PART ONE

Precursors

1

Colors of Error

Innovation and Failure from Plato to Digital Signal Processing

I. DENIAL

Think only success and ye shall find. This is the anachronistic dictate of the American dream and corporate capital from the industrial era to post-Fordism. "Even thinking about the possibility of failure is foreign to the manager's classic culture," Patrick Lagadec explains of Gerald C. Meyers's business philosophy, president of American Motors from 1977 to 1982. In Meyers's own words: "think success; plan for success; allow no negative thinking; associate with positive people; emphasize accomplishment; and cast off losers,"[1] a credo reiterated by many, including Harold Geneen, president of the ITT Corporation, who, according to Meyers, believed that "once you have set a business objective, you must achieve it. Those who do not do so . . . are not simply poor managers; they are not managers at all."[2] In this ethos, admitting error or failure, let alone a mistake, catapults one into nonbeