deviations from a code of behavior that should — and could — be followed flawlessly. So-called operator errors, in this formulation, are unprovoked and unnecessary: "Remove them and accidents cease." This fantasy of the perfect driver — and, by extension, of a nation of perfect drivers — rearticulated the mythology of man's perfectibility in the context of an emergent culture of automobility. It envisaged a world in which all reckless drivers would be rehabilitated and all road accidents would be obviated. It employed a logic of simple subtraction — accident-causing errors were to be eliminated one by one, through the implementation of the Three E's — in order to arrive at a smoothly functioning, totally safe system of transportation. Social progress was realizable, supposedly, because the number of anthropogenic accidents could be reduced to zero, and, tautologically, the number of anthropogenic accidents could be reduced to zero because social progress was being realized.

The Turn to Crash Injuries and "Crashworthiness"

The macro-discourse of automobility that associated accidents with a single, scientifically knowable chain of causality leading back to the human operator, and, correlatively, with an implicit vision of progress predicated on the eradication of human

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[230] Siegfried Giedion, Mechanization Takes Command: A Contribution to Anonymous History (New York: Norton, 1969) 30. Leo Marx concurs, adding that "such radical republican adherents of the Enlightenment as Turgot, Condorcet, Priestly, Paine, Franklin, and Jefferson . . . spoke for the revolutionary generation that initially theorized the possibility of comprehensive, or universal, human Progress. (As they saw it, Progress was closely bound up with a belief in 'the perfectability [sic] of Man.')" Leo Marx, "The Domination of Nature and the Redefinition of Progress," Progress: Fact or Illusion?, ed. Leo Marx and Bruce Mazlish (Ann Arbor: U of Michigan P, 1996) 206.

error, did not go entirely unchallenged during the period of its predominance, from roughly 1900 to the 1950s. Beginning in the 1930s, a few individuals, most of them medical professionals, began to seriously question the wisdom of concentrating on driver behavior as the cause of automobile accidents. Instead, they turned their attention to the consequences of accidents for automobile occupants. That is, they focused on the origins and mechanics of car-crash injuries, on the damage done to bodies, along with the structures, forces, and processes involved in the production of that damage. They wanted to know how and why crash injuries happened, as well as what could be done to prevent them from happening in the future. Rather than worrying about the psychological interior of the driving subject (his morals, his motives, his mind), they worried about the physical interior of the vehicular object (its surfaces, protuberances, and appurtenances). Rather than seeking to eradicate accidents by reforming the operator, they sought to mitigate their detrimental effects by rethinking the design of the machine that moved — and too often mutilated — him. Rather than acquiescing to the fantasy of driver perfectibility, they accepted the reality of the accident's inevitability.

Claire L. Straith, a plastic surgeon from Detroit, was the pioneering figure in the effort to radically recast the problem of automobile accidents during the 1930s.[231] Straith spent countless hours and much of his career reconstructing the bodies, especially the faces, of car-crash victims. "I have seen the torn and mutilated victims of crashes for nearly four decades," he declared in 1957. "At least we have the chance to help the victims, the ones lucky enough to survive, to return to normal appearances."[232]

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[231] Eastman 181-184.

[232] Quoted in Eastman, Styling vs. Safety 181.

Straith customized his own car for safety in the early 1930s, installing seatbelts and affixing to the dashboard crash padding of his own design and manufacture.[233] In 1934, he initiated what would become an ongoing dialogue with automobile-industry executives and engineers, urging them to remake the vehicle interior so as to lessen the frequency and severity of accident-related injuries. A year later, Straith met with Walter P. Chrysler, founder and head of Chrysler Corporation, who, along with the company's chief engineer, responded favorably to his ideas and suggestions. Debuted in the fall of the following year, the 1937 Dodge incorporated several Straith-inspired features, including inward-curved door handles, nearly flush window regulators and a completely encased windshield regulator (it was not unusual in those days for windshields to open for ventilation), non-protruding instrument-panel buttons, a raised dashboard (to reduce knee injuries), and a rubber-padded front-seat back (to protect rear-seat passengers).

As Eastman points out, other automakers such as Studebaker Corporation "adopted some of Chrysler's innovations while public concern over safety remained high in the later 1930s" — concern provoked, in part, by Furnas's Reader's Digest article.[234] Nevertheless, in the absence of either government regulation or a reliable gauge of success, such innovations were soon sacrificed on the altar of the "annual model change":

> The annual model change required new styling of the interior, as well as the exterior, and when the new models appeared after the war, the "safety smooth" dashboards, recessed door handles, and other small improvements had been replaced by new and different, but usually less safe, designs. A promising beginning of automobile design for crash protection had been brought to a halt by the demands of the annual model change. Chrysler safety engineer Roy Haeusler later reported that there was no way to evaluate the

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[233] Straith actually patented three types of automotive crash padding between 1935 and 1937.

[234] Eastman 182.

> effectiveness of his company’s instrument panel design, and, thus, no way to justify its retention — so it was changed for styling purposes.[235]

By the late 1940s, Straith was not the only physician researching car-crash injuries and recommending ways to redesign the vehicle interior for occupant safety. In June 1948, Fletcher D. Woodward, an otolaryngologist (ear, nose, and throat specialist) from the University of Virginia Hospital, delivered an address titled “Medical Criticism of Modern Automotive Engineering” at the American Medical Association conference in Chicago. Published later that year in the Journal of the American Medical Association, the address defended the medical profession’s increasing interest in the relationship between automobile design and accident injury. Woodward proposed that automotive engineers take their cue from aeronautical engineers, who, in recent years, minimized crash injuries by modifying cockpit instrumentation in light of studies conducted in the field of aviation medicine. He went on to specify a number of ways in which motorcars might be built for safety rather than for speed and style. Most interesting for our purposes, however, was Woodward’s explicit attempt to reframe questions of agency, accountability, and accidentality:

> In spite of the success of [highway-safety] campaigns, the automobile still remains a lethal and crippling agent, and since there appears to be little likelihood of accomplishing radical changes in human nature in general and exuberant youth in particular, it would seem the part of wisdom to shift the emphasis, for the moment at least, to desirable alterations in the machine itself, rather than to place all emphasis on attempts to bludgeon “old Adam” into safer driving practices.
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> Our highways are becoming increasingly laden with cars driven by average persons, and it appears inevitable that these machines will continue to collide, pass on turns, fail to observe stops signs, leave the road at high speeds and afflict mankind much as they have in the past.[236]

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[235] Eastman 184.

[236] Fletcher D. Woodward, “Medical Criticism of Modern Automotive Engineering,” Journal of the American Medical Association 138.9 (1948): 628-629.

This is a fairly astonishing statement for its day. In a few carefully worded sentences, Woodward repudiates five decades of thought and practice in the area of automobile safety. He pays lip service to the highway-safety movement, to be sure, but it is clear that he considers it a failure; indeed, not only the nature but also the very fact of his proposal presumes that failure. A newspaper reporter in 1902 wrote: "The accident which happens to the automobile is seldom due to the machine itself, but almost wholly to the loss of control or presence of mind of the operator." Forty-six years later, Woodward wants to reverse this line of reasoning: awkward or absent-minded operators are now "average persons" victimized by automobiles that "continue to collide, pass on turns, fail to observe stops signs, leave the road at high speeds." The seat of agency, once singular and synonymous with the driver's psyche, is now doubled and dispersed: the machine, no less than the man, exerts a kind of influence, exercises a kind of power, acts. Human nature cannot be changed by the bludgeons of the Three E's, no matter how hard or how often they strike. The "lethal and crippling" nature of the motorcar, on the other hand, can be changed with comparative ease, using nothing more than the ideas and implements of the modern engineer. As the total number of cars on the nation's roads climbs with each passing day, it becomes increasingly difficult to sincerely sustain the dream of accident eradicability. Instead, the accident "appears inevitable."

Woodward's address to members of the American Medical Association in 1948 was clearly informed by Claire Straith's innovative automotive designs.[237] But it arguably owed

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[237] Woodward, a la Straith, called for a car equipped with, among other things, "a latch to lock the backs of front seats in position . . . to prevent the added impact of them to the front seat passengers in sudden stops," seatbelts, "a hydraulic steering column which will move forward under a force of approximately 100 foot pounds," sponge-rubber crash padding "on the dash and back of front seats," and non-projecting knobs, buttons, and handles (Woodward 630).

an even bigger debt to the work of a self-trained engineer and pathologist from New York named Hugh DeHaven.

DeHaven's interest in crash injuries began in 1917 while he was a cadet in the Canadian Royal Flying Corps, which he joined after failing to meet U.S. Army Air Corps requirements. One day during a flight-training exercise, DeHaven's Curtiss JN-4 "Jenny" collided with another plane and crashed to the ground. DeHaven suffered serious injuries, including two broken legs, assorted bruises and lacerations, and a ruptured liver, pancreas, and gallbladder. During his six-month in-hospital convalescence, he became preoccupied with what he would later call "the mechanics of injury and safety design."[238] His colleagues were convinced that he was "lucky" to have survived the accident, that his victory over death was a "miracle." But, as A. Howard Hasbrook noted in an article for Clinical Orthopaedics in 1956, "DeHaven felt that the intactness of [his plane's] cockpit structure was the answer; thus was born the first concept of 'crashworthiness.'"[239]

DeHaven continued to pursue the concept of crashworthiness after leaving the hospital. Eastman notes that "When DeHaven returned to active duty, he was given . . . the job of rushing to local airplane crashes which happened frequently around the training field, and he had an opportunity to study crashes and related injuries in great detail and numbers."[240] Recalling these formative experiences, DeHaven later wrote: "Observations made at that time, during investigation of air crashes, gave strong indication that many of the

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[238] Hugh DeHaven, "Mechanical Analysis of Survival in Falls from Heights of Fifty to One Hundred and Fifty Feet," War Medicine 2.4 (1942): 586, fn.

[239] A. Howard Hasbrook, "The Historical Development of the Crash-Impact Engineering Point of View," Clinical Orthopaedics 8 (1956): 269.

[240] Eastman 211.

traumatic results of aircraft and automobile accidents could be avoided. Structures and objects, by placement and design, created an inevitable expectance of injury in even minor accidents."[241] The safety recommendations DeHaven made on the basis of these observations, however, tended to be either written off or ridiculed. Pilots scoffed at the suggestion that cockpits and cabin structures be reengineered for crashworthiness. (In the military aviator's macho code of honor, such a concern was tantamount to cowardice.) Other professionals, too, turned a deaf ear or raised a mocking eyebrow. Nader writes: "De Haven was turned away repeatedly by government and university people who called him a 'crackpot.' In the twenties and thirties, he recalls, 'The saying used to be, "If you want to be safe, don't fly."'"[242] Airlines and aircraft manufacturers turned DeHaven away as well.

It was not until 1942 that DeHaven's research came into public view, with the publication, in the American Medical Association's journal War Medicine, of "Mechanical Analysis of Survival in Falls from Heights of Fifty to One Hundred and Fifty Feet." In the paper, DeHaven assembled and analyzed eight documented cases of human free fall.[243] Most were suicide attempts, some were mishaps, but in each case, amazingly, the faller survived, often sustaining only minor injuries. DeHaven's stated objective in studying these so-called human oddities was, first, "to establish a working knowledge of the force and tolerance limits of the body" and, second, to facilitate the conscientious application of that knowledge to aircraft and automotive engineering and design.[244] By casting a clinical eye on cases in which

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[241] DeHaven, "Mechanical Analysis" 586, fn.

[242] Nader 82.

[243] DeHaven defines a "free fall" as "a fall free of any obstruction other than that encountered at its termination" (DeHaven, "Mechanical Analysis" 588).

[244] DeHaven, "Mechanical Analysis" 586.

ordinary individuals walked away (literally, in some cases) from downward plunges that seemingly should have killed them, DeHaven was able to dispel the myth of the body's mortal fragility under conditions of rapid deceleration and extreme force impact. This allowed him to convincingly argue that, contrary to widely held belief, the human body is capable of surviving the decelerative intervals and the impact velocities involved in many aircraft and automobile crashes. What the body is not capable of surviving, however, is an unsafely designed "structural environment," which DeHaven identified as "the dominant cause of injury."[245] Formally articulating ideas that Claire Straith had custom-built into his own car a few years earlier, he concluded "that structural provisions to reduce impact and distribute pressure can enhance survival and modify injury within wide limits in aircraft and automobile accidents."[246]

Well reasoned and well substantiated, the War Medicine article helped DeHaven overcome the "crackpot" designation. More important, though, it enabled him to obtain moral and material support from the Safety Bureau of the Civil Aeronautic Board, the National Research Council's Committee on Aviation Medicine, and the Office of Scientific Research and Development. A grant from the latter led to the creation in 1942 of the Crash Injury Research project at Cornell University Medical College in New York City.[247]

At Cornell, DeHaven and his three Crash Injury Research staffers developed a novel and sophisticated system for accumulating and analyzing data pertaining to survivable light-

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[245] DeHaven, "Mechanical Analysis" 587.

[246] DeHaven, "Mechanical Analysis" 596. I do not mean to imply that DeHaven intentionally sought to lend scientific support to Straith's ideas. In fact, it is not clear that he was even aware of them as such.

[247] Eastman 214. The project was headquartered in the Department of Physiology.

plane accidents and related injuries. Specially prepared forms were distributed to "highly motivated state police and state aviation groups," rather than to the Civil Aeronautics Administration, as might be expected (and was later done), since at that time "the Civil Aeronautics Act did not provide for investigation into the causes of injuries — only the causes of accidents."[248] On these forms were to be recorded, in DeHaven's words,

> careful estimates . . . of impact speeds and stopping distances which, with photographs of the general wreckage, cabin interior, seats, instrument panels, control wheels and other details, allow judgment of accident force and severity. By analyzing, cross referencing, and filing data, it soon was possible to identify specific structures and conditions which repeatedly caused similar injuries in similar accidents.[249]

This accident-reporting system represented an important philosophical and practical reorientation in the field of accident investigation in the United States. Prior to the Crash Injury Research project, accident investigators were concerned to ascertain the cause of the crash. This concern has not diminished to this day. But the new system — and the new, medicalized way of thinking it embodied — required that at least some accident investigators be attentive only to the causes of crash injury and fatality.[250] In this way, the new system implied the inevitability and ineradicability of the accident.

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[248] Hasbrook 271.

[249] Hugh DeHaven, "Cushion That Impact!," <u>Public Safety</u> May 1950: 10.

[250] DeHaven wrote: "Until the Crash Injury Research project was initiated the philosophy behind accident investigation was solely to find causes of accidents; this philosophy fell short of finding causes of injury and fatality in survivable accidents and left many problems of safety untouched. No organized attack could be made on basic problems of reducing the overall seriousness of injury in accidents without knowing what caused typical crash injuries." Hugh DeHaven, "Crash Injury Research; A Study Sponsored by the Navy and Air Force and Civil Aeronautics Administration; Summary Report for the Fiscal Year, July 1, 1949 to June 30, 1950," United States Air Force, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, September 1950, v.

DeHaven knew that preventing the causes of human injury meant convincing manufacturers to make their machines less dangerous to use and occupy — not less dangerous to use and occupy during the countless hours of “normal operation” but, rather, during the split second of the accident, during that miniscule interval in which there is no “operation” as such. It meant getting manufacturers to rethink their responsibility; in fact, it meant getting them to redesign their responsibility, to literally build it into their products. In a 1950 technical report summarizing a study jointly sponsored by the U.S. Navy, the U.S. Air Force, and the Civil Aeronautics Administration, DeHaven wrote:

> All details of these [accident-investigation] reports are recorded on punch cards and analyzed for characteristic “patterns of injury” resulting from specific structures. Dangerous structures are called to the attention of the manufacturer and recommendations are made for redesign to minimize known dangers. The information obtained has been of assistance to manufacturers in considering the overall configuration and arrangement of structure in new planes as well as in the redesign of seat backs, instrument panels, control wheels, seats, safety belts, flooring, and other details.[251]

By the early 1950s, the Crash Injury Research project had broadened its scope to include the study of automobile injuries, and by the mid-1950s a reporting system similar to the one used for light-plane accidents had been implemented in eighteen states.[252] In several of his published writings on the subject, DeHaven, like Fletcher Woodward, made explicit his intention to shine the national highway-safety spotlight not on poorly disciplined drivers and accident causes, as had been done for decades (with limited results), but on poorly designed vehicles and injury causes: “Despite nationwide accident prevention programs, the steadily increasing use or airplanes and automobiles is resulting in a greater number of accidents each year. Consequently there is an increasing need of safety engineering and

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[251] DeHaven, “Crash Injury Research” v.

[252] Eastman 222.

design to offset the danger of injury in crashes."[253] (I will say more about Cornell's automobile crash-safety research in the next section.)

Besides DeHaven, the most important player in aircraft crash-injury research during the 1940s and '50s was an Air Force officer and flight surgeon named John Paul Stapp.

During his tenure at the Wright Air Development Center's Aeromedical Laboratory in Dayton, Ohio, Stapp field-tested liquid-oxygen emergency breathing systems for military pilots and recommended ways to prevent high-altitude bends, chokes, gas pains, and dehydration.[254] In May 1947, Stapp was moved to Edwards Air Force Base (then known as Muroc Army Air Field) in California's Mojave Desert, where he organized an aeromedical field laboratory like the one at Wright Field (but with far fewer resources) and served as project officer — and test subject — for the first rocket-sled research program. The program was designed to study the strength of airplane seats and harnesses under simulated crash conditions and to determine the limits of human tolerance to rapid deceleration.

On December 10, 1947, after carrying out more than thirty runs using anesthetized chimpanzees or anthropomorphic dummies, Stapp strapped himself into the Northrop Aircraft "Gee Whiz" Decelerator Sled. When the speeding machine came to a sudden stop a few seconds later, the first rocket-sled experiment to use a live human volunteer was over, and a new kind of transportation-accident research had begun. Stapp had, in effect, taken DeHaven's free-fall studies — specifically, their concern with the survival limits of rapid deceleration and extreme force impact — and turned them into technically complex,

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[253] DeHaven, "Crash Injury Research" v.

[254] "The Fastest Man on Earth," Time 12 Sept. 1955: 85.

scientifically controlled field tests. Stapp not only gathered crash-injury information, he generated it.

By May of the following year, Stapp had ridden the rocket sled sixteen times and had been subjected to decelerative forces ("Gs") equivalent to thirty-five times the pull of gravity. "The men at the mahogany desks thought that the human body would never take more than 18 gs," Stapp told Time magazine in 1955. "Here we were, taking double that — with no sweat."[255] In June 1951, Stapp completed his work at Edwards, where he survived a total of twenty-six trips down the test track, sustaining only minor injuries. His unorthodox research had demonstrated that the human body, if properly positioned and restrained, could withstand at least forty-five Gs at 500 Gs per second rate of onset.[256] And if forces this extreme were not themselves lethal, as had been shown to be the case, then Stapp's hero, Hugh DeHaven, was quite right in saying that high-speed, heavy impact "crackups" were survivable, given the right "structural environment"; that is, an environment engineered for crashworthiness.

In April 1953, Stapp assumed command of the Holloman Air Force Base's Aeromedical Field Laboratory in New Mexico. At Holloman, Stapp continued his work on the effects of mechanical force on living tissue. His personally designed and directed research project, Biophysics of Abrupt Deceleration, investigated the problem of high-speed, high-altitude escape from aircraft, or "escape physiology."[257] Whereas Edwards' "Gee Whiz"

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[255] "The Fastest Man on Earth" 86.

[256] NASA History Office, "History of Research in Space Biology and Biodynamics at the U.S. Air Force Missile Development Center, Holloman Air Force Base, New Mexico, 1946-1958" <http://www.hq.nasa.gov/office/pao/History/afspbio/part4-1.htm>.

[257] According to a NASA History Office document, "The high-speed escape problem was one of imposing magnitude. A pilot bailing out at transonic or supersonic speed had to face first the ejection force required to get him out of his plane, then the sudden onslaught of windblast and wind-drag deceleration, likely to be followed by dangerous tumbling and spinning. Any one of these forces

only had the capacity to study the effects of rapid deceleration, Holloman's high-speed track, originally built in 1949 as a rail launcher for the Snark missile, had the capacity to study the effects of rapid deceleration in combination with those of windblast and tumbling. It was 1,550 feet longer than the Edwards rocket sled, and it featured an advanced system of water brakes, rather than mechanical-friction brakes, which "permitted both high deceleration forces and a wide range of duration and rate of onset."[258]

For Stapp's latest round of experiments, Northrop Aircraft created a rocket sled called "Sonic Wind No. 1." Practice runs began on November 23, 1953, and the first run with a living subject — a chimpanzee — took place on January 28, 1954. (Chimps were the animal of choice for rocket-sled research, but hogs and black bears were sacrificed in related experiments at Holloman.) With authorization from Air Research and Development Command Headquarters, Stapp took his first ride in Sonic Wind No. 1 on March 19 of that year, reaching a peak velocity of 615 feet per second. To explore the effects of abrupt windblast, a second human experiment was conducted seven months later, with Stapp again serving as test subject.

Stapp's final — and most celebrated — rocket-sled experiment took place on December 10, 1954, seven years to the day after he first climbed aboard the "Gee Whiz." On that late-autumn morning in 1954, Sonic Wind No. 1, with Stapp onboard, reached a record-breaking 632 miles per hour in five seconds — faster than the Lockheed T-33 observation aircraft flying overhead — then slammed to a halt in 1.4 seconds. The experiment subjected

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taken separately was a potential cause of injury or death, not to mention the anxiety on the part of aircraft pilots who did not know if they would survive or not in case of ejection." NASA <http://www.hq.nasa.gov/office/pao/History/afspbio/part4-1.htm>.

[258] NASA <http://www.hq.nasa.gov/office/pao/History/afspbio/part4-1.htm>.

Stapp's body to forces in excess of forty-six times the pull of gravity — the most any human being has ever deliberately endured — and it temporarily blinded him.

It also made him a national hero and a media icon. In the wake of his record-breaking ride, Stapp made several television appearances, including one on Ralph Edwards' This Is Your Life. Casting the scientist as superhero, Collier's dubbed Stapp the "Fastest Man on Earth" in a June 1954 cover story. Time did its own "Fastest Man on Earth" cover story on Stapp in September of the following year, and Twentieth Century Fox's On the Threshold of Space, a romanticized Hollywood B movie partly based on Stapp's rocket-sled research, appeared the year after that.

As early as 1948, Stapp was aware that his experiments, undertaken in the name of aviation medicine, held profound implications for automobile safety, and over the next few years he became increasingly interested in the issue of automotive crashworthiness. Soon he was saying the sort of thing that could have come out of the mouth of Straith, Woodward, or DeHaven: "Interiors of vehicles should be delethalized in order to increase their crash protective characteristics with specific attention given to any object which could cause injury if impacted by the occupant."[259]

In 1953, he proposed that the Aeromedical Field Laboratory carry out a series of controlled automobile crash tests in order to measure actual car-crash forces and "to establish criteria for modifications and specifications for vehicles, personnel restraints and . . . regulations for automotive safety."[260] Although some of his superiors did not approve of

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[259] John P. Stapp, "Human Factors of Crash Protection in Automobiles," The Society of Automotive Engineers Summer Meeting, June 3-8, 1956, Atlantic City, NJ (New York: Society of Automotive Engineers, 1956) 3.

[260] NASA <http://www.hq.nasa.gov/office/pao/History/afspbio/part5-7.htm>.

automotive research being conducted under the auspices of an aeromedical research institution, Stapp was able to persuade the decision-makers that car-crash injuries and fatalities were something the military should take seriously. The statistics supported his argument. At the time, automobile accidents ranked second as a cause of death and first as a cause of hospitalization among Air Force personnel, and first as a cause of death among Army personnel.[261] In 1954, the Air Force lost some 700 men in plane crashes and 628 in car crashes.[262] Such losses, Stapp insisted, constituted "a needless waste of manpower to the defense effort. . . . Driver's education will help somewhat to prevent accidents but concrete steps should be taken to protect the vehicle occupant when the accident occurs."[263]

This last statement neatly articulates the discursive turn to crash injuries and crashworthiness I have been highlighting in this section: driver's education is dutifully mentioned but only halfheartedly recommended ("somewhat"); the primary imperative is to protect the vehicle occupant, not prevent the accident; and the occurrence of that accident is a regarded as a matter of <u>when</u>, not <u>if</u>.

Full-scale crash-testing began in the spring of 1955. An un-instrumented trial run, using a 1945 Dodge Weapons Carrier and a pair of lap-belted dummies, took place in March 1955. Two months later, in front of an audience of invited guests from the ranks of industry, government, and academia, a fully instrumented crash test was staged, formally inaugurating the Aeromedical Field Laboratory's new Automotive Crash Forces project. (This turned out to be the first of three "Annual Automotive Crash Research and Field Demonstration"

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[261] NASA <http://www.hq.nasa.gov/office/pao/History/afspbio/part5-7.htm>.

[262] "The Fastest Man on Earth" 86.

[263] Stapp 1.

conferences held at Holloman.) Multiple and various crash tests, as well as multiple and various smaller-scale force-impact experiments, were conducted over the next three years, using anesthetized animals, anthropomorphic dummies, and even human volunteers (not Stapp, however). Air Force salvage vehicles were rolled over while in motion, crashed into fixed barriers, and crashed into other vehicles. In some tests, vehicles were brought to an abrupt halt by means of metal cables attached to their frames. Hogs were restrained in specially designed “swing seats” and released like a raised pendulum into various types of steering wheel and column. Other specially designed machines were employed as well, including a crash-restraint demonstrator, originally built for aircraft and informally known as “The Bopper,” and a short, two-rail deceleration device called “The Daisy Track.”

The Development of Scientific Crash-Testing

The Aeromedical Field Laboratory at Holloman was not the only organization in the United States during the 1950s carrying out scientifically controlled car-crash and force-impact tests. On the contrary, a number of public and private institutions, most of them research universities, along with a few automobile manufacturers, most notably Ford Motor Company, were doing so, and their experimental findings and automotive-engineering recommendations quickly circulated among interested individuals and institutions. Practically everything about these tests was unprecedented: their rationale, methods, and objectives; their technical and administrative sophistication; their scale, variety, and sheer quantity. Never before had automobile crash-test research been carried out with such rigor and attention to detail, with so much high-tech equipment and so many labor-intensive hours, in and across so many industrial and institutional sites. Throughout the 1950s and ’60s, such research extended, in the most violent and spectacular manner imaginable, the scientific quest for information pertaining to the causes of crash injuries as well as the possibility of mechanical crashworthiness.

Some of the most significant crash-test research in the postwar period took place at Cornell University. While the crash-injury group at the Medical College in New York City was busy gathering, cataloging, and analyzing data pertaining to actual motor-vehicle mishaps, researchers at the Cornell Aeronautical Laboratory in Buffalo were busy creating, controlling, and learning from their own "accidents." As Edward R. Dye, Head of the Laboratory's Industrial Division, explained in 1955:

> Our research at the Laboratory in Buffalo is aimed toward the collection of engineering information, by mathematical analysis and/or applied research techniques, on the factors which cause injury to the human and [toward] the use of the information so collected to design ways of increasing the safety in the mechanical automobile device.[264]

Cornell Aeronautical Laboratory's earliest impact experiments, dating from the late 1940s, saw hen eggs standing in for human heads. After the Medical College's Crash Injury Research group discovered that approximately three-quarters of all deaths in light-plane crashes were due to head injuries, the Laboratory began researching ways to protect the pates of aircraft pilots and passengers. Reasoning that both eggs and heads are "hard shells surrounding a semi fluid and are, in general, ellipsoidal in shape," researchers dropped eggs from various heights onto various energy-absorbing materials and recorded the results.[265] In

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[264] Edward R. Dye, "Automobile Crash Safety Research," Medical Aspects of Traffic Accidents Conference, May 4-5, 1955, Montreal, Canada (Buffalo: Cornell Aeronautical Laboratory, 1955) 1.

[265] Dye, "Automobile Crash Safety Research" 2. See also Edward R. Dye, "Cornell University Tests Show Just What Happens in a Crash . . . and How to Protect Yourself," Woman's Day Nov. 1954: 86.

addition, they developed a small swing-like contraption in which an egg was placed and then crashed against a concrete column. In another set of experiments, sponsored by the Medical Science Division of the Office of Naval Research, gelatin-filled human skulls sealed with cellophane tape were dropped from various heights onto hard, flat surfaces (and later, onto differently shaped surfaces) in order to ascertain fracture thresholds and rates and heights of rebound. In related experiments, plastic head-forms were catapulted at speeds of up to forty miles an hour into cockpit instrument panels.[266] Each of these tests, significantly, was studied with the aid of a high-speed motion-picture camera — an instrument whose centrality to postwar crash tests will be discussed in a moment.

The Laboratory began researching automobile crash-safety in 1953. In that year, the Liberty Mutual Insurance Company of Boston sponsored an elaborate research project with three basic objectives: first, to measure the kinematic motions of belted and unbelted occupants during the crash-deceleration interval; second, to find ways and means of reducing the injurious effects of those motions; and third, to find ways and means of reducing the monetary costs of crash-caused vehicular damage.[267] To achieve the first objective, complex "crash-snubbing" tests were staged, using a 1950 two-door, five-passenger Ford sedan and an unmatched pair of specially designed human surrogates: "Thick Man," modeled on an adult male, and "Half Pint," modeled on a six-year-old child.[268] ("Thin Man," a cruder sheet-metal dummy, was used extensively in earlier, aircraft-related experiments at the Laboratory.)

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[266] Dye, "Automobile Crash Safety Research" 3-4. See also DeHaven, "Cushion That Impact!" 11.

[267] Dye, "Automobile Crash Safety Research" 7-8.

[268] Unlike full-scale crash tests, these crash-snubbing tests used a two-inch-thick, 200-foot-long steel cable to abruptly stop the car — "a violent form of crack-the-whip," in Dye's words (Dye, "Cornell University Tests" 85).

According to Dye, the dummies were carefully developed by the Laboratory “to behave, in these violent adventures, exactly as living passengers would.”[269] The dummies’ kinematic motions — their precise positions and flight paths during the decelerative interval — were captured and analyzed by means of high-speed motion-picture cameras. “Because the action is so fast,” Dye explained in an article for Woman’s Day magazine in 1954, “we collect our data with special electronic instruments and high-speed movie cameras; later we can study the accident in slow motion. This lets us see exactly what happened; how injuries are received. The tales these movies tell are often remarkable. The blows sustained in so brief a time would amaze you.”[270]

Before resuming my discussion of the development of scientific crash-testing, I want to take a moment to consider the implications of Dye’s Woman’s Day article for one of the major claims I am making in this chapter. Specifically, I want to think about that article in relation to J. C. Furnas’s “—And Sudden Death,” published in Reader’s Digest in 1935, as a means of highlighting the discursive differences between prewar and postwar regimes of accident.

As I argued earlier, Furnas’s article reflected and vividly expressed the dominant discourse of accidentality in the early days of automobility. Conjuring a phantasmagoria of car wrecks, crash injuries, and fresh corpses, it explicitly indicted the vehicle operator, while implicitly exonerating the vehicle engineer, the vehicle manufacturer, and the vehicle itself — not to mention the wider socio-technical system in which each of these actors/agencies was imbricated. It addressed its sickening depictions and strident admonitions to the reader-

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[269] Dye, “Cornell University Tests” 33.

[270] Dye, “Cornell University Tests” 85.

cum-driver in an attempt to discourage him or her from behaving recklessly on the roadways. It implied the possibility of mobility without mistakes, of speed without victims, and it made the case for mindful motorism not in some "niche" forum, not in some special-interest publication on the margins of American society and culture, but in Reader's Digest, a mainstream, mass-circulated periodical for the general reader. To be sure, Furnas's target audience was not the nation's small, incorrigible contingent of joy-riders and thrill-seekers, but rather the nation's much more encompassing class of ordinary, everyday motorists.

Dye, too, targeted a mass, middle-class, socially traditional audience, albeit a more gender-specific one. His article, "Cornell University Tests Show Just What Happens in a Crash . . . and How to Protect Yourself," was the cover story in the November 1954 issue of Woman's Day, a magazine geared, by and large, to the cultural priorities and proclivities of white, suburban housewives. The article consisted of two interrelated parts. The main part, denoted in the pre-ellipsis portion of the piece's title, offered a non-technical overview of Cornell Aeronautical Laboratory's automotive crash-safety research program — its origins, motivations, procedures, technical apparatus, and scientific findings. The subsidiary part, denoted in the post-ellipsis portion of the title, showcased the objectified, commodified fruits of that research program: namely, Cornell-designed frame-anchored front and back seatbelts, a "chest-guard" cushion for the steering wheel, and Ensolite foam padding for the dashboard.[271] It also served as a step-by-step how-to manual, since the seatbelt kit, steering-wheel cushion, and dashboard-pad materials all had to be installed by the consumer herself

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[271] The seatbelt kit and steering-wheel cushion each were available by mail order from a manufacturer in Rochester, New York, while the dashboard-pad materials could be acquired at the local hardware store (or so it was suggested) or through the mail from a manufacturer in New York City.

— or, more probably, by her husband, a probability confirmed by the accompanying photographs, which depicted a man doing the work of installation.[272]

Like Furnas, Dye addressed the reader in the second person. But whereas Furnas had passionately beseeched the reader to resist the temptations of reckless driving, Dye calmly reassured the reader that at least one organ of scientific research was working hard to protect her and her family, including her young children, from the injurious effects of automobile accidents. “At our laboratory,” he asserted, “we are finding out a great deal about automobile accidents and what happens to the men, women, and children involved.”[273] Given the makeup of the magazine’s readership, Dye’s reference to children was doubtless strategic. The cover photograph played on the idea that children were “precious cargo” that might be damaged or destroyed like goods in transit — or, conversely, “packaged” for protection. (I discuss the notion of the “safely packaged passenger” in the next chapter.) The photo showed a woman, one hand on the wheel and the other on the gear shift, in the driver’s seat of a car. Sitting next to her was a smiling young boy, unbelted and facing backward. Diagonally across his torso, written in a stenciled font like that used to label containers of goods packaged for shipment, appeared the word “FRAGILE.” In the text of the article, this emotional appeal to mothers with young children found reinforcement in disturbing descriptions of crash tests involving the child-sized dummy Half Pint. To wit: “Half Pint took a nose dive into the back of the front seat, sailed over that to strike his head on the steering

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[272] The installation procedures appear, from a present-day perspective, ludicrously involved and extensive. In particular, it is hard to imagine anybody, besides an auto mechanic or an exceptionally handy person, being able to successfully install the frame-anchored seatbelts.

[273] Dye, “Cornell University Tests” 33

wheel, bounced from that into the windshield and finally dropped to the floor, severely bending his back — in the wrong direction."[274]

Descriptions of this sort were only occasionally employed. Contrary to Furnas, who had hacked at the Reader's Digest reader with a hatchet of grisly imagery, Dye preferred to soothe the Woman's Day reader with a balm of scientific certainty. "You can't guard against danger until you know precisely what the danger is," he declared.[275] Fortunately, a highly skilled team of engineers and other experts were working behind the scenes to know precisely what that danger was, and how to guard against it — this, in a nutshell, was the article's thesis. Indeed, Dye promised the reader that science was pinpointing the heretofore under-examined causes of crash injuries, and that the market, in coordination with the research university, was manufacturing products to alleviate them. "As more and more knowledge is assembled, we are becoming more and more encouraged," he wrote. "It is possible, our findings indicate, to make very substantial improvements in safety without radically changing automobile design."[276] Rather than emphasizing the need to drive safely and slow down, as Furnas had so zealously done, Dye emphasized the need to buy wisely and buckle up. While accidents cannot be eliminated by eliminating bad behavior, as Furnas had intimated, they can be "tamed" through science, engineering, and enlightened consumption:

> The chances of getting involved in an accident increase all the time: more cars are crowding our highways. All these cars are guided and controlled by humans like us, who can make errors in judgment. So there are bound to be accidents. Thus, a successful attack on this very big problem has to focus on

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[274] Dye, "Cornell University Tests" 85-86.

[275] Dye, "Cornell University Tests" 86.

[276] Dye, "Cornell University Tests" 85.

> the accident itself, the crash, the smashup. If that can somehow be tamed, injuries can be ameliorated and loss of life reduced.[277]

Dye was quite right to see Cornell Aeronautical Laboratory's crash-safety research program as an attempt to "tame" the accident. What he did not see, however, or at least did not mention — but which his article's rationale and rhetoric articulated at every turn — was that other, equally important aspect of the postwar project to tame the accident: namely, the public-pedagogical aspect. Like the heroizing mass-media accounts of John Paul Stapp's rocket-sled rides I discussed at the end of the previous section, and like the driver's-education collision-experiment films I discuss in the next chapter, Dye's article sought to introduce American citizens and consumers to the science and technology of crash-safety research, and to do so in a way that was at once dramatic and digestible.[278] Stapp's media celebrity, collision-experiment films' pedagogy, Dye's historiography and how-to instructions — each was part of a broader cultural and institutional impulse to domesticate the accident during the 1940s, '50s, and '60s, to bring it "closer home," as Furnas had said of his very different approach to the problem two decades earlier. Each was part of a larger constellation of efforts to naturalize the notion that, while "we" as a society cannot get rid of the accident, "we" scientists and technicians <u>can</u> manage it and, what's more, make it useful. "We" can <u>learn</u> from the accident so that "you" can <u>live</u> with the accident — this, in effect, became the new motto of social and technological progress. In the decades following World

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[277] Dye, "Cornell University Tests" 33.

[278] Both media coverage of Stapp's experiments and collision-experiment films frequently interpolated slow-motion spectacles of decelerative/destructive testing into their visual discourse. Dye's article, by contrast, had to rely on serial photographs and serial illustrations of crashing cars and flying dummies, as well as provocative verbal characterizations of those cars and dummies, to arouse interest and sustain attention. Consider, for instance, this phrase: "those dummies move with amazing violence when they don't have the benefit of safety belts" (Dye 85). And this one, quoted previously: "The blows sustained in so brief a time would amaze you."

War II, the material disciplining of the accident through science and technology went hand in hand with the symbolic domestication of the accident through public relations and popular mediatizations.

As noted earlier, a number of organizations besides the U.S. Air Force’s Aeromedical Field Laboratory at Holloman and Cornell University’s Aeronautical Laboratory in Buffalo were carrying out scientifically controlled car-crash and force-impact tests during this period, including Wayne State University in Detroit, the Indiana State Police Department, the U.S. Army at the Aberdeen Proving Ground in Maryland, and automobile manufacturers such as Ford Motor Company. (I will say more about Ford’s crash-safety research in the next chapter.) Amplifying this new wave of crash-test research were James J. Ryan’s program of experiments at the University of Minnesota and the Automobile Collision Injury Research project at the University of California, Los Angeles, both of which, for a few years during mid- and late 1950s, operated under contract with Stapp’s Automotive Crash Forces project.

Ryan was contracted in December 1955 to oversee the research and development of two automotive safety devices of his own design: an energy-absorbing hydraulic bumper and a rollover bar for open-top military vehicles. In 1957, at the Third Annual Automotive Crash Research and Field Demonstration, Ryan tested his devices in front of an audience of experts. First, an Air Force weapons carrier containing an anthropomorphic dummy was crashed into a fixed barrier at twenty-five miles per hour; neither the vehicle nor the occupant was damaged. Next, Ryan and one of his graduate students drove a specially equipped passenger car into a fixed barrier at twenty miles an hour. Despite the fact that the car's collapsible steering wheel failed to function properly, Ryan received only a minor cut.[279]

Ryan, a Professor of Mechanical Engineering at the University of Minnesota, was doubly implicated in the postwar push to technoscientifically to make knowable and know the transportation accident. If Stapp was the bridge that spanned from aeronautical to automotive crash-safety research in the 1950s, then Ryan was the colossus who stood astride the two, a foot firmly planted in each camp. Ryan did not really invent the aviation flight-data recorder, although he is sometimes credited with having done so. Yet, as I argued in the previous chapter, his General Mills Ryan Flight Recorder did constitute the most sophisticated and successful response to the Civil Aeronautics Board's call for an onboard, crash-protected graphic-recording instrument during the postwar period, establishing technical standards for flight-data recorders for years to come. Ryan's work on automotive safety attacked the problem of the accident from a different direction. Whereas his flight recorder worked on the accident after the fact as a means of avoiding its recurrence in the future, his hydraulic bumper and rollover bar were designed to operate during the tiny temporality of the accident's irruption. Of these three technologies, only the General Mills Ryan Flight Recorder was an accident technology in the sense I have been defining it in this dissertation, the other two being examples of what I called in Chapter One single-tense safety devices. But this distinction does not really matter for the point I want to make here. Rather, what matters is that Ryan, like Stapp, personified — and his inquiries and innovations crystallized — the mid-century drive to subject aircraft <u>and</u> automobile accidents to rigorous

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[279] Eastman 191. Curiously, Eastman does not mention the experiment's effects on the graduate student. I suppose it doesn't really matter anyway, since graduate students, like guinea pigs, are expendable.

scientific experimentation and analysis, in order to turn “the accident” into an object of institutional knowledge and control.

Compared to Ryan’s research on bumpers and rollover bars, the automotive crash-testing program at the UCLA branch of the Institute of Transportation and Traffic Engineering (ITTE) was much more elaborate and encompassing, as well as longer lived. Established in 1947 by an act of the California Legislature, the ITTE was commissioned to study the design, construction, operation, and maintenance of U.S. highways, airports, and other public-transportation facilities. Between 1950 and 1960, the ITTE conducted approximately fifty “automobile collisions on purpose,” in order to provide what chief research engineer Derwyn M. Severy called “critically needed data on physical factors relating to vehicular collision dynamics and attending motorist injuries.”[280]

By the early 1960s, the ITTE was the nation’s, and probably the world’s, most technically advanced, scientifically generative, and culturally conspicuous apparatus for the production of automobile crash-test research. As such, it represented the most substantial and sweeping, not to mention spectacular, materialization within the institutional order of the new, postwar regime of accident — a regime, as I have argued in this chapter, characterized by a turn <u>away</u> from discourses and practices of accident eradication and <u>toward</u> discourses and practices of crash-injury minimization and crashworthiness engineering. Severy said as much in 1957:

> A new approach in combating death and injury on the highway was initiated in 1948 by the Institute of Transportation and Traffic Engineering, University of California. This approach stemmed from the concept that a certain number of automobile collisions are inevitable but that the resulting injuries are, to a large extent, preventable.[281]

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[280] Derwyn M. Severy, <u>Automobile Collisions on Purpose</u> (Los Angeles: The Institute of Transportation and Traffic Engineering, University of California, 1961) 186.

In a footnote to this passage, Severy added these crucial sentences: “This concept is not in conflict with the statement that injuries are prevented by preventing accidents. It simply recognizes the limitations of accident prevention measures and deals directly with the sequential important issue, the reduction of motorist injuries.”[282] Here, then, is yet another oblique but unmistakable repudiation of the juridical logic of responsibility that underpinned the platform of the early highway-safety movement and, by implication, of the discourse of the reckless driver that realized and rationalized that platform.

I will consider the ITTE’s cultural visibility and influence, as embodied in its series of driver’s-education films, in the next chapter. The remainder of this chapter concentrates on the ITTE’s technoscientific sophistication, particularly its photographic apparatus. It is my contention that imaging technologies were doubly vital to institutional attempts to manage the automobile accident during the 1950s: on the one hand, they enabled researchers to “read” the accident, to make the accident’s evidence not only legible but meaningful and useful; on the other hand, the images they produced could be easily interpolated into disciplinary media such as driver’s-education films.

In 1948, Severy and his ITTE associates searched the scientific literature for specific information “about the collision characteristics of the automobile and the physical factors

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[281] Derwyn M. Severy, “Photographic Instrumentation for Collision Injury Research,” Journal of the SMPTE 67.2 (1958): 69.

[282] Severy, “Photographic Instrumentation” 69. Severy made this point slightly differently a few years later: “Vehicle collisions whether on land, in the air or at sea, are a part of the price we pay for transportation. . . . the multi-variant nature of any transportation system makes accidents an unwanted, regrettable, but nevertheless, a not completely irrepressible byproduct. A supplement to Accident Prevention should, therefore, be Injury Minimization” (Severy, Automobile Collisions on Purpose 186).

associated with such impacts."[283] They found little that was scientifically valid or valuable. As Severy says, "Statements concerning these matters, even when made by engineers, were admittedly based on an educated guess rather than on experimental findings."[284] This comment, made contemporaneously by an authority on the subject, supports one of this section's major claims: namely, that it was not until after World War II that a truly scientific automotive crash-testing apparatus emerged and, I would add, became socially and institutionally effective.

Initial attempts to derive data from full-scale car crashes took place in 1950. A case of strange bedfellows if ever there were one, ITTE scientists joined forces with professional stunt drivers, who agreed to allow their cars to be equipped with electrical recording instruments in advance of public exhibitions of head-on collisions staged for entertainment purposes. Seeking to make the most of their limited resources, researchers hoped to be able to gather scientific data at the same time that stunt drivers were garnering paychecks and spectators were getting thrills. Although some "interesting observations" were made using these methods, according to Severy, "the data obtained were not as precise or complete as desired."[285] In a paper presented at the Hollywood Section meeting of the Society of Motion

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[283] Derwyn M. Severy, Automobile Crash Effects (Los Angeles: The Institute of Transportation and Traffic Engineering, University of California, 1954) 2.

[284] Severy, Automobile Crash Effects 2.

[285] Severy, Automobile Crash Effects 2. Severy, in a report coauthored with ITTE principals John H. Mathewson and Arnold W. Siegel, put it this way three years later: "While we learned a great deal and received splendid cooperation from both management and drivers, we were eventually forced to the conclusion that the demands of the audience and our research requirements were incompatible." Derwyn M. Severy, John H. Mathewson, and Arnold W. Siegel, Statement on Crashworthiness of Automobile Seat Belts (Los Angeles: The Institute of Transportation and Traffic Engineering, University of California, 1957) 1.

Picture and Television Engineers (SMPTE) in November 1957 (and published three months later in Journal of the SMPTE) Severy stated that

> The only instrumentation that provided acceptable data for these early collision experiments was a single high-speed motion-picture camera. Since each car had an independent speed which would not be maintained at a preassigned speed or even at a constant speed, the point of impact could not be accurately anticipated. This made it necessary for the high-speed camera to be panned and stopped at precisely the correct instant at the point of impact. Frequently, this resulted in loss of photographic coverage.[286]

The aims of experimental science cannot abide such messy contingency, and so several alternatives to stunt-driver exhibitions were attempted or considered, including non-destructive rapid-deceleration tests, laboratory-based artificial-impact experiments, and, with the cooperation of the Los Angeles Police Department, on-the-scene automobile accident investigations. Each, however, ultimately proved to be either insufficiently reliable or insufficiently "realistic." In a speech given at the California State Governor's Safety Conference in Sacramento in October 1954, Severy claimed that "These problems suggested that the only way to determine automobile crash effects, to the degree of precision essential to this type of investigation, was to stage full-scale crashes under the varying conditions that might occur."[287]

The ITTE began conducting full-scale, scientifically controlled automobile collision experiments in February 1954. The first such experiment employed a 1937 Plymouth instrumented with electrical extensometers (strain gauges) and mechanical and electrical accelerometers, instrumented seats and dummies (variously restrained), an unyielding barrier composed of large-diameter utility poles backed with several tons of dirt, and a few high-

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[286] Severy, "Photographic Instrumentation" 69.

[287] Severy, Automobile Crash Effects 4.

speed motion-picture cameras to capture the action for subsequent analysis.[288] ITTE technician Paul Niquette detailed the photographic instrumentation in a piece for California Engineer in 1954:

> A good deal of the data for the tests are contained in these films. Not only do the pictures (taken at speeds between 1000 and 2400 frames per second) reveal deceleration rates of the car and dummies, but also deceleration patterns of the car frame by means of small metal targets mounted on rods which are in turn welded at several points along the frame.
>
> Two GSAP [Gun Sight Aiming Point] movie cameras mounted on the shelf behind the back seat of the crash-car revealed additional information on the dummies' motion during impact. Another camera located thirty feet from the barrier panned the movement of the car and truck as they sped toward the carrier. A similar motion picture camera mounted on top of the instrument truck, trained forward on the car and barrier, points up steering problems and crash behavior.
>
> A speed graphic camera with an electronic timing device took a still picture of the car two-hundred milliseconds after the car first contacted the barrier. This was the time of zero forward velocity, approximate maximum deceleration, and greatest crush-in volume.[289]

What Niquette describes here is a far cry from the single hand-panned camera of the stunt-driver exhibitions, which had taken place only a few years earlier. And by the time Severy delivered his paper at the SMPTE meeting in late 1957, the ITTE's imaging apparatus and accessories, like the ITTE crash tests themselves, had become more intricate and elaborate still.

Consider, for example, the setup for a head-on collision experiment carried out in June 1957. Three Speed Graphic still cameras, controlled by an electronic time-delay device, snapped pictures of the impact, at the moment of maximal implosion, from three different vantage points, including one bird's-eye view. Thirteen motion-picture cameras, running at

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[288] Severy, et al., Statement on Crashworthiness 3. See also Paul Niquette, "Engineered Automobile Crashes," California Engineer Apr. 1954 <http://www.niquette.com/articles/carcrash.html>.

[289] Niquette.

various speeds (24, 64, 200, 600, 900, and 1,400 frames per second), were loaded with various film stocks and positioned at various angles and distances. Each crash-car contained one of these cameras, and two more were mounted on a specially constructed steel tower, twenty-four feet above the point of impact. To facilitate later frame-by-frame, or "micromotion," analysis of the footage, specially developed "target-lights" were deployed to provide "an intensely concentrated light-source in an otherwise poorly illuminated area," and spatial parameters and temporal intervals were precisely measured and marked.[290] Automobile exteriors and pavement surfaces were emblazoned with "painted targets" in the form of calibrated indices and geometric coordinates, while infinitesimal durations and linear chronologies were tracked with centisecond clocks and strobe lights. These techniques and technologies enabled researchers to scrutinize the kinematic motions of vehicles and occupants, including their velocities, acceleration patterns, deformations (vehicles), and postural variations (occupants). Finally, photographs were taken of the cars' undercarriages before and after the crash; the negatives were then superimposed to produce a composite picture that provided information on vehicle distortions and displacements. This method ensured that the collision experiments enjoyed "three-dimensional photographic coverage" without the logistical difficulties attending the installation of an underground camera.[291]

Non-photographic recording technologies were used to collect data as well. The vehicles and their anthropometric occupants were elaborately instrumented with mechanical

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[290] Severy, "Photographic Instrumentation" 73.

[291] Severy, "Photographic Instrumentation" 71. In addition, as Severy notes, it also improved upon older techniques. "This method replaced two rather tedious earlier methods, one involving direct measurement of the frame of the car, the other, measurements made on a photographic negative using an optical comparator. Both of the previous procedures were subsequently plotted graphically or diagrammatically" (Severy, "Photographic Instrumentation" 76).

and electrical sensing devices to measure various tensions, pressures, and velocities.[292] These sensors were connected by electrical cables to multichannel recording oscillographs and auxiliary electrical-transducer equipment, carried in manually driven "instrument recording and safety cars" that moved alongside the crash-cars.[293]

Although it is not my focus here, it is worth pointing out that the oscillographic recorder, no less than the motion-picture camera, operated as an accident technology and forensic medium in this context. In many respects, it can be said to belong to the same order of accident technology as Babbage's self-registering apparatus for railroad trains, the flight-data recorder for airplanes, and, most recently, the event-data recorder for automobiles, also known as the "car black box." (I discuss the car black box in this study's Conclusion.) Like each of these devices, the oscillographic recorder was a machine employed to automatically register, measure, and store precise physical and temporal information about the (mal)functioning of a modern mode of transportation in a moment of chaos and catastrophe.

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[292] In deciding whether to use "anthropomorphic" or "anthropometric" in reference to test dummies, I have let the relevant historical literature be my guide. So, for example, I use the former term when discussing Stapp's experiments because that is the one he used in his writings. Here, in connection with the ITTE experiments, I use the latter term because that is the one Severy used. In a technical report published in January 1965, Severy actually commented on this terminological distinction and on his reasons for using "anthropometric": "Anthropomorphic (dummy) — Of human-like form; the author prefers the term anthropometric (dummy) which characterizes man both as to form and as to certain other measured specifics." Derwyn M. Severy, Human Simulations for Automotive Research (New York: Society of Automotive Engineers, 1965) 7. Expanding on Severy's remarks, I would note that there is a historical component to this distinction. The first (anthropomorphic) dummies only crudely approximated the human form; later (anthropometric) dummies were more metrically precise, as well as more "biofidelic."

[293] Severy, "Photographic Instrumentation" 70. These cars were called "safety" cars because the instrumentation engineers who rode in them had the power to remotely stop the crash-cars prior to impact in the event of a malfunction.

Conclusion

By the mid 1920s, the American automaker General Motors was using its massive, newly built, state-of-the-art Proving Ground in Milford, Michigan, to carry out some of the most varied, extensive, and cleverly conceived automobile performance tests in the world — speed tests, brake tests, steering tests, and so on.[294] Early in the next decade, GM began to carry out destructive tests as well, and here again the company was in the vanguard.

Two basic types of destructive test were designed and implemented: rollover tests (ground-level and spiral-ramp) and barrier-impact tests.[295] In a typical ground-level rollover test, a car was overturned by maneuvering it onto a skid on a level sod field. In a typical spiral-ramp rollover test, a driverless a car was pushed onto a spiral ramp located at the top of the hill, causing it to turn over and tumble down. And in a typical barrier-impact test, a driver steered a car toward a concrete wall and escaped just before impact. GM Proving Grounds Communications Manager Gerald M. Wilson states: "We've got footage of crash-testing where the operator would stand on the running boards and put a brick on the accelerator, and just before he'd hit the wall, he'd jump into the arms of a couple waiting fellows, who caught him while the car crashed into the wall."[296]

These tests are fascinating for several reasons, but for present purposes it suffices to make two crucial points. First, both the rollover and the barrier-impact tests were primarily

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[294] Louis C. Lundstrom, "On the 40th Anniversary of the General Motors Proving Ground," General Motors Engineering Journal 11.3 (1964): 26-30.

[295] "Studies for Passenger Safety," General Motors Engineering Journal 3.2 (1956): inside back cover. See also Kenneth A. Stonex and Paul C. Skeels, "A Summary of Crash Research Techniques Developed by the General Motors Proving Ground," General Motors Engineering Journal 10.4 (1963): 7-11.

[296] "Crash Testing," Modern Marvels, The History Channel, 1999.

designed to assess the structural strength and sturdiness of the automobile body, not the fragilities and vulnerabilities of the occupant body under crash conditions. The machine's durability was what was in question and at stake in these experiments, not the human's security. The crash tests were not about how to damage-protect the person, in other words, but about how to damage-protect the car. Wilson puts it this way:

> We know from some of the films we have in the archives that back in the '20s and '30s, they were doing crash-testing more for structural analysis. It wasn't safety testing like we think of today, occupant protection and seatbelts and whatnot; it was more like, "How is the vehicle going to hold up?" If you could show that your vehicle can withstand some minor bumps and bangs in the course of driving it, there's a competitive advantage there, from a durability standpoint.[297]

The second point is that compared to the crash tests of the 1950s and beyond, these tests were not technically sophisticated or scientifically controlled. A single, stationary or hand-panned motion-picture camera, running at standard speed and framing a medium-long or long shot, photographed the crash test from start to finish — if, that is, the test was photographed at all. Moreover, the cars were devoid of human surrogates, were minimally instrumented or totally uninstrumented, and once set in motion, whether propelled into a concrete wall or plummeted down a hillside, were literally out of control. The vehicle's structural integrity was assessed on the basis of visual inspections executed after the crash. "It was crash it and analyze it afterward," Wilson says. "See if it bent the way we thought, and then ask what we could do to maybe improve it."

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[297] Gerald M. Wilson, telephone interview, Oct. 2003. Over time, this logic died a double death. By the mid-1960s, a car with an unforgiving front framework came to be seen as inherently more dangerous, not less. This new way of thinking was crystallized in the development of the "crumple zone," a structural feature that absorbs energy by compressing during impact. And today, of course, safety is mobilized as a major selling point, while claims of durability tend to be reserved for light trucks (pickups, sport-utility vehicles, etc.), not cars.

This is what cutting-edge automobile crash-testing looked like in the 1920s and ’30s, when the discourse of the reckless driver reigned supreme. These early crash tests put into material practice the notion that automakers were not responsible for accidents and, therefore, had no obligation to protect drivers when they behaved badly. Compared to performance tests, destructive tests were few and far between, and were deemed to be of secondary importance. According to GM engineers Kenneth A. Stonex and Paul C. Skeels, “Since most of the early tests looked alike to the unaided eye and the gross damage on repeated tests was quite similar, it did not seem necessary to conduct the tests on successive yearly models.”[298] The fact that crash tests were not carried out annually signals their low priority. Also, the term “unaided eye” is significant (if not entirely accurate) here, because it speaks to the tests’ dearth of instrumentation: a movie camera and a few accelerometers, maybe. As I indicated earlier, often a movie camera was not used at all. And when it was used, its intended purpose was less to provide footage that could be subsequently subjected to frame-by-frame analysis, and more to merely document the event, to establish its achieved actuality by making it archivable.

But most telling, perhaps, was the absence in these tests of animals, cadavers, and dummies. Denied a sacrificial surrogate, the human body was effectively written out of the crash scenario, expelled from the scene of extreme force impact — this, paradoxically, even as the mind that supposedly moved that body was being blamed for authoring the accident in the first place. The only “injuries” that mattered, in this view, were those inflicted on the machine. After all, those injuries could hurt sales. And so could calling attention to safety — and therefore danger — by stocking the crash-cars with human stand-ins.

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[298] Stonex and Skeels 7.

The crash tests conducted at the Institute of Transportation and Traffic Engineering in the 1950s, by contrast, were all about the body. Hence the centrality in these tests of anthropometric dummies. Simply put, the dummies were the stars of the show: film cameras captured the motions they made, while electrical sensors and recording oscillographs registered the forces they "felt." What's more, their simulational precision, or "biofidelity," as engineers called it, was unprecedented — there were no anthropometric dummies per se before the late 1940s — and this, too, underscored the importance of the body in these tests. In point of fact, ITTE crash tests were not so much about "the body" as they were about a particular relationship <u>between</u> bodies, human and machine. They were about what happens when the two bodies "accidentally" and abruptly come into forceful contact with each other: the so-called second collision (the first being the one between the exterior of the vehicle and another material object). Although she is referring to the bodies of real-life disaster victims rather than crash-test dummies, Ann Larabee makes the point perfectly: "The violence inflicted on bodies themselves transforms them into maps that can reveal the physical intimacies and betrayals of technological interactions."[299] The impulse to scientifically map "the violence inflicted on bodies" during the second collision implied something that the early highway-safety movement could not bear to consider, much less bring itself to admit: namely, that bodies would never really be rid of accidents.

Thus, the challenge for the ITTE and other, similar institutions of the postwar period was to figure out how accidents could be <u>survived</u>, not eradicated, and researchers like Severy were convinced that motion-picture photography, with its unique capacity to visibilize the otherwise invisible aspects of car crashes, would help them do so. "Many

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[299] Ann Larabee, <u>Decade of Disaster</u> (Urbana: U of Illinois P, 2000) 6.

collision events occur too quickly for even a group of trained observers to perceive them," he said in October 1954. "Only high speed cameras can provide such information on a time basis expanded sufficiently to allow the human mind to perceive the events."[300] Severy put it this way four years later: "Photographic close-ups of the rapid sequences of injury-producing events have provided new and otherwise unobtainable scientific insight into the mechanisms of injuries in these events."[301]

Specifics notwithstanding, this sort of claim was nothing new. As Severy himself noted, "Close-up observation of split-second events has long been a recognized application for high-speed photography."[302] Indeed, the use of photographically based images for the scientific study of bodies in motion harks all the way back to the pre- and early histories of cinema — most famously, Etienne-Jules Marey's and Eadweard Muybridge's respective investigations of animal locomotion. To really see bodies in motion, bodily movement must be technologically seized and analyzed, and photographic images taken in rapid succession have always offered a means to do so. The question is, What did cinema's capacity to technologically seize and analyze bodily movement offer postwar crash-test researchers? What cultural anxieties and fantasies motivated this particular use of high-speed cinematography? Why, in short, was the movie camera made into an accident technology?

In Screening the Body: Tracing Medicine's Visual Culture, Lisa Cartwright examines the ways in which cinema as an apparatus and an institution has been used to define, monitor,

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[300] Severy, "Automobile Crash Effects" 4. I have omitted Severy's emphasis.

[301] Severy, "Photographic Instrumentation" 69.

[302] Severy, "Photographic Instrumentation" 75.

and regulate "life" in the culture of Western medical science.[303] She argues that the motion picture was a crucial instrument in the emergence of a modernist mode of representation "geared to the temporal and spatial decomposition and reconfiguration of bodies as dynamic fields of action in need of regulation and control."[304]

Crash-test motion-picture photography, together with the micromotion analysis that mapped out and made sense of its images, rearticulated this mode of representation. Crash-testing brought the medical moving image into a new context and made it serve a new master. The imperative was still to arrest and analyze bodily movement, to seize and slice it into ordered and orderly segments of time and space. But the nature of the bodies, of the movement, and of the circumstances had all changed. The human bodies were no longer essentially physiological bodies, like those that populate the pages of Cartwright's book, and their movements were no longer seen as expressions of "life." Instead, they were hopelessly physical bodies, and their movements were seen as the imposition of a kind of lifelessness — the kind of lifelessness that comes in the crash's split second. In that split second, the human body is wholly at the mercy of forces that are both exterior and superior to it. It is inert and impotent, just like the non-agential anthropometric dummy that represents it. (This is precisely why the dummy is such an eerily appropriate surrogate for the crash victim.) It is a piece of meat trapped in an imploding machine. Severy describes the high-speed, head-on collision:

> No greater duration than one-quarter of a second is required for two well-engineered automobiles approaching one another at 50 mph to be converted into junk. Driver reaction time — the time required to perceive, interpret and

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[303] Lisa Cartwright, Screening the Body: Tracing Medicine's Visual Culture (Minneapolis: U of Minnesota P, 1995) xi.

[304] Cartwright xi.

> commence to react to an environmental disturbance — averages 3/4 sec. Should a head-on collision between cars traveling 50 mph appear imminent when the cars are still 100 ft apart, no preventive effort could be initiated before they crashed. The ensuing quarter-second of destruction embroils the motorists within collapsing structures with injurious forces having a magnitude measured in tons rather than pounds. Even if there were sufficient time to brace himself, these forces completely overwhelm the motorist.[305]

This is the terrifying scene that motion-picture photography rendered observable, readable, and productive in the 1950s. These were the bodies and the movements it segmented and slowed down. "In scientific cinema," according to Scott Curtis, "there is a double 'extraction': the camera penetrates and captures a reality otherwise invisible, and then, through quantitative analysis, useful, objective data is 'extracted' from the image itself."[306] Following Curtis, we can say that crash-test cinematography and its complement, micromotion analysis, were deployed to "doubly extract" the reality of the accident. They promised to "open up" the accident by getting inside the instant. In the cultural fantasy they crystallized, the accident's unruly contingency is mapped and managed through scientific mediatization. Mary Ann Doane writes: "The act of filming transforms the contingent into an event characterized by its very filmability, reducing its contingency."[307] Like all accident technologies, the film camera captured and contained the accident's sensuous and affective excesses so as to make them amenable to rational analysis and explanation. It revealed the catastrophic consequences of our technological relations, to be sure, but only as part of an institutional attempt to recuperate those relations.

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[305] Severy, "Automobile Collisions" 186.

[306] Scott Curtis, "Still/Moving: Digital Imaging and Medical Hermeneutics," Memory Bytes: History, Technology, and Digital Culture, ed. Lauren Rabinovitz and Abraham Geil (Durham: Duke 2004) 228.

[307] Mary Ann Doane, The Emergence of Cinematic Time: Modernity, Contingency, the Archive (Cambridge: Harvard UP, 2002) 23.

CHAPTER FOUR

COLLISION-EXPERIMENT FILMS

Introduction

In recent years, there has been increasing popular and scholarly interest in highway-safety films, or, as they are sometimes called, driver's-education "scare" films, produced in the United States during 1950s, '60s, and '70s. The most gruesome and grossly exploitative of these educational films — Safety or Slaughter (1958), Signal 30 (1959), Mechanized Death (1961), Wheels of Tragedy (1963), and Highways of Agony (1969) — cobbled together footage of human carnage and machinic wreckage, crudely captured in the aftermath of actual automobile accidents, accompanied by the stern admonitions and lurid descriptions of a voice-of-God narrator.[308]

Ken Smith's Mental Hygiene: Classroom Films 1945-1970, a critical and historical survey of postwar "social-guidance" films written for the general reader, devotes an entire chapter to highway-safety films ("Bloody Highways").[309] In her essay "Signal 30," Mikita Brottman analyzes the film of the same name (itself a reference to the Ohio State Highway Patrol's call-out code for a serious highway accident), suggesting that the film's conflicting modes of discourse — crashes are avoidable, the fault of the careless driver, versus crashes

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[308] As is customary in voice-of-God narration, the voice of God in highway-safety films is, without ambiguity or exception, the voice of a man.

[309] Ken Smith, Mental Hygiene: Classroom Films 1945-1970 (New York: Blast, 1999).

occur "out of the blue," the fate of the hapless driver — point to a more fundamental instability in the representation of automobile accidents.[310] Bret Wood's Hell's Highway: The True Story of Highway Safety Films, an independent documentary film released in the summer of 2003, chronicles the rise and fall of Mansfield, Ohio's Highway Safety Foundation, and considers the motivations behind and implications of the "educational" films it produced. Finally, one of the surest manifestations of the cultural fascination with (and kitschy appeal of) highway-safety films is the commercial availability, and, in some cases, public-domain accessibility, of the films themselves. Videotape and DVD compilations such as Something Weird Video's Highway Safety Films (1996) and Driver's Ed Scare Films series, A/V Geeks' Anatomy of an Auto Accident (2002), and Fantoma Films' The Educational Archives, Volume Three: Driver's Ed (2002) can be purchased online or through mail-order catalogs, while the Prelinger Archives, in conjunction with the Internet Archive, allows World Wide Web users to download Signal 30, Signal 30: Part II (2002), and other highway-safety films free of charge.[311]

As the only social-guidance "genre that grew not more refined and sympathetic as the years passed, but cruder and more brutal," most highway-safety films, beginning with Safety or Slaughter in 1958, sought to discipline drivers, particularly teenaged drivers, through uncensored exposure to horrific, "real-life" images and sounds (screams, moans, sobs) of

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[310] Mikita Brottman, "Signal 30," Car Crash Culture, ed. Mikita Brottman (New York: Palgrave-St. Martin's, 2001) 239.

[311] As with most computer-mediated transactions in a capitalist economy, "free of charge" here does not necessarily mean readily obtainable and usable; neither does it mean there are absolutely no monetary costs involved. In order to download and view motion pictures from the Prelinger Archives, one's computer must be equipped with a fast microprocessor, ample memory, and the proper software. Moreover, there is the issue of bandwidth: without a high-speed Internet connection, the process of downloading large data files (such as digitized movies) is time-consuming and comparatively inefficient, if not practically impossible.

mutilated bodies and mangled machines.[312] Yet one strain or subgenre of highway-safety film, though crude and brutal in its own way, took a decidedly different tack. Films such as Crash Research (1955), Crash and Live! (1955), Safety Through Seat Belts (1959), and Safety Belt for Susie (1962) prominently featured meticulously staged, elegantly photographed, and scientifically motivated footage of automobile collisions. As such, they stood worlds apart — formally, stylistically, and technically — from Safety or Slaughter, Signal 30, and other gory highway-safety films.

Instead of proffering rough-and-ready images of actual crash victims — dazed, dying, or dead — and their unintentionally crushed cars, Crash Research and other collision-experiment films (as I will call them) proffered carefully composed tableaux of anthropometric test devices, or "crash-test dummies," and "their" deliberately damaged or destroyed vehicles.[313] Instead of incorporating scenes shot on location with non-actors (victims, police officers, paramedics, rescue workers, bystanders), collision-experiment films incorporated scenes shot on a soundstage or some other specially designated, technically prepared site (a racetrack, an airstrip, a military base, an automaker's proving ground) with nonhumans. Instead of mobilizing the truth-value of cinema verité, with its conceit of candid realism, and the institutional authority of the state (as embodied in the highway patrolman), collision-experiment films mobilized the truth-value of high-speed cinematography, with its claim to superhuman "sight," and the institutional authority of technoscience (as embodied in the laboratory experiment). Both gory highway-safety films and collision-experiment films

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[312] Smith 73.

[313] I should note that Crash and Live! was not a film per se, but rather a televised news program. I use the term "film" for the sake of convenience.

attempted to provoke fear and anxiety in spectators as a means of “scaring them straight” — that is, as a form of negative inculcation, or, more strongly, psychological coercion — and thus can be said to have exhibited a common aim. The former, however, attempted to do so by showing what happens after an automobile accident, encouraging spectators to identify with the excruciating morbidity and untimely mortality of human beings, while the latter attempted to do so by simulating what happens during an automobile accident, encouraging spectators to identify with the vulnerability, fragility, and incapacity of human surrogates.

The classic collision-experiment film focused on safety-engineering research conducted at either Ford Motor Company or University of California, Los Angeles’s Institute of Transportation and Traffic Engineering (ITTE). Crash Research and Crash and Live! portrayed and promoted the innovative research and development that underlay Ford’s “Lifeguard Design” safety package, which, in 1956, included an energy-absorbing, recessed-hub steering wheel; double-grip rotary door locks; a cushioned instrument panel and sun visors; a swing-away, shatter-resistant rearview mirror; and optional front and rear seatbelts anchored to the vehicle’s steel floorboard. Created for the purpose of public pedagogy rather than product promotion, Safety Through Seat Belts and Safety Belt for Susie were organized, both rhetorically and dramatically, around ITTE crash-test footage (much of it rendered in slow motion and accompanied by melodramatic music and superadded sound effects) and the scientific findings it facilitated. Together, these four films, so iconographically and ideologically representative of the collision-experiment subgenre, provide a window onto the most prevalent non-technical — that is to say, commercial and civic — uses to which crash-test footage was put during the 1950s and ’60s. They also speak volumes about the nature of a new regime of accident that emerged and operated in the United States after World War II.

In this chapter, I undertake close critical readings of these films in order to show how two prominent social actors, one in commercial industry (Ford), one in the research academy (ITTE), scientistically reimagined and popularly reimaged the relationship between automobility and accident — and, more abstractly, between agency, technology, and contingency — in the context of postwar America. Collision-experiment films are important for this study because they constituted the most culturally visible and sensational expression of the turn to crash injuries and crashworthiness that I discussed in the previous chapter. Through a combination of science and spectacle, expert knowledges and popular truths, these films endeavored to make the car crash's new medicalization popularly meaningful and socially useful. They brought the crash test's new scientization out of laboratories and proving grounds and into classrooms (the ITTE films), living rooms (Crash and Live!), and conference halls (Crash Research). They served as a sort of disciplinary mass medium, shaping popular perceptions of, and inculcating "appropriate" attitudes toward, the everyday — and yet somehow always unexpected — violence of mechanized mobility. In this way, they audiovisually articulated a new regime of accident for the American public.

Crash Research and Crash and Live!

Both Ford Motor Company's Crash Research and the independently produced Crash and Live! (subtitled A Special News Report on Passenger Safety) were tied to the inaugural National Safety Forum and Crash Demonstration. Held in Detroit and Dearborn, Michigan, on September 7–8, 1955, "just after Labor Day weekend when the nation's attention will be focused on traffic accidents," the Ford-sponsored Safety Forum brought together approximately 150 safety engineers and experimenters, traffic and transportation specialists, legal and medical professionals, insurance- and auto-industry executives, and print and broadcast journalists for a program of panel presentations, roundtable discussions, facilities tours, and, most spectacularly, full-scale crash-test demonstrations, each involving two brand-new Ford Fairlanes and several intricately instrumented, numerically identified "FERDs": anthropometric dummies acronymically named for the Ford Engineering Research Department.[314] The Safety Forum served as the launchpad for an extensive cross-media marketing campaign to introduce the Lifeguard Design safety package (which would be included on all 1956 models) and to establish Ford as the industry leader in safety research and crash protection. As its opening titles indicate, Crash Research was prepared for presentation at the Safety Forum as a "progress report" on Ford's "continuing research program designed to reduce the possibility of injury in automobile accidents."[315] As its subtitle indicates, Crash and Live! was fashioned as a behind-the-scenes bulletin, in which coverage of Safety Forum proceedings anchors and occasions a series of Lifeguard Design product demonstrations and plainspoken explanations given by Alex L. Haynes, Ford's Executive Engineer of Product Study.[316]

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[314] Ford Motor Company, "Program to Provide Maximum Public Impact for Announcing Ford Motor Company's Safety Research Program in Conjunction with Introduction of the 1956 Ford Family of Fine Cars," 1955. Quoted in Joel W. Eastman, Styling vs. Safety: The American Automobile Industry and the Development of Automotive Safety, 1900-1966 (Lanham: UP of America, 1984) 229.

[315] This and all subsequent quotations, until otherwise noted, are from the film Crash Research.

[316] Crash and Live! constituted one of the fruits of Ford Motor Company's carefully coordinated, lavishly funded post-Safety Forum media blitz. According to Joel W. Eastman, "A Ford public relations report issued in November estimated that the publicity on the safety package and forum had been carried in newspapers with a circulation of over 100,000,000 readers. Ten major news and general magazines had featured articles on Ford safety, including Time, Newsweek, Business Week, Saturday Evening Post, and True. All of the television networks and many independent stations had devoted time to the safety features, including a network news program with an estimated 22,000,000 viewers, and a Ford safety film was being shown on television as well as in

Crash Research starts silently, with a long panning shot of a moving car crashing broadside into a stationary one, immediately after which an offscreen narrator, matched with images of technicians fine-tuning recording instruments and designers hunching over drafting tables, states:

> The crash which you have just seen, from moment of impact until the vehicles came to rest, took three-tenths of one second. In about the same time it takes to puff a cigarette, an accident has been re-created and the results have been recorded. The measurements, the data collected from Experiment Number 220, will affect the thinking and planning of the many specialists who make up our research staff. The crash teams, the engineers, the scientists will interpret their findings for the designers who must build a new concept of injury prevention into the cars of tomorrow. We'd like to give you a brief picture of the planning behind this concept and the work that goes into these full-scale crashes, what happens in that important three-tenths of a second, and how we measure results.

As the introductory voiceover suggests, Crash Research aims to enact an audiovisual anatomy lesson in auto-collision experiments, specifically those recently conducted by Ford Motor Company. To this end, the film offers a schematic diagram of the vehicles (crashing car, stationary car, towing car, instrument truck) and their relative positions and trajectories, along with an explanation of how the sixteen instrument cables "carry the time and force messages to the sensitive measuring devices in the truck." Having established the basic elements, their functions, and their spatial relations, the film proceeds to examine, visually and verbally, the components of the crashing car, the stationary car, and the instrument truck. We are told that the

> crashing car is of particular interest, because in many ways it is quite an unusual automobile. First, the occupants. On the outside, they're fairly normal: six-foot, 190-pound adult males. On the inside, they're equipped with

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movie theaters and drive-in theaters" (Eastman 231). Although Eastman does not provide the title of either the news program or the film, it is likely that the former is Crash and Live! and the latter is Crash Research.

> electronic devices and contact points that are going to tell us when and where they have been hurt, and how they feel about it.

Lifeguard Design safety features are identified (door locks, rearview mirror, sun visors, instrument panel, steering wheel), and, “since none of us is going to sit in the backseat and watch,” the purpose and precision of the measuring devices are stressed: high-speed motion-picture cameras, “1,100 feet of cable” with sensors connected to “all the areas that can give us facts,” signal amplifiers, and oscillograph recorders “that tell us to the thousandth of a second what happened and when.”

The next few minutes of the film are composed of soundless, slow-motion crash-test footage (some of it shot from inside the vehicle), accompanied by voiceover narration that directs the spectator’s gaze to aspects of the image deemed significant or substantiating (“Watch the rearview mirror and the visor on the right”; “Watch that door!”; “Note that our dummies, without seatbelts, reacted more violently”). The film concludes with the following statement from the narrator:

> The crashes you have seen are a spectacular and exciting part of our job — but only a part. We don’t like to smash these automobiles because they’re expensive. But this is the only way to simulate the actual conditions which can establish the design criteria so that we can achieve this new concept: the safely packaged passenger. There are many things we don’t know, and we’re still looking for many answers. Our goal is reduction of passenger injuries. We’re on the right track. And when Test 520 and 2,020 have been recorded, analyzed, and evaluated, you’ll be riding in a better and safer car.

Crash and Live! commences with stock footage of Air Force officer John Paul Stapp’s celebrated ride in “Sonic Wind No. 1,” the rocket-propelled test sled that, in December 1954, achieved top speed of 632 miles per hour before slamming to a dead stop in less than a second and a half. “Not many of us, I know, are exposed to these hazards,” the film’s emcee says, framing the images of Stapp’s sled hurtling across the New Mexico desert.[317] "Yet the protection of the human body is of vital concern to all of us. And many of today's common safety devices have had their origins in specialized occupations." Standing in front of the Ford Rotunda in Dearborn, Michigan, the emcee refers to a research center at Cornell University devoted to the study of crash injuries and "what could be done to prevent, or at least lessen, them." He goes on to insist that, for the first time, these academic studies have been turned into "something practical, something available to us, the public," thereby linking the Cornell research to the National Safety Forum and its sponsor, Ford Motor Company.

Inside the Rotunda, we are shown brief excerpts of Safety Forum speeches by Stapp, John O. Moore (Director of Automobile Crash Injury Research at Cornell University Medical College), and Haynes.[318] Stapp notes that his rocket-sled experiments, though undertaken in the name of aeronautical safety, generated information relevant to automobile safety. After asserting that "Aviation experience has demonstrated that people can be packaged as effectively as merchandise is packaged to prevent damage," Moore summarizes a few of Cornell's general findings: "the automobile package is a relatively safe structure"; during an accident, it is considerably more dangerous to be ejected from the car, or "thrown clear," than to remain inside it; and roughly forty percent of drivers injured in accidents are wounded by the steering-wheel assembly, while nearly the same percentage of front-seat passengers injured in accidents are wounded by the instrument panel.

After affirming the value of Stapp's and Moore's studies, Haynes invites us to tour Ford's safety-research laboratory. There, he walks the emcee through a series of simulated

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[317] This and all subsequent quotations, until otherwise noted, are from the film Crash and Live!.

[318] It is possible that these speech "excerpts" were restaged, and perhaps revised, for Crash and Live!.

safety tests, including a pair involving weighted pendulums and steering wheels (collapsible and not), and another pair involving pike-mounted manikin heads and instrument panels (cushioned and not). The steering-wheel tests are shown in “real time” and in slow motion, while the instrument-panel tests are separated by a brief digression, in which Haynes invokes the legend of Isaac Newton’s discovery of the law of gravitation. Drawing an analogy between an apple and an automobile, Haynes drops an apple onto the ground, inspects it, and declares: “It’s bruised, it’s dented. But the seeds in here, they’re perfectly all right. Nature provided protection for the seeds for just such a drop, such a fall. That’s exactly what we’re trying to do to our passengers in our cars.”

The film then turns to the Safety Forum crash-test demonstrations, where an on-site announcer prepares the assembled audience (and, by extension, the Crash and Live! audience) for what it is about to witness, identifying the features and explaining the functions of the various vehicles, dummies, and devices. Each of the two crash-test demonstrations is displayed at standard speed in a single, high-angle long shot, panning left to right, and then replayed in slow motion from a slightly lower and closer vantage point. After the first demonstration, the on-site announcer calls attention to specific aspects of the wreckage, including the positions of the dummies and the damage done to them, as well as the effectiveness of the seatbelts, sun visors, and safety door locks. Similarly, after the second demonstration, Haynes, examining the smashed automobiles and their shaken occupants, highlights the benefits of Ford’s safety package.

In the film’s penultimate scene, company president Henry Ford II presents Cornell’s Crash Injury Research project with a check for $200,000 and promises

> that all of the pioneer safety features, and the specifications and design of those features, developed by Ford Motor Company are to be made available to

> any automobile company that wants them. We also will release any and all information which has been developed through our new research program in the crash-injury field.

The emcee, summing up, salutes the "bold and significant step" taken by Ford, the aim of which "is to prevent needless injuries and help save the most precious thing in the world — human lives."

Safety Through Seat Belts and Safety Belt for Susie

Institute of Transportation and Traffic Engineering chief research engineer Derwyn M. Severy maintained that "the key to public acceptance of safety devices lies in public information," and in 1957 the ITTE released Impact, the first in a series of widely distributed driver's-education films produced by the UCLA branch in cooperation with the U.S. Public Health Service.[319] Part science documentary, part cautionary tale, films such as Safety Through Seat Belts and Safety Belt for Suzie alternated ITTE crash-test footage with moralizing vignettes in which conventional nuclear families demonstrate the critical importance of "buckling up."

A triumphal orchestral score, cued to roaring sounds and heroic images of U.S. military fighter jets executing tightly coordinated, highly stylized maneuvers, opens Safety Through Seat Belts. The offscreen narrator asserts that, although such spectacular stunts seem dangerous to the average observer, from the perspective of the pilots, those "skilled professionals who reduce the normal hazards to standardized procedures," they are routine

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[319] Derwyn M. Severy, Automobile Collisions on Purpose (Los Angeles: The Institute of Transportation and Traffic Engineering, University of California, 1961) 202. Other ITTE collision-experiment films include Interrupted Morning (1961), Broken Glass (1962), Fatal Meeting (1962), Intersection Collision (1964), Red Light Return (1965), Safe on Impact (1965), The Automobile-Pedestrian Collision (1966), Rear-end Collision (1966), Broken Bus (1967), and Whiplash (1968).

and relatively safe.[320] The real danger, we are told, awaits the aviators back on the ground, once they have exited their airplanes and entered their automobiles.

The narrator introduces Lieutenant White, “a Navy test pilot and also an engineer,” as he greets his wife and young children (one boy, one girl) on the tarmac. “Lieutenant White is a realist,” the narrator continues, with “a healthy respect for accidents, the unforeseen, the uncontrollable.” But as “a man influenced by facts,” particularly “the brutal facts about auto mortality,” Lieutenant White “has an even greater respect for safety precautions, both in the air and on the ground.” Consequently, he and his family always use their safety belts when driving or riding “in that most lethal of wheeled wonders, the automobile.” An animated graph, underscored by menacing music, illustrates the dramatic increase in the annual number of accident injuries in the United States, followed by a series of ostensibly unposed, occasionally gruesome still shots of crash victims (dead or wounded, adults and children), wrecked cars, police officers, and rescue workers.[321] “This senseless waste of human life, such deadly violence ensuing from what appeared to be minor collisions, led research groups such as the Institute of Transportation and Traffic Engineering of the University of California to conduct a serious of auto-crash tests.”

And so commences the film’s detailed depiction of ITTE collision experiments as technically rigorous, scientifically sound, and socially beneficial. Passing in rapid succession, images of electronic recording equipment, motor vehicles (“elaborately instrumented to

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[320] This and all subsequent quotations, until otherwise noted, are from the film Safety Through Seat Belts.

[321] This sequence is the only one I know in a collision-experiment film that crosses over, albeit briefly, into gory-highway-safety-film territory. Unlike the typical gory highway-safety film, however, the “real-life” shock sequence in Safety Through Seat Belts uses black-and-white still shots, rather than full-color moving images.

collect all the data necessary for later evaluation of just what happened in their brief moment of importance before being consigned to the scrap heap”), technical personnel, motion-picture cameras (“automatically controlled to begin functioning just ten seconds before impact” and arranged so as to “record the event from all significant angles”), overhead rigging, anthropometric dummies (“well-engineered mechanical substitute[s]” that “simulate the behavior of their human counterparts under the forces of collision”), pavement markings, and aluminum monorails (that guide “both crash cars to a predetermined point of impact”) testify to the intricacy of the preplanning and the complexity of the undertaking. We are urgently informed that all material traces of mechanical failure and potential instances of human fallibility must be preemptively excised — positively exorcised, in fact — from this otherwise immaculate site of technical investigation and scientific experimentation:

> The entire event must be under precise control at all times. . . . The final two days are the most critical. Everything is checked and rechecked. They cannot afford any malfunctions when they have only one shot, and even so, things do go wrong. Then it is still another ordeal of checking and testing every device, every connection, until all human error has been eliminated.

The countdown begins, the music swells, the cars collide and spin out, a door springs open, a dummy ejects and scrapes along the asphalt. “An actual crash lasts approximately four seconds,” the narrator says, “each fraction of which contains dozens of events of life-and-death significance.” Additional collisions are depicted at standard speed, replayed in slow motion, and analyzed after impact in a succession of statically framed compositions, while sensationalist voiceovers describe violent beatings and fatal plunges, twisted wreckage and metal-carved faces, severe crash loads and crushed chests, overwhelming lateral forces and deadly consequences. There is, it seems, a lesson to be learned in all of this, a moral to the story of scientifically staged collisions, which teaches the limits — the mortal limits — of human action and reaction, of embodied agency and intention:

> The forces measured on the various parts of the body at impact were obviously far outside the limits of man's ability to control his own actions. These were precisely the kind of facts that they were after — from out of the twisted mass of steel, from out of the action-packed few milliseconds, after all safe-driving practices had already been passed, when man no longer had control and was only a passenger in a lethal missile coming to a screeching halt.

In the film's penultimate sequence, several private organizations and public institutions (American Medical Association, National Safety Council, California Highway Patrol, U.S. Air Force, U.S. Public Health Service), represented onscreen as official emblems or building facades, proclaim the gospel of the safety belt. The film concludes with images of Lieutenant White and family driving and arriving home, cheerfully climbing out of the car, and strolling across a neatly trimmed lawn toward the entrance of their suburban abode, hand in hand and smiling all the while, as the narrator makes one final plea for prudent conduct, one last appeal for reason and rational self-interest:

> As individuals, we can be guided by the facts. The stakes are too high to rest on sentiment, superstition, and vague misgivings. Seatbelts will reduce the hazard, and they are available. Even a careful driver such as Lieutenant White can be involved in an accident, and a safety belt is the cheapest insurance available. Today's traffic requires the maximum application of all safe-driving practices and the use of the best devices that science can discover to reduce the staggering toll of accident injuries and deaths. In this effort, all of us as individuals have a vital stake. For, you know, safety doesn't happen by accident; it takes constant vigilance to maintain it.

Safety Belt for Susie begins with images of an amusement park on a sunny day. A merry-go-round melody fills the air. A roller-coaster climbs, twists, and dips. Children shriek with delight. The first of the film's character-narrators, Jim Norwood, introduces his wife, Alice, their young daughter, Nancy, and her slightly smaller, identically dressed doll, Susie.

"[Nancy has] made Susie an important part of our family. You know how it is, when a little girl has no brothers or sisters, her doll can become pretty important. And sometimes, so help me, I almost think the girl — I mean the doll [laughs] — has a personality of her own."[322] After being securely strapped in, Nancy and Susie, seated side by side, enjoy the rides.

Moments later, the scene shifts from the viewpoint of a first-car rider in a plunging roller-coaster to that of a front-seat passenger in a cruising automobile, implying the existence of affective, perceptual, and kinesthetic continuities between thrill-riding (the childlike exhilarations of mechanized mobility) and car driving (the adult privileges of mechanized mobility). We are riding with Jim, Alice, and, in the backseat, sitting upright and facing forward as though she were human, Susie, who are on their way to pick up Nancy from her grandmother's. Husband and wife chat idly as they glide down the open road, the sun shining brightly, the landscape passing picturesquely. Suddenly, from around a sharp bend, an oncoming car appears and veers into Jim's lane, forcing him to swerve to the right, slam on the brakes, and crash into a tree. Screeching tires, ominous non-diegetic music, synecdochic close-ups (spinning wheels, jerking torsos, shattering windshield), and rapid-fire editing (thirteen shots in seven seconds) accentuate the abrupt violence of the accident. "Although we were both wearing seatbelts, Alice was badly shaken up," Jim says, noticing the wound on his wife's forehead. "I'd have to get Alice over to Dr. McAlister right away. Then we discovered something that gave us both a genuine shock." Looking down, the couple spies Susie, her inverted body jammed between the front seat and dashboard, neck bent as if broken, eyes closed, hair dangling down. Jim gasps: "What if this had been Nancy?!"

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[322] This and all subsequent quotations, until otherwise noted, are from the film Safety Belt for Susie.

The next scene takes place in the office of Dr. McAlister, the film's second character-narrator. "I examined both Mr. and Mrs. Norwood," the physician explains in a voiceover, "and I was happy to tell them that, apart from a few abrasions and shattered nerves, they had suffered no serious injury. If they hadn't been wearing their seatbelts, however, the verdict would have been different — disastrously different." Seeing Susie reposed on the couch, Dr. McAlister takes the opportunity to tell the Norwoods about his own "work with dolls that had survived car collisions" at the Institute of Transportation and Traffic Engineering at the University of California at Los Angeles, thereby initiating (and narratively grounding) the film's climactic montage of crash-test footage.

Structurally, stylistically, and rhetorically, the collision-experiment section of <u>Safety Belt for Susie</u> bears a striking resemblance to that of <u>Safety Through Seat Belts</u>, released three years earlier. Collisions are visually registered — immediately before, during, and immediately after impact — from various angles, heights, and distances, then visually reiterated at various speeds, verbally defined by an authoritative offscreen narrator (in this case, the character Dr. McAlister), and aurally augmented by hyperbolic sound effects and bombastic orchestration. Unlike <u>Safety Through Seat Belts</u>, however, the collision experiments depicted in <u>Safety Belt for Susie</u> focus on "what happen[s] to children, with and without belts, because this subject had not been explored." To be sure, the novelty of such experiments (at least as far as ITTE is concerned) is borne out by the obvious crudeness of the child surrogates, which, in contrast to the adult surrogates, those technically sophisticated "anthropometric test devices," appear to be nothing more than toy dolls acquired off the shelf.[323] Nevertheless, according to the voiceover, the dolls, despite their lack of human

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similitude and proper scientificity — or perhaps because of it: because of their iconic "innocence," their clear coding as children's playthings — managed to arouse an impression of dread, "a feeling of tension and a sense of impending tragedy," in the researchers.

At the start of the experiments, the dolls, each identified (and personified) by a strip of masking tape affixed to its forehead ("Fran," "Carla," "Betsy," "Anna"), are shown resting on dummies' laps, reclining in open bassinets, and standing in backseats. In the split second after impact, they are shown, in slow motion, tumbling into front seats, flying through midair, and slamming into interior surfaces. Finally, after the vehicles have come to rest, they are shown in various states of damage, deformation, and dismemberment — except, that is, for those restrained with a safety belt or harness. (The restrained dolls, we are informed, "came through uninjured.") The collision-experiment section ends, visually, with a series of close-ups of the battered faces and contorted bodies of the unrestrained dolls — those that, had they been real children, "would have been killed" — and, aurally, with the superimposed sobs of a baby, the sentimental strains of the score, and the solemn speech of Dr. McAlister: "I wish that everybody could see these scenes, because I don't believe that anyone who did would ever let the children go riding unrestrained again."

In the film's denouement, we see Jim, Alice, Nancy, and Susie getting into the family car, which not only has been fully repaired, inside and out, but newly equipped with rear seatbelts. "We never go anywhere now that we aren't all safely belted," Jim announces proudly. Before the Norwood family drives away, Dr. McAlister makes "a frank appeal to all mothers and fathers: Without restraints, such as safety belts, the rear seat of an automobile, in

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[323] The dolls were, in fact, store-bought, but they were modified by ITTE researchers. See Derwyn M. Severy and Arnold W. Siegel, "Engineered Collisions," Proceedings of the Fifth Stapp Automotive Crash and Field Demonstration Conference, Sept. 1961 (Minneapolis: U of Minnesota P, 1961) 45.

itself, is not adequate protection. University research shows that children who will otherwise be killed can live to prove that safety is no accident."

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Through the strategic deployment and subtle intertwinement of rational arguments, emotional appeals, audiovisual techniques, and ideological encodings, Crash Research, Crash and Live!, Safety Through Seat Belts, and Safety Belt for Susie, like all collision-experiment films, work, implicitly or explicitly, to advance three basic claims: (1) automobile accidents and the injuries and fatalities that result from them constitute a serious national/societal problem; (2) scientists and technicians are diligently working to mitigate or minimize this problem; and (3) motorists must take initiative and action, as private individuals, to protect themselves and their families.

Despite these commonalities, Crash Research and Crash and Live!, on the one hand, and Safety Through Seat Belts and Safety Belt for Susie, on the other, differ in approach and emphasis. More precisely, they differ, first, in how they construct the problem of automobile safety and, second, in their assessment of what action should be taken in the name of self-protection. The former pair of films, as Ford Motor Company-authored or -authorized productions, frame the issue in terms of corporate innovation, industrial design, product safety, and customer satisfaction: market-based "solutions" to personal problems. In these films, it comes down to a question of proper "packaging" (supplied by the manufacturer), as well as proper participation in the rituals of enlightened consumption (buying the right car). The latter pair of films, as public-university-affiliated productions, frame the issue in terms of academic research, institutional knowledge, safe conduct, and civic duty: a matter of public education, health, and welfare. In these films, it comes down to question of proper practices (inculcated by public institutions), as well as proper participation in the rituals of safe subjectivity ("buckling up").

Enlightened Consumption

Crash Research and Crash and Live! differ from Safety Through Seat Belts and Safety Belt for Susie in their modes of address, in the way they interpellate their audiences. The Ford Motor Company films address their audiences, first and foremost, as consumers.[324] Their discourse is designed to persuade, carefully crafted to win customers and deliver profits. As key components of Ford's Safety Forum publicity campaign, itself part of the company's broader effort to promote its 1956 models, it is not surprising that Crash Research and Crash and Live! operate, in part, as extended sales pitches, as primitive or prototypical infomercials, complete with authoritative explanations (the voice-of-God narrator in Crash Research, the onscreen engineer-executive in Crash and Live!) and elaborate product demonstrations (the experiments in the lab, the exhibitions in the field). They have a twin product to peddle — something concrete (a safety package) and something abstract ("safety"), the one supposedly the guarantor of the other. They intimate the existence of an affliction (car-crash injuries and fatalities) and then promise to cure it. Actually, it is more accurate to say that they construct it and contain it at the same time. With one sweep of the hand, the etiology of the affliction is determined, its symptoms circumscribed, and, most important, its remedy commodified. The prescribed elixir, the formula and "fix," turns out to

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[324] It is perhaps more accurate to say that the Ford films' message, their sales pitch, is directed at a particular range of consumers — namely, those able to afford the purchase of a "big-ticket" item (members of the middle and upper-middle classes), and those socially and ideologically empowered within those classes, during this period, to make the decision and shake on the deal (men, husband-breadwinners).

be a consumer good. In the Ford films, safety is realized through the magic of the marketplace transaction, bought and sold.

The logic here is familiar, for it recycles and recombines deeply entrenched and distinctly American ideologies of techno-capitalist progress. Stuart Ewen and Roland Marchand have each examined the social, historical, and ideological dimensions of commercial advertising and mass consumption, and their insights are instructive for the present discussion. Although Ewen and Marchand are primarily concerned with advertisements from the 1920s and ’30s, countless rearticulations of the representational codes, argumentative forms, and rhetorical strategies they analyze can be discerned in American ads appearing throughout the twentieth century, including the period of interest here, the 1950s, when, as Ewen says, “the proffered dreams of the captains of consciousness, worked out in the twenties, really began to take concrete form.”[325]

Ewen observes that commercial advertising frequently encourages Americans to look upon major corporations as “people” they can count on to moderate the shocks and swings of modern life, as sources of consistency and dependability in a world of ever-accelerating, often bewildering social, cultural, and economic change. “During the twenties, corporate advertising often worked to create a personified conception of its own beneficence. While daily life was projected as a flux of disastrous and unpredictable events, ‘image’ advertising (often termed ‘good-will’ advertising) studied methods of locating stability and reliability within the corporate walls.”[326] Such advertising creates an image of an increasingly fast-paced (and possibly speed-obsessed) culture, an off-kilter industrial society whose members’

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[325] Stuart Ewen, Captains of Consciousness: Advertising and the Social Roots of the Consumer Culture, 25th anniversary ed. (New York: Basic, 2001) 206.

[326] Ewen 100.

everyday experiences are riven by ruinous mishaps, unsettling surprises, and uncertain outcomes — in other words, by accidents, including those occasioned by modern means of transportation — and then promises redress for that culture and redemption for that society through faith in the corporation, desire for its products, and allegiance to its ethos.

Yet it is not only corporate-image advertising that follows this pattern; commodity advertising, too, often adopts a similar approach. Since the 1920s, the decade in which the American advertising industry revised its methodology, consolidated its power, and exponentially expanded its sphere of influence, advertisements for consumer goods have consistently celebrated novelty above all else — the "newness" of the product, as against the functionally outmoded or merely unfashionable, offered as a sure sign of its superiority, be it practical or "magical" (social-symbolic).[327] "In advertising," Sut Jhally writes, "the commodity world interacts with the human world at the most fundamental of levels: it performs magical feats of transformation and bewitchment, brings instant happiness and gratification, captures the forces of nature, and holds within itself the essence of important social relationships (in fact, it substitutes for those relations)."[328] The power to perform these magical feats, the ability to capture the forces of nature, owes, in no small measure, to the newness of the commodity, and, in the dream world of mass consumption, novelty betokens modernity. According to Marchand,

> The ad creators of that era [the 1920s and '30s] proudly proclaimed themselves missionaries of modernity. Constantly and unabashedly, they

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[327] For Raymond Williams advertising constitutes "a highly organized and professional system of magical inducements and satisfactions, functionally very similar to magical systems in simpler societies, but rather strangely coexistent with a highly developed scientific technology." Quoted in Sut Jhally, "Advertising as Religion: The Dialectic of Technology and Magic," Cultural Politics in Contemporary America (New York: Routledge, 1989) 227.

[328] Jhally 218.

> championed the new against the old, the modern against the old-fashioned. This bias, inherent in their economic function, ensured that advertisements would emphasize disproportionately those styles, classes, behaviors, and social circumstances that were new and changing.[329]

Even in its most hegemonic moments, however, commercial advertising's championing of "the new" and "the modern" is not necessarily, or even usually, pure or absolute. Indeed, as Marchand explains, it often betrays a profound ambivalence about the "virtues" of modern life, if only to recuperate them in the end. In advertisements that relate what he calls "the parable of Civilization Redeemed," customs, qualities, and dispositions acquired through or associated with modern civilization and techno-capitalist progress, because they are seen as running counter to, or, worse, recklessly disregarding, the natural order ("Nature"), are ineluctably attended by all manner of ills and aggravations. In this morality play, Nature strikes back, exacting a toll on modern man for his disregard or disobedience, not so much in the manner of the return of the repressed as the revenge of the transgressed. Fortunately, industrial capitalism, or civilization, oriented as it is to the future (which is always imagined to be infinitely better than the present) and steadfast in its refusal to relinquish the fruits of progress (much less renounce the foundational belief therein), never fails to provide a means of calming the nerves it rattles or of healing the maladies it engenders. Those means, the heroes of the parable of Civilization Redeemed, are mass-produced commodities, specifically "products that would enable Nature's original and beneficent intentions to triumph."[330] In response to Nature's retaliatory strike, civilization marshals its material resources, stiffens its ideological resolve, and, above all, exercises its

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[329] Roland Marchand, Advertising the American Dream: Making Way for Modernity, 1920-1940 (Berkeley: U of California P, 1985) xxi.

[330] Marchand 223.

rational faculties to develop consumer goods that appropriate or approximate natural processes and properties deemed beneficial to humans. Having outsmarted Nature at its own game, modern man is hereby absolved, progress confirmed, the American way of life ensured. The parable of Civilization Redeemed

> confirmed Americans in one of their treasured common beliefs — the belief in unequivocal progress, in the compatibility of technology with the most desirable qualities of Nature. . . . By exploring apparent and incongruous exceptions to the principle of progress without cost, and by demonstrating man's capacity to prevent these unnecessary discontents of civilization, the parable of Civilization Redeemed buttressed a central tenet of American folk wisdom.[331]

Stuart Ewen puts it this way: "As we are confronted by the mass culture, we are offered the idiom of our own criticism as well as its negation — corporate solutions to corporate problems."[332]

The Ford films rearticulated the parable of Civilization Redeemed in the context of an emergent culture of automobility in the United States. They did this by proposing that in the realm of automotive transportation, "apparent and incongruous exceptions to the principle of progress" — car crashes — could be effectively neutralized through an ambitious, unprecedented, and expensive corporate solution: the reengineering of the automobile "package" in the name of passenger safety.

The Safely Packaged Passenger

Thematically central to Crash Research and Crash and Live! is the trope of "the safely packaged passenger." Crash Research invokes the safely packaged passenger to identify the

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[331] Marchand 227.

[332] Ewen 219.

primary objective of Ford Motor Company's capital-intensive research-and-development program. Connotatively, however, the invocation does a good deal more: it moralizes and mythologizes that objective, ennobling the impulse behind it and romanticizing the means used to achieve it. To be sure, in Crash Research, the safely packaged passenger, constructed as a groundbreaking contribution to the theory and practice of automobile engineering and design, implies Ford's technological sophistication and industrial vanguardism ("the cars of tomorrow"), corporate sacrifice and economic altruism ("We don't like to smash these automobiles because they're expensive"), and philanthropic initiative and sense of social responsibility ("Our goal is reduction of passenger injuries"). Crash and Live!, for its part, likens automobile occupants to consumer goods (Moore's "merchandise") and organic essences (Haynes's apple seeds) to be damage-protected through improved packaging — improvements embodied in the proprietary products of Ford Motor Company (the Lifeguard Design safety package) and effected through the company's unwavering dedication to technoscientific innovation (all that painstaking laboratory research, all those complicated field experiments) and its magnanimous concern for the well-being of the public (the $200,000 research grant, the selfless sharing of scientific data, "the most precious thing in the world — human lives").

Variations on the safely-packaged-passenger theme appeared in other Ford Motor Company illustrations and explanations during the mid-1950s. In his article on how "to package bodies effectively against collision," published in Ford's Report to the Public on the National Safety Forum, the companion booklet to the Safety Forum, Moore refers to an airplane cockpit as "the 'container' surrounding the pilot" and to "biological tissue such as flesh, bones or sinews" as being "like any other material" in that "it has certain stress characteristics — a yield point and a break point."[333] A ninety-second television spot for 1956 Fords demonstrates this "entirely new concept of passenger packaging for passenger safety" with the aid of one product spokesman and three simple props: a porcelain teacup, a steel barrel, and a flight of stairs. After tumbling down the stairs, the "fragile teacup," having been tightly fastened to the underside of the barrel's lid, is revealed to be fully intact. "Not even a crack," the spokesman boasts. "That's because the cup was securely packaged. First, it couldn't fly our of the barrel and break because the lid was firmly secured. Second, it was strapped down so it couldn't hit anything inside the barrel and break."[334] Robert S. McNamara, an upper-echelon Ford executive from 1946 to 1960, remembers his preoccupation with passenger packaging during this period, not through the figures of apple seeds and porcelain teacups, but through those of hen eggs and human skulls:

> [Researchers at Cornell University] said the major problem is packaging. They said, "You buy eggs, and you know how eggs come in a carton?" I said, "No, I don't buy eggs; I never — my wife does it." "Well," they said, "you talk to her and ask her, when she puts that carton down on the drain board when she gets home, do the eggs break?" And so I asked Marg, and she said, "No." And Cornell said, "They don't break because they're packaged properly." Now, if we packaged people in cars the same way, we could reduce the breakage. . . . So we dropped human skulls in different packages down the stairwells of the dormitories at Cornell. Well, that sounds absurd, but [Cornell] was absolutely right. It was the packaging which could make the difference.[335]

While the safely packaged passenger was probably a slogan coined by Ford's marketing department, the scientific findings on which it was based derived from Cornell's

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[333] Ford Motor Company, Report to the Public on the National Safety Forum (Detroit: Ford Motor Company, 1955) 15, 8, 7.

[334] Ford Motor Company, television advertisement, 1956.

[335] The Fog of War: Eleven Lessons from the Life of Robert S. McNamara, dir. Errol Morris, Sony Pictures Classics, 2003.

Crash Injury Research project, as McNamara's remarks indicate, as well as from Stapp's rocket-sled deceleration experiments, both of which I discussed in the previous chapter.[336] The novelty — and audacity — of the slogan lay in its equation of person with product, commuter with cargo, human being with brute thing. For crash-injury researchers and aeronautical/automotive engineers, this equation promised, and indeed provided, a new way to think the physical relations between and reciprocal dynamics of aviator/motorist and aircraft/motorcar, between the soft flesh of the one and the hard interior of the other. That this new way of thinking about the human-machine interface was predicated on the abstract reduction of a breathing occupant to a brittle object would not, in all likelihood, have given these physicians and technicians pause, ethically or intellectually; after all, in the modern West, the sciences have routinely and often dogmatically identified living organisms — humans included — with nonliving entities such as corpses and machines. But what about the audiences of Crash Research and Crash and Live!? How might they, as members of the lay public (and as potential Ford customers), have made sense, or been expected to make sense, of this strange new way of thinking, in which cars suddenly became cartons and containers, and bones and biological tissue transmogrified into fragile freight? What public discourses and practical knowledges were available to American citizens and consumers in

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[336] I should make clear that the terms "package" and "packaging" as applied to aircraft and, later, automobiles had currency among researchers at Cornell before migrating to Ford. (See, for example, Hugh DeHaven, Accident Survival — Airplane and Passenger Car [New York: Society of Automotive Engineers, 1952].) But, as far as I have been able to determine, "the safely packaged passenger" — this precise locution — originated at Ford. Incidentally, outside of the strictly American context (the Cornell-Ford lineage), the idea that automobile occupants could and should be conceptualized as packages to be damage-protected found expression almost a decade later in F. W. Babbs and B. C. Hilton's "The Packaging of Car Occupants — A British Approach to Seat Design," a technical paper included in The Seventh Stapp Car Crash Conference — Proceedings (Springfield: Charles C Thomas, 1965) 456-464. To this day, within automotive-engineering circles, "occupant packaging," as term and concept, continues to be employed; see, for example, R. W. Roe, "Occupant Packaging," Automotive Ergonomics, ed. Brian Peacock and Waldemar Karwowski (London: Taylor & Francis, 1993) 11-42.

the mid-twentieth century that might have helped them to appreciate or negotiate the curious figure of the safely packaged passenger?

We can begin to answer these questions by noting that the passenger-in-package metaphor, used in the twentieth century in connection with the automobile, was not, in fact, entirely novel, but rather recalled the traveler-as-parcel metaphor, used in the nineteenth century in connection with another, earlier means of mechanized transportation: the locomotive. Author and art critic John Ruskin famously claimed that the railroad "transmutes a man from a traveler into a living parcel," expressing in succinct phrase and scornful tone a sentiment widely held among middle-class members of the nineteenth-century traveling public.[337] As Wolfgang Schivelbusch observes, "This figure of speech contains the implication that the railroad was to travel as industry was to manufacture."[338] The railroad industrialized the means of terrestrial travel, of course, but it also industrialized the experience of terrestrial travel. Schivelbusch argues that while it would be foolish to ignore the differences between the "active-productive" situation of the industrial laborer and the "passive-consumptive" situation of the railway traveler, the latter, too, takes part in the process of "industrial production, although from the consumer's standpoint."[339] This is because, as Karl Marx notes, that which the traveler purchases and receives — namely, change in locality, or exchange of localities — is simultaneously produced and consumed.[340]

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[337] Quoted in Wolfgang Schivelbusch, The Railway Journey: The Industrialization of Time and Space in the 19th Century (Berkeley: U of California P, 1986) 54 and 121.

[338] Schivelbusch 121.

[339] Schivelbusch 120.

[340] Marx writes: "Men and commodities travel by the help of the means of transportation, and this traveling, this change of location, constitutes the production in which these means of

In the case of mechanized transportation, where travel is continuously consumed as it is mechanically produced, change in locality is both industrial process and industrial product. Because the railway traveler feels the unsettling vibrations, sees the streaking landscapes, and hears the clattering noises produced by the machinery, he engages industrial production with an immediacy and intensity unknown — or better, alien — to the "passive" or "pacified" consumer of the reified commodity, the tangible thing. It is in this sense that the railway traveler functions as a kind of industrial laborer.[341]

If, as Schivelbusch contends, the railway traveler performs a kind of industrial labor, producing and consuming mechanized transportation in the same instant, then the railroad car or compartment functions, in part, as a kind of factory, a facility for mass manufacture. The social space of locomotivity, the locus and subject-position of the railroad patron, conflates the site of industrial production (the workplace) and that of industrial consumption (the marketplace) — collapses the polar positions in the circuit of capital, in effect — for the duration of the journey. The automobile occupant, like the railway traveler, participates in the industrial production of (his or her own) transportation. The social space of automobility, like that of locomotivity, superimposes the once-discrete sites of industrial labor and leisure, workplace and marketplace. Car driver and rail rider, backseat passenger and first-class traveler, motorist and locomotivist — all are proletarians of a sort.

Yet there is a key difference between Ford's packaged passenger, the subject of twentieth-century automobility, and Ruskin's parceled traveler, the subject of nineteenth-

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transportation are consumed. The utility of transportation can be consumed only in this process of production. It does not exist as a use-value apart from this process." Quoted in Schivelbusch, Railway Journey 120.

[341] Schivelbusch does not address the question of whether the railway traveler, in his capacity as industrial laborer, is alienated, in the Marxian sense, from that labor.

century locomotivity. Ruskin's railway traveler is processed as a piece of freight, to be delivered to its destination as efficiently as possible: loaded and unloaded. "The whole system of railroad traveling is addressed to people who, being in hurry, are therefore, for the time being, miserable," Ruskin grumbled.[342] Ford's packaged passenger, by contrast, is treated as precious cargo, to be delivered to its destination as safely as possible: handled with care.

Ford's radical redefinition and redesign of the automobile interior, then, undertaken in the name of safeguarding life itself ("Lifeguard Design"), constitutes a kind of retrofitting of mechanized transportation's factory floor, a material re-creation of the industrial means of production, as well as a biopolitical regulation of the industrial environs of labor, the purpose of which is to obviate or ameliorate "occupational hazards." Seen in this light, automobile accidents and car-crash injuries are peculiar rearticulations of workplace accidents and occupational injuries, insofar as cars and factories alike involve the industrial production of unintended consequences — what Ernst Bloch calls "a production that knows no civilized schedule" — and the mechanical infliction of corporal trauma.[343] By manufacturing and marketing "safety," Ford Motor Company, in spite of itself, its industry, and even the "American way of life" it had so cleverly, (and profitably) cultivated over the years, implicitly equated the technical refinements, aesthetic intoxications, and, as Crash author J. G. Ballard insists, erotic pleasures of the automobile interior with the bodily perils, nasty realities, and slavish concessions to "survival" of the industrial workplace.[344]

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[342] Quoted in Schivelbusch, Railway Journey 121.

[343] Quoted in Schivelbusch, Railway Journey 131.

[344] J. G. Ballard, Crash (New York: Picador-Farrar, Straus & Giroux, 1973).

The heritage of the traveler-as-parcel metaphor notwithstanding, the concept of the safely packaged passenger — its utility, its intelligibility, even its possibility — was partly conditioned, within the spheres of science and industry and without, by a wider configuration of commercial exigencies and cultural understandings having to do with the distribution and damage-protection of mass-produced commodities. Consumer capitalism depends no less on economies, efficiencies, and instrumentalities of mass distribution than it does on those of mass production and mass consumption. Distribution involves the movement of goods from manufacturer to marketplace, of course, but it also involves the purposeful preparation of those goods for that movement — which is to say, it involves packaging. Harold J. Raphael, author of Packaging: A Scientific Marketing Tool, writes:

> Although it conceivable that certain commodities could be transported and sold without any form of protection provided, the great majority of consumer goods need some degree of protection from one or more hazards and, therefore, must be packaged. For these items it is necessary that the package protect the product from all hazards from the time it is packaged until the ultimate consumer uses it in its entirety.[345]

The ability to conceive (in the case of the crash-injury researcher) and to comprehend (in the case of the car consumer) the notion that a human being might be safely "packaged" inside an automobile requires at least a rudimentary understanding of the protective function of commodity packaging. By 1955, the year Ford heralded the arrival the safely packaged passenger, such an understanding would have been widely shared and deeply entrenched for several generations. Indeed, industrially produced and packaged goods of all shapes, sizes, and sorts were such a fixture of American life by the end of the nineteenth century, let alone by the middle of the twentieth, that they would have been entirely unremarkable, their sheer

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[345] Harold J. Raphael, Packaging: A Scientific Marketing Tool (Library of Congress Catalogue Card No. 78-98906, distributed exclusively by the Michigan State University Book Store, East Lansing, MI 48823, 1969) 43.

ubiquity and practical necessity simply taken for granted. Even if they never or only occasionally reflected on the fact, American consumers knew from everyday experience — known concretely, not abstractly — that most of the merchandise they bought and brought into their homes had been deliberately boxed, bagged, or bottled to defend against damage or breakage, spillage or spoilage, evaporation or contamination. Furthermore, they knew that time and transportation were the principal factors and forces threatening to cause those corruptions, to ruin the purity, integrity, or longevity of the product. Ford engineers and marketers banked on the fact that the vast majority of Americans of the 1950s not only possessed such knowledge but could and would reason by analogy: ’56 Fords promised to package passengers as precious cargo in order to safeguard their cosmetic “purity,” bodily integrity, and biological longevity.

The image of university researchers dropping swaddled skulls down dormitory stairs doubtless would have been a tough sell, even for a marketing machine as powerful and prestigious as that of Ford Motor Company. It was too arcane and too clinical, not to mention too weird, an image for the average American (and average American family) to identify with, much less embrace. But the symbolism of an apple and its seeds? the fragility of a teacup? the function of an egg carton? Now <u>those</u> were things to which every American could relate. Surely every American could understand why those things required stabilization and shock absorption when in transit. If Ford could convince motorists that they, too, required stabilization and shock absorption, would not the company’s ’56 models practically drive themselves off dealers’ lots? Ford sought to persuade motorists to identify with the contents of commercial cargo and to associate the family car with a shipping carton or container. The safely-packaged-passenger trope asked American consumers, first, to imagine their bodies as breakable objects and, second, to preserve and protect those breakable bodies by buying (into) Lifeguard Design. It asked them to conceptualize their own commodification as a means — indeed the only means short of automotive abstinence — of personal prophylaxis, of ensuring their own health and welfare, safety and survival.[346] It asked them to draw an imaginary equivalence between porcelain teacups, hen eggs, and human skulls — their own skulls — after all.

Safe Subjectivity

Whereas the Ford Motor Company films Crash Research and Crash and Live! foreground the purportedly causal relationship between the purchase of a safety package and the possession of something called "safety," the Institute of Transportation and Traffic Engineering films Safety Through Seat Belts and Safety Belt for Susie emphasize the "life-and-death significance" of strapping on a seatbelt.[347] The Ford films imply that the secret to safety lay in improvements in industrial design, in the reimagining and refashioning of the automobile's inner chamber, the human-machine interface. They proffer a techno-capitalist fix and propose a "top-down" approach to the problem: the big automaker produces safety on the assembly line and the little man buys it in the car dealership. Safety, in this view, is

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[346] Safety and survival for their commodity-bodies were to be achieved, not incidentally, through the purchase of a superior commodity.

[347] This distinction is perhaps drawn too sharply. After all, one of the five features of Ford's Lifeguard Design safety package was front and rear seatbelts, which means that Ford, too, condoned the wearing of seatbelts, if only implicitly. Interestingly, though, the Lifeguard Design seatbelts were optional. That they were not a standard feature of the safety package suggests that Ford believed, or at least wanted its customers to believe, that '56 models were inherently safe whether occupants wore their seatbelts or not. The practice of seatbelt-wearing, it seems, was deemed less important than owning a car with a collapsible steering wheel, a padded instrument panel, and so forth. The underlying message to consumers was that an "active-restraint" device (the manually operated seatbelt) is not as critical, in terms of safety, as "passive-restraint" devices (the other safety-package features).

acquired in one shot, at the moment of purchase, and thereafter furnished automatically with each use of the vehicle.

While the ITTE films do not implicitly or explicitly reject the premise that safety is, in part, a function of vehicle design, they focus instead on instilling the proper attitude in and disciplining the behavior of "the motoring public." Preaching clear thinking and "constant vigilance," they paint a picture in which, more than anything else, the individual's voluntary adoption and subsequent habituation of a particular set of driving practices, the wearing of a seatbelt chief among them, constitute the best defense against the national/societal problem of car-crash injuries and fatalities. Safety, in this view, must be consciously enacted, not acquired all at once or furnished automatically; what's more, it must be consciously reenacted with each and every use of the vehicle. If the Ford films can be said to have favored a top-down approach, starting at the automobile factory and radiating downward and outward, then the ITTE films can be said to have favored something like a "bottom-up" approach, insofar as they endeavored to effect a transformation in both mindsets and material practices, a reorientation of basic assumptions and actions vis-à-vis automobility, at the "grassroots" level: that is, at the level of the individual user.[348] Put differently, the ITTE films sought to produce a "safe subject," which Jeremy Packer defines as "a self that reflects upon various practices and discourses regarding safety in the construction of its ethical subjectivity."[349]

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[348] I say "something like" a bottom-up approach because, of course, this call for safe-driving practices issued from a major social and economic institution, the research university, and thus cannot be claimed to have been a genuine grassroots impulse or operation.

[349] Jeremy Packer, "Disciplining Mobility: Governing and Safety," Foucault, Cultural Studies, and Governmentality, ed. Jack Z. Bratich, Jeremy Packer, and Cameron McCarthy (Albany: State U of New York P, 2003) 155.

What about this safe subject? Who is he, and what is expected of him? The narrative sequences in Safety Through Seat Belts and Safety Belt for Susie center on normative American families of the 1950s: nuclear, white, middle-class, suburban, patriarchal. The automobile user is understood to be, and is represented as, the father-husband. The films' mise-en-scène and narrative devices put the father-husband character (Lieutenant White, Jim Norwood) in the driver's seat, literally and figuratively. He drives — propels and steers — the machine. He drives himself and his family. He drives the plot and the story, the "action." And, by implication, he drives the economy, the society, the nation. As head of the household, microcosmic and macrocosmic, he is charged with a demanding dual responsibility: father-provider (breadwinner) and father-protector (guardian). He is made responsible for the safety and survival of himself and his family, as well as for the safety and survival of his economy, his society, and his nation.

Just as the films' narratives of risk and responsibility are primarily organized around the father-husband character, so the films' discourses of risk and responsibility are primarily directed at their audiences' father-husbands. Or perhaps it is more accurate to say that the films' discourses of risk and responsibility interpellate their audiences as "father-husbands."[350] In any case, these discourses, these calls for vigilant paternity and safe subjectivity, pivot on and are powered by two intersecting dialectics. One involves the films' modes of appeal and address to the audience: rational-scientific versus visceral-affective; the other involves the films' claims and constructions of human agency: present-potent versus absent-impotent.

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[350] I should point out that sometimes the mother-wife, in her role as family caretaker, is called upon as well, such as when Dr. McAlister makes "a frank appeal to all mothers and fathers" at the end of Safety Belt for Susie.

Urgent appeals to the spectator's status as a rational being, capable of cool calculation in personal matters and deferential to scientific authority in public ones, permeate the visual and verbal texts of Safety Through Seat Belts and Safety Belt for Susie. These rational-scientific appeals are not homogeneous in form or content, but rather differentially inflected and enunciated, and can be discerned, by turns, in the traits and demeanor of particular characters, in the words and tone of the offscreen narrator, and in the images and editing of the crash-test footage.

In the ITTE films, as in all patriarchal texts and discourses, the man (or masculinized figure) occupies the seat of sound judgment, the locus of logical reasoning. Both Lieutenant White (Safety Through Seat Belts) and Jim Norwood (Safety Belt for Susie) are shown to be devoted "family men." In addition, they are coded, through dress and deportment, as well-groomed, well-mannered, and well-adjusted citizens. They possess all the conventional signifiers of masculine control and confidence, all the trappings of white, middle-class amiability and achievement. Lieutenant White is a Navy officer (loyal, disciplined), a jet pilot (virile, courageous), and an engineer (intelligent, resourceful). Norwood, while he might have been "driving a little too fast" (virile, courageous), had the good sense take his wife straight to the doctor after the accident (loyal, disciplined) and to install rear seatbelts while the car was in the shop (intelligent, resourceful).[351] "Influenced by facts" determined and disseminated by trusted public institutions (science, the university, the media) and unmoved by "sentiment, superstition, and vague misgivings," White and Norwood are men who clearly have put their powers of reason to good use in this world, and we the audience, it is implied,

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[351] In Safety Belt for Susie, the Jim Norwood character admits, in a voiceover, that he might have been "driving a little too fast."

would do well to emulate them, especially when it comes to car-driving attitudes and behaviors.

Besides inviting us to identify with the male protagonists' "common sense," their "intuitive" rationality, the films address their audiences more frontally and rhetorically in the non-narrative sequences. Significantly, these sequences draw on codes and conventions from two documentary subgenres: the propaganda film and the science-education film. Like the propaganda film, they endeavor to secure ideological allegiance and to ensure practical compliance by mobilizing an army of communicative tactics and techniques, from subtle intimation to blatant exhortation to psychological intimidation. Like the science-education film, they endeavor to illuminate and illustrate complex scientific principles (in this case, the physics of car crashes) using terms and concepts that are thought to be comprehensible to the lay public. Audiences are repeatedly exhorted to buckle up and repeatedly instructed why it matters. Sometimes these exhortations and instructions are portrayed as issuing directly from government agencies or other organs of expertise and authority, as in Safety Through Seat Belts, which concludes with statements of endorsement from the American Medical Association, the National Safety Council, the California Highway Patrol, the U.S. Air Force, and the U.S. Public Health Service. Sometimes they involve the narrated recitation or animated illustration of crash-injury statistics ("the brutal facts about auto mortality"). But mostly they involve the photographic representation, special-effects dissection, and scientistic interpretation of staged collisions.

Crash-Test Footage

As I suggested at the end of the last chapter, still and motion-picture photography have been bound up with scientific epistemology and experiment since their respective inventions. Marita Sturken and Lisa Cartwright observe that

> In modernity, the idea of seeing farther, better, and beyond the human eye had tremendous currency; photography as the quintessential modern medium aided in this quest. The camera was imaged by some as an all-seeing instrument. . . . This embrace of the image or imaging instrument as that which helps us to see further than the human eye continues to be a theme in scientific discourse. . . . Scientific images are thus understood as providing the capacity to see "truths" that are not available to the human eye.[352]

In collision-experiment films (and this includes the Ford Motor Company films), crash-test footage is adduced as scientific evidence in order to convince spectators of the mortal dangers of driving without a seatbelt and, consequently, of the vital need to use one. To these ends, an array of cinematic techniques is employed to arrest (the freeze frame), retard (slow motion), and scrutinize (the close-up) the otherwise unseen or unseeable physical phenomena involved in a car crash, especially the exact orientations, trajectories, and points of impact of automotive and anthropometric bodies in motion. In order to see "farther, better, and beyond," multiple collisions are shown multiple times, from multiple perspectives, at multiple speeds. These temporal elongations, graphic magnifications, sequential reiterations, and perspectival variations serve to assign and authenticate a select range of scientific meanings, to discipline the signification of the experimental findings and to stamp to the footage with the imprimatur of "truth." The photographic and editing manipulations, moreover, work in conjunction with the voice-of-God narration, that auditory sign of masculine mastery and imperial omniscience, to simultaneously normalize and

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[352] Marita Sturken and Lisa Cartwright, Practices of Looking: An Introduction to Visual Culture (Oxford: Oxford UP, 2001) 280-281.

transcendentalize scientific means and methods. Indeed, the language of measurement and numerical precision, along with pointed references to “data,” “facts,” “analysis,” “engineers,” “university research,” “scientific experiments,” and “electronic recording apparatus,” is frequently invoked in collision-experiment films to underscore the supreme scientificity of the tests and of the technologies used to register and reproduce them.

While the crash-test sequences are assembled to operate as a species of rational-scientific argument, their persuasive power, the full force of their address and rhetorical efficacy, is only partly explained thereby. Complementing and combining with the sequences’ rational-scientific appeals are a number of visceral-affective ones. Sound and aurality have long been articulated to emotion and affectivity (and, correlatively, to passivity and femininity) in Western thought and expression (including cinematic expression), and so it is no surprise that the footage’s audio track is configured to stir the spectator’s passions — from the histrionics of the narrator’s diction and delivery, to the cacophony of squealing tires and shattering glass (added in post-production rather than recorded synchronously), to the ornateness of the score’s cadences and crescendos.[353] It is not only the audio track that plays to the passions, however; many of the visuals do so as well. In the Institute of Transportation and Traffic Engineering films, for example, the shots of the post-collision wreckage are milked for sentiment. We see close-ups of dummies pinned under overturned vehicles, hanging precariously out of broken windows and flung-open doors, splayed in anatomically impossible positions, piled haphazardly on top of each other, scraped up and smashed to pieces. Shots such as these attempt to scare the spectator into submission: “If you do not

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[353] This statement refers only to the ITTE films; the Ford films’ crash-test sequences are aurally accompanied only by voiceover narration.

wear your seatbelt," they seem to say, "then you are this dummy — and, as you can see, this dummy is dead."

Of course, the dynamic collision shots — those showing vehicles and dummies immediately before, during, and immediately after impact — no less than the static postmortem shots, are composed, edited, and processed to carry affective charges and to elicit visceral responses. As spectacles of corporal violence and technological destruction, they, too, have the capacity to shock the spectator, to produce fear and dread as embodied effects. That such spectacles are "real" serves only to heighten the feelings of shock, fear, and dread, presumably.

These images are registered and resonate on another plane of affectivity as well. For it is not enough to say that these scenes of destructive violence are constructed so as to be shocking, fearsome, and dreadful; it must also be said that they are constructed so as to be shockingly, fearsomely, and dreadfully beautiful. To be sure, their visceral repulsions are matched by their aesthetic attractions, their instinctual aversions by their perceptual fascinations. This aestheticization of automobile collision is accomplished, in large part, through the use of slow-motion cinematography. Margaret Morse argues that in televised sports (particularly American football) "the slowness which we associate with dignity and grace transforms a world of speed and violent impact into one of dance-like beauty. . . . Slow motion sets apart sport on television in an oneiric world which can make few claims to 'look like' quotidian reality."[354] Similarly, in collision-experiment films, slow motion gracefully

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[354] Margaret Morse, "Sport on Television: Replay and Display," Regarding Television: Critical Approaches — An Anthology, ed. E. Ann Kaplan (Frederick, MD: University Publications of America, 1983) 49.

transforms the “world of speed and violent impact” that is the car crash into a beautiful ballet of implosion and explosion, into a dream of destruction as well as an object of desire.

Earlier I suggested that the very same images are adduced as scientific evidence in collision-experiment films. I suggested that the cinematic techniques of freeze frame, slow motion, and close-up are strategically deployed in crash-test sequences to naturalize scientific epistemologies, stabilize scientific meanings, and legitimize scientific truth-claims. Do I now mean to suggest that these images and techniques are designed to persuade as much through pathos as through logos? as much through emotional identification as through clinical detachment? as much through the aesthetics of machinic destruction as through the hermeneutics of scientific discovery? Precisely. In fact, the two appeals, logos and pathos, cannot be disentangled in these sequences, even if they can be distinguished for analytical purposes. They operate together, in dialectical tension and through dynamic interplay. They constitute a structuring ambivalence, one exploited for maximal ideological effect. To be sure, the buy-our-safety-package and wear-your-seatbelt messages are crafted to “make sense” to mind <u>and</u> body; safety is sold through the seductions of science <u>and</u> spectacle. The upshot is that, in collision-experiment films, scientific ways of seeing (looking for knowledge) and popular ways of seeing (looking for pleasure) are not mutually exclusive but mutually intensifying.

Agency and Accident

There is another governing dialectic, or structuring ambivalence, at work in collision-experiment films, one that centers on the nature and limits of human agency. The films’ discourse alternately affirms and denies the efficacy of human intention and action. On the one hand, it insists that the driving-subject possesses the power to protect his body (and those of his family) from the ravages of automobile accidents, whether through the instrument of enlightened consumption or through that of safe subjectivity. This power exists and must be exercised in the absence of the accident, prior to encountering the set of circumstances that precipitates it. On the other hand, the films' discourse emphasizes the absolute helplessness of the driving-subject, his utter inability to direct and control, much less protect, his body in the presence of the accident, during the unfathomable immediacy and radical contingency of its emergence. The ability to exercise the power he possessed prior to the accident vanishes precisely with the accident's onset and, moreover, does not return until the accident's violent propulsions and pressures have subsided . . . if it returns at all.

The injunction to purchase a safety package, expressed in the Ford Motor Company films, or to strap on a seatbelt, expressed in the Institute of Transportation and Traffic Engineering films, presupposes the rationality, the suggestibility, and the agency of the driving-subject. Ford's injunction presupposes that the automobile consumer, if apprised of his purchasing options and educated as to the dangers of accidents, can and will take appropriate action: he will buy a safety package. The ITTE's injunction presupposes that the automobile user, if apprised of his practical options and educated as to the dangers of accidents, can and will take appropriate action: he will wear a seatbelt. In either case, the driving-subject is understood to be empowered to act, to be capable of making a critical difference, but only — and this is crucial — well in advance of the accident's irruption. He can safeguard his person, even save his life, but only, paradoxically, in those prior, comparatively calm moments when his person does not seem to need safeguarding or, his life, saving. The films' discourse aims to persuade the driving-subject to use his reason to prepare his body for something that is, by definition, unreasonable: an indeterminate, undifferentiated, indefinitely deferred “accident.” For once the accident is upon him, once the abstract has been rendered concrete, the absent made present — crushingly, inescapably present — it is always already too late; neither his reason nor his agency will be of any use to him in such circumstances: his fate is sealed. Recall the words of the narrator in <u>Safety Through Seat Belts</u>: “The forces measured on the various parts of the body at impact were obviously far outside the limits of man’s ability to control his own actions.” Almost as frequently and strenuously as collision-experiment films stress the need for preparedness as an immunization, if not against the accident per se, then against its most frightful consequences, they stress the tragedy of unpreparedness, figured as a state of irrationality or irresponsibility tantamount to suicide. One term of this dialectic affirms the subject’s potency in a universe in which foresight and free will triumph over chance and “bad luck,” judicious Man over capricious Nature; the other denies “man” any potency at all, mental or physical, subject as he is, at any moment, to the accident’s — Nature’s — instantaneously incapacitating energies.

Embedded in collision-experiment films’ construction of human agency as now present-potent, now absent-impotent, lies a particular conception of the accident and of human-technology relations more generally. As I intimated in the preceding paragraph, according to these films, no form of preparation, be it purchased or practiced, can immunize against the seemingly spontaneous occurrence of the accident. Alex L. Haynes, in his Safety Forum speech, defines the Ford Engineering Research Department’s mission as “that of providing methods of protecting occupants, car occupants, involved in accidents that are not avoidable."[355] Lieutenant White "plans to protect the lives of his family on the road. He does not expect to get into a serious accident, for he is a careful driver. But he is also a man influenced by facts, and the brutal facts about auto mortality are now painfully clear."[356] In other words, accidents happen. Many are not avoidable, even if one is a careful driver. Accidents thwart the best-laid plans, defy expectations. Therefore, prudence dictates that, when it comes to our everyday interactions with technology, we should expect the unexpected by taking proper precautions. While the accident, in this view, constitutes a technologically transmitted disease whose sudden onset cannot be predicted or prevented, the most harmful of its side effects can be diminished through adherence to a daily regimen of prophylactic products and procedures.

Conclusion

In 1955, the same year that rocket-sled researcher John Paul Stapp appeared on the cover of Time magazine, Crash Research and Crash and Live! introduced American consumers to Ford Motor Company's latest innovation in automobile engineering and design: the Lifeguard Design safety package.[357] The motoring public of the mid-'50s was accustomed to the automobile industry's decades-old policy of "annual model change" (or, as its detractors dubbed it, "planned obsolescence"), but Ford's safety package represented a fundamentally different kind of design change: not one oriented around the production of

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[355] Crash and Live!.

[356] Safety Through Seat Belts.

[357] Not incidentally, the Ford films also introduced, and took pains to explain, the technoscientific apparatus of automobile crash testing — its objectives, methods, logistics, workers, instruments, and facilities. The ITTE films, especially Safety Through Seat Belts, go into even greater depth and detail about the mechanics of auto-collision experiments.

speed (horsepower) or the pleasures of styling (cosmetics), as was the norm, but one oriented around the problem of safety (“life”). For the first time, one of Detroit’s “Big Three” publicly acknowledged, or at least alluded to, the complicity of the car’s construction in the generation of crash injuries and fatalities. More than this, Ford openly promoted automobile safety as a core value, as something both intrinsically desirable and commercially achievable, while boldly challenging competitors to follow its lead in the area of safety research and crash protection.

Two years later, UCLA’s Institute of Transportation and Traffic Engineering released Impact, the first in a series of driver’s-education films focusing on “the preparation, conduct and results” of its “experimental collision research.”[358] Subsequent ITTE productions such as Safety Through Seat Belts (1959) and Safety Belt for Susie (1962) reiterated Impact’s wear-your-seatbelt message and reaffirmed its public-pedagogical mission. These films told the motorist in no uncertain terms, and showed him in a hundred ways, that he was not as inviolable or invulnerable as he thought he was, that riding unrestrained turned him, for all intents and purposes, into a mindless, powerless manikin. They told him the story of his mindlessness through moralizing vignettes about conventional nuclear families, and showed him a picture of his powerlessness through strategic appropriations and incorporations of crash-test footage. In the ITTE films, as in the Ford films, crash-test footage is doubly articulated: to the “hard” sciences, on the one hand, and to public and popular cultures, on the other. It is mobilized in each of these realms, moreover, as an instrument of persuasion and a technology of power. Collision-experiment films call on crash-test footage’s scientific

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[358] Derwyn M. Severy, John H. Mathewson, and Arnold W. Siegel, Statement on Crashworthiness of Automobile Seat Belts (Los Angeles: The Institute of Transportation and Traffic Engineering, University of California, 1957) 28.

legitimacy and its popular legibility, and do so in such a way that the perennial problem of "the accident" is both explained and contained, scientized and neutralized.

CONCLUSION

ACCIDENTS, ATOM BOMBS, AND VIRTUAL CRASHES

The will to mastery becomes all the more urgent the more technology threatens to slip from human control.

— Martin Heidegger[359]

The Accident's Disruptive Power

In Metaphysics, Aristotle states: "[We] must first say regarding the accidental, that there can be no scientific treatment of it."[360] Here, Aristotle dismisses accidents as intrinsically insusceptible to philosophical inquiry. As Michael Witmore observes, "Aristotle's impulse is always to think about accidents as a problem, singling them out as an exception to the rules that govern change in the world. Underlying this impulse to isolate accidents is a desire to limit their disruptive power."[361] For Aristotle, accidents are epistemologically problematic because they do not obey metaphysical laws of causality, and because they do not obey these laws, they cannot be studied "scientifically." Philosophy is concerned to describe, understand, and explain regularities, but accidents have causes and

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[359] Martin Heidegger, "The Question Concerning Technology," Basic Writings, ed. David Farrell Krell (New York: Harper & Row, 1977) 289.

[360] Quoted in Michael Witmore, Culture of Accidents: Unexpected Knowledges in Early Modern England (Stanford: Stanford UP, 2001) 28.

[361] Witmore 28.

purposes that are highly irregular. This makes them unsystematizable. Knowledge has nothing to say about them and can do nothing with them.

In an age of scientific rationalism, the accident cannot be dismissed as an irregular cause (Aristotle) or explained in terms of divine intervention (John Calvin), much less in terms of magic ("uncivilized" peoples). To make matters worse, in an age of heavy industry and high technology, the accident assumes a new brutality. This brutality, like "neurological modernity" more generally, is frequently bound up with the acute experience of speed and shock.[362] As Ben Singer notes, Georg Simmel, Siegfried Kracauer, and Walter Benjamin all argued that modernity is characterized by the incessant production and inescapable reception of a bewildering barrage of physical and perceptual stimuli.[363] The accident in neurological modernity is speedy and shocking in a way heretofore unimagined and unfelt.

Over the last century and a half, no accident has been more speedy and shocking, and at the same time more ordinary and omnipresent, than the transportation accident. New kinds of accident breed new fears, anxieties, and uncertainties. The fear of the transportation accident lies in the body's always potentially traumatic relationship to the immediacies and instantaneities of mechanized mobility. It's not just that the crash is so unexpectedly violent, but that it's so unexpectedly violent so <u>suddenly</u>. This is what racks the nerves and shocks the system. Transportation-accident anxieties are about the embodied consequences of the crash's collapsed proximities and compressed temporalities. They are about the threat of the accident coming so crushingly fast that there's no time to react, corporally or cognitively.

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[362] The application of the term "neurological" to modernity comes from Ben Singer, "Modernity, Hyperstimulus, and the Rise of Popular Sensationalism," <u>Cinema and the Invention of Modern Life</u>, ed. Leo Charney and Vanessa R. Schwartz (Berkeley: U of California P, 1995) 72.

[363] Singer 72-73.

They are about the experience of a socially and historically contingent assemblage of physical and psychological vulnerabilities, incapacities, and insecurities.

In this study, I have examined a specific set of cultural and institutional attempts to allay transportation-accident anxieties and to limit the accident's "disruptive power": the development and diffusion of accident technologies and techniques in the 1940s and 1950s, as well as a precursory development in the late 1830s. The emergence of accident technologies after World War II was conditioned by a wide range of forces — material, social, political, and economic. I have endeavored to trace some of its conceptual, cultural, and discursive lines of determination. It has been my contention that this emergence at once reflected and facilitated a rupture in the discursive construction of the transportation accident, resulting in the rise of a new regime of accident. By the mid-twentieth century, accidents were no longer something that could be eradicated through the eradication of human error, as they had been in Charles Babbage's day. But neither were they something to be simply accepted. Instead, they were something to be expertly monitored, recorded, and analyzed. They were something to be known. In line with this new cultural desire and project, accidents were subjected to rigorous investigation and controlled experiment. New means and methods were designed and implemented to technologically write, scientifically read, and institutionally manage them. Thus, contra Aristotle, were accidents made susceptible to "scientific treatment." Thus, too, were they made productive for "progress."

Origins of the Study, Contributions to the Field

The origins of this study can be traced to Ken Hillis's "Technologies of Representation of Technologies" seminar, held in the spring of 2001. One of the seminar's assigned texts was Paul Virilio's Open Sky, and I immediately became intrigued by Virilio's peculiar take on technological accidents.[364] Soon I began to seek out and read other Virilio essays, interviews, and books in which "the accident" was treated as a crucial critical-theoretical object. I came across this quotation in Politics of the Very Worst:

> The accident is an inverted miracle, a secular miracle, a revelation. When you invent the ship, you also invent the shipwreck; when you invent the plane, you invent the plane crash; and when you invent electricity, you invent electrocution. Every technology carries its own negativity, which is invented at the same time as technical progress.[365]

A few pages on, Virilio adds: "The accident is thus the hidden face of technical and scientific progress."[366] In these passages, as in his epigraph to this dissertation, Virilio links technological accident to technological progress — a linkage I found fascinating and worthy of further exploration.

Unfortunately, Virilio doesn't offer much in the way of actual support or substantiation for such a provocative thesis. For better and for worse, Virilio's writing practice is highly (and sometimes wildly) speculative; its beauty and power lay in its conceptual and theoretical suggestiveness, not in its empirical or historical rigor. I began to wonder what it would mean to take Virilio seriously on this point. Was there any valid empirical or historical evidence that could be used to support Virilio's thesis? For that matter, was there any evidence that seemed to undermine or contradict it? Most pressingly, how might one go about studying, from a critical cultural and historical perspective, the relationship between technological accidents and ideologies of technological progress?

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[364] Paul Virilio, Open Sky, trans. Julie Rose (London: Verso, 1997).

[365] Paul Virilio, Politics of the Very Worst, trans. Michael Cavaliere, ed. Sylvère Lotringer (New York: Semiotext(e), 1999) 89.

[366] Virlio, Politics of the Very Worst 92.

The first inklings of an answer to this question emerged while watching and listening to my colleague Mark Robinson's "Technologies of Representation of Technologies" seminar presentation on cockpit-voice recordings. As I sit and write these words four years later, most of the presentation's details escape me, but I distinctly remember that it included audio playback of a couple of chilling cockpit-voice recordings taken from ill-fated aircraft. Stimulated by my colleague's presentation and accompanying paper (unpublished), I began thinking about the cockpit-voice recorder: about its history and conditions of possibility, about the epistemological assumptions that underwrite its utility and reliability, about the implications of its instrumentalization for scientific and institutional objectives, and, finally, about its status as a cultural artifact and popular icon ("the black box"). I decided to undertake a historical and discursive analysis of the black box as a way to begin to get at some of the ideas and issues embedded in Virilio's conceptualization of the technological accident. Later, when I expanded the parameters of my investigation to include other technologies of recording and representation employed to scientifically study the inner workings of crashes and catastrophes — Babbage's auto-inscription apparatus and high-speed motion-picture photography chief among them — the foundation for Technologies of Accident was laid.

Technologies of Accident consists of four major claims and interconnected lines of argument, which I want to identify and disarticulate here for the purposes of clarity and summary. The first and most fundamental claim is that the accident was made into an object of scientific and institutional analysis, knowledge, and control in the 1940s and '50s. The second claim has to do with the distinction between the ways in which the accident was imagined, represented, and "worked on" in the nineteenth century, on the one hand, and the ways in which it came to be imagined, represented, and "worked on" in the twentieth, on the other. Mid-nineteenth-century practical reason held that the accident could be eliminated through better science and engineering; mid-twentieth-century practical reason, by contrast, held that the accident was here to stay, and so the problem for scientists and engineers became not the eradication of accidents but, rather, the mitigation or minimization of what were thought to be their most harmful effects.

This study's third claim is that the particular discourse of technological progress that prevailed in the nineteenth century underwent a radical reconfiguration in the twentieth. Far from being thrown into the dustbin of history after the disasters of Titanic and World War I, as many commentators have suggested, techno-progressivist rhetorics and ideologies adapted themselves to a world in which technological crashes and catastrophes were increasingly being treated by scientists and engineers as an opportunity for education, improvement, and advancement. Hence, the new technocratic impulse and imperative: "learn from failure." If in the 1800s "progress" was conceived in linear terms, in the 1900s, particularly after World War II, it was conceived in cybernetic terms. A linear conception of progress brooks no backward movement, no reverse thrust. Progress is figured as a straight and steady march onward and upward. Accidents are anathema in such a view because they represent a critical disturbance in rectilinear momentum, an unanticipated and unwelcome regression. What I am calling a cybernetic conception of progress, on the other hand, holds that sociotechnical feedback loops are integral to forward movement. In this formulation, accidents are seen as absolutely essential repositories of technical information, and this information is to be incorporated into and instrumentalized by the sociotechnical system for its own betterment. Accidents, then, are a necessary and salutary form of negative feedback.

The fourth and final claim, the linchpin that holds the first three claims together, is that accident technologies played a key role in each of the practical, discursive, and institutional ruptures and realignments described above. They embodied the serious and substantial attempt to technoscientifically analyze and control the accident, to institutionally discover it and discipline it, after World War II. They made possible the monitoring, measuring, mapping, and managing of transportation accidents, and they were vitally important to the wider sociotechnical project of “learning from failure.” What’s more, as forms of forensic media, accident technologies were operative and effective beyond the walls of the research laboratory or government agency. Their texts, along with their status as cultural artifacts and popular icons (the black box, the crash-test dummy), often became instruments of public pedagogy or instances of popular iconography.

This dissertation seeks to contribute to the scholarly literature in three fields: cultural studies, communication studies, and media studies. Technologies of Accident is a cultural study of technology. It employs a genealogical methodology to show how the postwar development and deployment of accident technologies articulated and were articulated by their social, material, and symbolic conditions and contexts. It also directly engages — and attempts to rethink — a recurring theme in cultural studies of technology: the discourse of progress. Critical theorists and cultural studies scholars have tended to assume that the myth of technological progress has remained essentially the same over the centuries. I believe that this is an uncritical oversimplification. My view is that we need to be more attentive to the ways in which that myth has been reconstituted and redeployed in relation to changing cultural, discursive, and institutional circumstances. The discourse of progress did not “die” in the twentieth century; instead, it was radically rearticulated.

From Harold Innis to James Carey to Jeremy Packer, communication studies has long been interested in the connections and correspondences between transportation technologies, discourses, and practices, on the one hand, and communication technologies, discourses, and practices, on the other.[367] This study offers a way to begin to think about the transportation-communication nexus through the prism of accident and accidentality, that is, through the prism of "what goes wrong." In this way, Technologies of Accident can be said to resonate with communication studies scholarship that addresses the topic of "communication breakdown" or "the failure to communicate," as does the scholarship of John Durham Peters in Speaking into the Air: A History of the Idea of Communication.[368] I strongly suspect that there is much to be gained from studying the relationship between transportation and communication in terms "technical difficulties."

Finally, I hope that my notion of "forensic media" encourages media studies scholars to think more broadly and inclusively about media forms, functions, practices, and techniques. Media studies is currently experiencing an exciting moment of transition and transformation, thanks in large part to its enthusiastic embrace of "new" — that is, emergent and convergent — media objects, processes, institutions, and economies. No doubt the field has been reinvigorated, reconfigured, and appreciably expanded as a result. Still, I think the media studies envelope could be, and should be, pushed further. It could and should, for example, include the study of what I have been calling forensic media. In my

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[367] See James W. Carey, Communication as Culture: Essays on Media and Society (New York: Routledge, 1988); Harold A. Innis, The Bias of Communication (Toronto: U of Toronto P, 1991); Jeremy Packer, Mobility Without Mayhem: Mass Mediating Safety and Automobility (Durham: Duke UP, forthcoming); and Jeremy Packer and Craig Robertson, eds., Thinking with James Carey: Essays on Communications, Transportation, History (New York: Peter Lang, 2005).

[368] John Durham Peters, Speaking into the Air: A History of the Idea of Communication (Chicago: U of Chicago P, 1999).

conceptualization, forensic media are information and communication forms and practices that are doubly articulated: to the “hard” sciences and their associated expert knowledges and institutional practices, on the one hand, and to the realm of public culture and popular truth and knowledge, on the other. Because forensic media are both media technologies and scientific instruments, critical analyses of forensic media would ideally bring together vocabularies, theories, and methodologies from media studies with those from science and technology studies.

In this remainder of this Conclusion, I want to outline some potential directions for further research on accident technologies and techniques. First, I will explore an additional framework for understanding and contextualizing the postwar emergence of accident technologies: an atomic structure of feeling. Next, I will bring the discussion of accident technologies into the present by identifying and briefly considering what I believe are three key contemporary articulations of the accident-technology impulse: the car black box, the cockpit-video recorder, and computer-animated reconstructions. I will end with a word about the scholarly literature on “risk,” its conspicuous absence from this study, and its potential utility for further research on accident technologies.

Crash Tests and Blast Tests

As I was researching and writing this dissertation, I became increasingly intrigued by the possibility that the postwar transportation-accident anxieties I was examining were closely connected to postwar atomic-bomb anxieties. The more I investigated this possibility, the more I became convinced that the two kinds of anxieties were articulated together in meaningful ways — that they were, in fact, part of a common structure of feeling. The respective attempts to institutionally manage those anxieties appeared to be cut from the same cloth as well. Scientifically controlled experiments were conducted and forensic media (high-speed motion-picture photography in particular) were mobilized to study atomic blasts no less than automobile crashes. And just as automobile crash-test footage was appropriated for and interpolated into driver's-education films produced in cooperation with the U.S. Public Health Service, so atomic-bomb footage was appropriated for and interpolated into government propaganda films produced by the U.S. Federal Civil Defense Administration.

Here, I want to begin to suggest how automobile crash tests (discussed in Chapters Three and Four) and atomic blast tests might be understood as interrelated articulations of postwar anxieties regarding the vulnerability and sustainability of American bodies, institutions, and ideologies. I offer this discussion as a potentially useful way to further contextualize the emergence of accident technologies and forensic media in the postwar period.

On March 17, 1953, with the predawn detonation of a device named Annie, the United States Atomic Energy Commission (AEC), together with the Department of Defense and the Federal Civil Defense Administration (FCDA), commenced Operation Upshot-Knothole, a series of atomic-bomb tests conducted at the Nevada Proving Grounds (now the Nevada Test Site), sixty-five miles northwest of Las Vegas. Upshot-Knothole was undertaken, in part, to obtain information that could be used to improve the design of fission and thermonuclear weapons. Unlike previous operations, however, Upshot-Knothole, and the Annie shot in particular, was as much about understanding — and dramatizing — the effects of a nuclear attack on civilian artifacts and infrastructure as it was about collecting scientific data for the purpose of building a better bomb.

I use the term “dramatizing” because, as a so-called open shot, Annie was staged as a public spectacle. The AEC and the FCDA invited more than 250 journalists, 360 mayors and governors, and numerous civil-defense officials to tour the site beforehand, witness the explosion from a designated location (informally dubbed “News Nob”), and, if possible, survey the damage afterward. Significantly, these were not the only non-military personnel to experience the event; an estimated eight million Americans woke up early to watch the sixteen-kiloton blast on live television, and millions more listened to it on the radio. In the days and weeks that followed, moreover, scores of articles on and photographs of Operation Doorstep, the FCDA name for the civil-defense component of the Annie shot, appeared in the nation’s daily newspapers and weekly news magazines. After Doorstep, Americans no longer had to imagine what a nuclear attack on the home front might look like, or what could be done to prepare for it. That’s because the barrage of print, broadcast, newsreel, and government-produced images and information that accompanied the operation served as an apparatus for the production of public education and institutional disciple, educating citizens as to the civil effects of an atomic strike and disciplining them in how protect themselves, their families, and their properties against those effects should the bomb land, like the morning newspaper, on their “doorstep.”

Both Operation Doorstep and 1955’s Operation Cue, which, like its predecessor, was orchestrated as a national media event, a revelation in the desert, examined the effects of nuclear heat, blast, and radiation on the stuff of suburbia.[369] For Doorstep, two identical two-story, center-hall, wood-frame houses with basement shelters (“typical American homes,” according to the FCDA booklet) were erected — one sited at 3,500 feet from ground zero

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[369] Operation Cue was the FCDA name for the civil-defense component of the Apple-II shot, which was part of the AEC’s Operation Teapot series.

(House No. 1), the other at 7,500 feet (House No. 2).[370] Each structure was supplied with domestic wares, government-surplus furniture, and "families" of fashion mannequins dressed in garments donated by J. C. Penney. Outside, fifty automobiles of various make, model, and year, some containing mannequins, were positioned at various distances from and orientations to ground zero. According to Harold L. Goodwin, director of the FCDA's operations staff, "these tests were especially important because they would indicate whether the family car would provide any effective protection against the radiation, heat, and blast of a nuclear bomb."[371]

Two years later, Cue proceeded along similar lines, though its experiments were more elaborate, its test objects more varied and numerous. Five different models of single-family house were tested — two-story brick, one-story wood-frame rambler, one-story precast concrete, one-story masonry block, and two-story wood-frame, the last a structurally reinforced (and ten percent more costly) version of the Doorstep house — along with an assortment of motor vehicles, group and family shelters, and industrial, commercial, and institutional buildings. The houses were stocked with mannequins "to represent Mr. and Mrs. America," as well as with electrical appliances, home furnishings, and other household items, to create a picture of middle-class domesticity "complete in every detail."[372] Also tested was a veritable cornucopia of foods and foodstuffs: staples such as flour and sugar; semi-perishables such as butter, apples, onions, and potatoes; refrigerated meats; frozen foods;

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[370] Federal Civil Defense Administration, Operation Doorstep (Washington, D.C.: GPO, 1953) 3.

[371] Richard G. Hewlett and Jack M. Holl, Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission (Berkeley: U of California P, 1989) 147.

[372] Operation Cue (motion picture), Federal Civil Defense Administration, 1955.

heat-processed foods in cans and glass; and canned and bottled beverages such as soft drinks. These categories, according to the FCDA report, were "based on a survey of foods most frequently used in the American diet."[373] As with Doorstep, high-speed motion-picture cameras filmed the devastating effects of atomic detonation on the artifacts and amenities of suburban America. The most spectacular of these images appeared in news stories, as well as in government-produced reports, pamphlets, advertisements, and motion pictures.

How do Operation Doorstep and Operation Cue resonate with the Ford and the Institute of Transportation and Traffic Engineering (ITTE) collisions experiments discussed in Chapters Three and Four? In what ways did they collectively articulate an atomic structure of feeling in the 1950s?

The collision experiments of the 1950s scientized, and their media representations dramatized, the creeping suspicion that the rapid rise in automobile consumption and use, the centrality of automobility to the American ethos and economy, so frequently and so exuberantly proclaimed in the postwar years, came with a full complement of "undesirable byproducts" in the form of wounds, mutilations, and deaths, incessantly and indiscriminately inflicted on the social body. The civil-defense experiments of 1953 (Doorstep) and 1955 (Cue) vividly enacted, and their media representations vividly depicted, other "undesirable byproducts" of mid-twentieth-century science and technology: nuclear heat, blast, and radiation. Though conceived and conducted for expressly different purposes, both programs of experiment — automotive and atomic — subjected the stuff of mid-century, middle-class America to the rigors of scientific investigation and to the ravages of destructive testing.

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[373] Federal Civil Defense Administration, Cue for Survival (Washington, D.C.: GPO, 1955) 23. Would the food packages remain intact? Would the foodstuffs remain unspoiled and uncontaminated? The answers to such questions, it was thought, would help families survive in the aftermath of an atomic strike.

Both sought to understand the effects of overwhelming forces and pressures, of mechanical impact or nuclear exposure, on the infrastructure and apparatus of everyday life, and on the flesh and bone of human beings. And both served not only narrow technical and scientific purposes, but also broad pedagogical and propagandistic ones, as startling images of and sobering information about imploding vehicles and exploding domiciles circulated through the country, shaping public awareness and inculcating “appropriate” attitudes and behaviors.

I want to suggest that the Ford and ITTE crash tests and the FCDA blast tests embodied and enacted the postwar perception that the American enterprise was constantly vulnerable to violence and, worse, increasingly under threat of annihilation. At risk were not only the integrity and longevity of individual organic bodies, susceptible as they were to impalement by steering columns or incineration by atomic fireballs, but also the integrity and longevity of collective symbolic bodies — institutions and ideologies such as the family, the nation, and the so-called American way of life, with its valorization of private mobility and private property, and its foundational belief in techno-capitalist progress. Ford and the ITTE smashed the family car to pieces; the FCDA blew the family home to smithereens. In doing so, they implied that the normative American family’s twin sources of shelter (and symbols of self-sufficiency) were prime targets of attack, and, by extension, so was the normative American family. The American Dream, too, it appeared, was under assault, its promise of unfettered mobility — spatial and social — hanging in the balance. Just as crash testing effectively exposed the lethality of vehicles of spatial mobility (the privately owned car), so blast testing effectively exposed the fragility of trophies of social mobility (the privately owned house). Together, they called into question, if only implicitly, the sustainability, even the sanity, of the American idealization and particular incarnation of technological capitalism.

It would be wrong to conclude, however, that the auto-collision and atomic-bomb experiments of the 1950s served only to arouse anxieties, to stoke the fires of the public's apocalyptic imagination. On the one hand, the experiments and their multiple mediations sounded the alarm, insisting that the citizenry recognize the new "reality" of its acute vulnerability. On the other hand, they offered hope and reassurance, stressing that car crashes or nuclear blasts were, in fact, survivable. Citizens were instructed in no uncertain terms that the key to individual, familial, and national survival lay in taking the proper precautions, or what the FCDA called "preparedness." Ford defined preparedness as enlightened consumption, equating self-protection with the purchase of a cutting-edge consumer good: its "Lifeguard Design" safety package. Unlike Ford, the ITTE did not propose that preparedness could be realized through the magic of a marketplace transaction. Instead, it preached the virtues of rational prudence and prescribed a form of behavior modification: the wearing of a safety belt. The FCDA, for its part, advocated both good consumption and good discipline, imploring every father to buy his family a fallout shelter, while tutoring every citizen in the protocols of preparedness.

Together, the Ford, ITTE, and FCDA experiments figured a dialectic of vulnerability and survivability organized around two of the most socially powerful artifacts and culturally prominent icons of mid-twentieth-century science and technology: the automobile and the atomic bomb. Crash tests and blast tests provided graphic evidence that America and its way of life were vulnerable to attack from the products of techno-capitalist progress, both from within (auto accidents) and from without (atomic strikes). At the same time, the tests promised that the American nation and culture were sustainable, indeed redeemable, through those products, insofar as they taught American engineers how to build safer vehicles and domiciles, American consumers how to buy them, and American citizens how to use them.

Contemporary Articulations of Accident Technology

Up to this point, Technologies of Accident has had a decidedly historical orientation. It has concentrated mostly on the prehistory and emergence of accident technologies and forensic media. How might research on accident technologies proceed if we were to take into account relevant developments in the last twenty or so years? Further, how do such developments illustrate, extend, or complicate the analyses offered in the previous chapters? I cannot hope to do justice to these complex questions in this Conclusion. It will suffice, instead, to identify and briefly comment on what I take to be three of the most important rearticulations of accident-technology desire and design in recent years: (1) the car black box; (2) the cockpit-video recorder; (3) computer-animated reconstructions.

The car black box. Though most drivers are unaware of it, the event-data recorder, or car black box, has been standard equipment on most automobiles, domestic and import, for several years. The device, which is typically installed under the passenger seat, digitally records a wide range of performance data, from engine speed and vehicle speed, to brake use and seatbelt use, to airbag operation and gas-pedal position. Such data have been used variously by police departments, insurance agencies, trial lawyers, and medical researchers. What’s more, several companies have been marketing event-data recorders to parents, who use them to vicariously monitor their child’s driving habits. The device has raised a number of privacy concerns and questions: Who owns the data? Who is allowed access it, and under what circumstances? Who is allowed to make use of the data? Who is allowed to archive it?

In Chapter Two, I touched on the issue of technologized surveillance in relation to early flight-data and cockpit-voice recorders. I noted that the first flight-data recorders were valued by government officials and airline executives alike for their supposed ability to make airplane pilots "altitude conscious." I also pointed out that the man credited with inventing the cockpit-voice recorder, David Warren, in his technical memorandum of 1954, anticipated (and then dismissed) pilots' objections to being "bugged." Apart from these brief discussions, I have not dwelled on the panoptic dimensions of accident technologies in these pages. For better and worse, this was a conscious decision: I didn't want to deflect attention from the more properly forensic dimensions of accident technologies, which have been the focus of this study. A rigorous critical analysis of the car black box, however, would require a broader focus, one that encompasses the issue of surveillance.[374]

The cockpit-video recorder. Recently, the National Transportation Safety Board has been pushing the Federal Aviation Administration to require the installation of crash-resistant video cameras in airplane cockpits on the grounds that the cameras would increase aviation safety. Airline pilots and their unions, chief among them the Air Line Pilots Association, International, have vehemently objected on the grounds that the cameras would intrude on their privacy. Today, the matter remains unsettled, but some experts believe it is only a

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[374] James Hay and Jeremy Packer sketch the contours of such an analysis in their essay, "Crossing the Media(-n): Auto-mobility, the Transported Self and Technologies of Freedom," Mediaspace: Place, Scale and Culture in a Media Age, ed. Nick Couldry and Anna McCarthy (London: Routledge, 2004) 209-232. As they point out, unlike the Foucaultian conception of panopticism, based on Jeremy Bentham's model of an ideal prison, "it is the unerring tape-trail, not the immediate presence of surveillance, which internalizes, or simply demands, proper conduct" (223).

matter of time before federal accident investigators are analyzing cockpit video in addition to cockpit audio.

This controversy rearticulates the controversy that surrounded cockpit-voice recorders during the 1950s and early ’60s: on one side, the pilots’ privacy; on the other, the public’s safety. A critical analysis of the cockpit-video recorder would need to take into account the ways in which the technology operates in discursive constructions of the private and the public. It would need to interrogate the assumptions underlying both the notion that video images would increase safety and the notion that they would intrude on privacy. It would need to consider, as well, the implications — practical, cultural, institutional, and epistemological — of using images in addition to sounds to determine the “true cause” of the plane crash.

In thinking about the possible emergence of a cockpit-video recorder, I have been struck by the technology’s potentially popular implications. Images are not sounds. They have a distinct set of cultural currencies and valences, and as chilling as cockpit-voice recordings are to listen to (I have listened to far too many, courtesy of websites such as AirDisaster.com), the idea of seeing a flight crew in its frantic final moments seems more chilling still. I bring this up because accident-technology texts can and do circulate popularly, as I demonstrated in Chapter Four in reference to crash-test footage. Every once in a while, a television news program or cable-TV documentary will play snippets of a cockpit-voice recording. And one can occasionally find “bootlegged” cockpit-voice recordings on the Internet. How would cockpit-video recordings alter the popular-cultural economies of accident-technology texts? What implications would such images have for popular truths, meanings, perceptions, and experiences of transportation accidents?

Computer-Animated Reconstructions. In the Introduction to this study, I noted that as part of the 1998 Titanic Research and Recovery Expedition, sections of the sunken vessel were digitally mapped and mosaicked. Culturally and institutionally, there is today a profound desire to “reconstruct” transportation accidents as digital images and computer animations. On the one hand, these images and animations are being used by legal and scientific institutions to render the materially destructive violence of transportation accidents virtually apparent and accessible: that is, amenable to digital manipulation and reconfiguration. Here we can see the impulse to rearticulate forensic desire (and Heidegger’s “will to mastery” more generally) to the new utilities, potencies, and certainties allegedly afforded by the virtual. On the other hand, digital images and computer animations are being used by news and entertainment industries for the purposes of programming.

The first major U.S. court case to make use of computer animation for accident reconstruction was 1988’s Connors v. United States. The trial concerned Delta Air Lines Flight 191, which crashed on approach to Dallas-Fort Worth Airport, on August 2, 1985, killing 137 people. On one side stood the families of the victims, who brought the suit; on the other side, the Federal Aviation Administration (FAA) and the National Weather Service (NWS), which were accused of failing to warn the flight crew of an impending thunderstorm. During the trial, the Department of Justice, arguing on behalf of the FAA and the NWS, presented an elaborate ensemble of computer graphics and animations, which simulated the flight path, radar and instrument displays, and weather conditions, sometimes synchronized to the actual cockpit-voice and air-traffic-control audio recordings. The court ruled in favor of the government agencies, and today the landmark case is widely credited with legitimating the use, and demonstrating the persuasive power, of computer-animated reconstructions in litigation.

Since then, the use of professionally produced computer-animated reconstructions in legal proceedings has skyrocketed, as it has in the engineering subfield known as “failure analysis,” owing to the increasing affordability and functionality of computer hardware, and to the increasing specialization and sophistication of animation software. Indeed, the particular techniques and technologies that constitute “forensic animation,” as it professionally known, have “spawned a thriving industry worth about $30 million annually.”[375] In recent years, forensic animations have been employed by legal parties and by failure analysts to represent or reconstruct a wide range of events and circumstances, including those involving transportation accidents, structural failures, natural disasters, technological catastrophes, biological processes, the workings of mechanical devices, and criminal activities.

Yet computer-animated reconstructions increasingly circulate not only within insular economies of institutional power and knowledge (law courts, engineering laboratories), but also within the wider economies of public and popular culture, most noticeably and most frequently on commercial television. Indeed, in the last several years, there has been an explosion of television programs, dramatic and documentary, showcasing state-of-the-art forensic techniques and technologies, including forensic animation. Television viewers have been offered computer-animated reconstructions of numerous real-life crimes, disasters, and tragedies, including the John F. Kennedy assassination, the crash of TWA Flight 800, the

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[375] Jacob Ward, “Crime Seen,” Wired 10.05 (May 2002) <http://www.wired.com/wired/archive/10.05/forensics.html>.

murders of Nicole Brown Simpson and Ron Goldman, the sinking of the Titanic, Princess Diana's car crash, and the collapse of New York City's Twin Towers.

The National Geographic Channel recently premiered a series called Seconds from Disaster, in which computer-animated reconstructions are afforded center stage. Each hour-long episode is organized around a single transportation or technological accident: the crash of the Concorde in July 2000; the Oklahoma City bombing in April 1995; the derailment of a high-speed train in Germany in 1998; the meltdown at the Chernobyl nuclear power plant; the 9-11 attack on the Pentagon; and several others. "One moment, everything appears to be normal," reads the copy on the Seconds from Disaster website.

> Seconds later, an unimaginable disaster. How could this happen? See how disasters are caused by a sequence of events locked together in time. Blending advanced CGI, archival footage, re-enactments, forensic science, dramatic eyewitness accounts and expert testimony, join us as we deconstruct, moment-by-moment, the chain of events leading to some of the world's most infamous disasters.[376]

Here, the promise of forensic animation (and forensic science more generally) is communicated with breathless urgency. But what, exactly, is the nature of that promise? What cultural work is being performed by TV shows like Seconds from Disaster? And how, if at all, does this cultural work resonate with the deployment of computer-animated reconstructions within legal circles and technoscientific communities?

By way of conclusion, let me propose some provisional answers. First, and most obviously, computer-animated accident reconstructions, like all visualizations of technological disaster, promise to deliver spectacle, or, more specifically, spectacular violence, with all the sensory excitations and affective intensities that are assumed to attend

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[376] Nationalgeographic.com, <http://channel.nationalgeographic.com/channel/seconds/index.html>.

it. In this respect, the imperatives and effects of computer-animated reconstructions of real transportation accidents, configured for and disseminated by commercial television, are strikingly similar, if not identical, to those of that most hyperreal of visual idioms, the action-adventure movie. To be sure, the visual codes of spectacular violence, along with the techniques used to generate them and the pleasures derived from consuming them, move easily across generic boundaries, as well as across media forms, audiences, and economies.

Unlike action-adventure spectacles, however, computer-animated accident reconstructions purport to reproduce the real, the historical real, "what really happened." Seconds from Disaster's audience is invited to understand the program's iconography of destruction not as spectacle for spectacle's sake — not as mere entertainment, in other words — but rather as spectacle in the service of historical truth. The message is clear: thanks to amazing advances in forensic science and computer technology, the truth of the accident can now be ascertained with certainty. And thanks to media texts, technologies, and industries, that truth can be communicated to the masses. Computer-animated reconstructions compel the accident to speak its truth, and commercial television spreads the good news.

I want to suggest, finally, that the use of computer animation for accident reconstruction in the realms of law, science, and engineering, on the one hand, and in realms of mass media and popular culture, on the other, might be usefully understood as interrelated, if uncoordinated, rearticulations of the broader cultural project with which this study has been concerned. As I suggested in the Introduction, the project I have in mind is the ideological recuperation of the transportation/technological accident. This recuperation involves the instantiation and institutionalization of specific rhetorics and rituals, within communities of expertise and without, and computer-animated reconstructions play a key role in this normalizing operation. For scientists and engineers, forensic animation offers a means by which the transportation/technological accident can be anatomized and disciplined, mastered and neutralized. The accident is attacked as a major front in modern science's epic battle against irreducible complexity, unruly contingency, and, ultimately, human mortality. For citizens and consumers, the popularization of forensic animation offers a means by which to manage the ordinary terror of the transportation/technological accident, as crashes and catastrophes are remembered, demystified, and transubstantiated into edifying and reassuring spectacles.

Postscript: What About "Risk"?

Finally, a brief word about "risk." I am quite aware that the now voluminous scholarly literature on "risk" constitutes this study's elephant in the room. At numerous points during the researching and writing of this dissertation, I was tempted to draw on the writings of the risk sociologists (particularly Ulrich Beck and Anthony Giddens), or the risk anthropologists (particularly Mary Douglas, with and without Aaron Wildavsky), or the risk governmentalists, that is, those studying the matter from a Foucaultian perspective (particularly Robert Castel and Francois Ewald).[377] Brief references to the latter two authors notwithstanding, I deliberately resisted this temptation. I did so for a couple of key reasons. First, the risk literature tends to take accidents at face value. It almost always treats accidents in an uncritical and ahistorical manner by accepting and adopting received understandings of the accidental and accidentality. The social, cultural, historical, and discursive

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[377] See Ulrich Beck, Risk Society: Towards a New Modernity (London: Sage, 1992); Mary Douglas, Risk and Blame: Essays in Cultural Theory (London: Routledge, 1992); Mary Douglas and Aaron Wildavsky, Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers (Berkeley: U of California P, 1982); and Anthony Giddens, The Consequences of Modernity (Stanford: Stanford UP, 1990). See bibliography for Castel and Ewald references.

constructedness of the category “accident” receives little or no attention. The result is that accidents, in much of the scholarly literature on risk, are naturalized, and their social situatedness and historical embeddedness are obscured. Second, I wanted to avoid conflating or confusing the concept of risk with that of accident. Risk and accident are not the same thing, and with so much having been written about the former in recent years, I decided to put my efforts into beginning to theorize and historicize the latter. Instead of talking about risk and its relation to modernity, I wanted to talk about accident and its relation modernity.

As I move forward with this research project, it will be incumbent upon me to find ways to incorporate the risk scholarship into my particular take on twentieth-century accidents and accidentality.

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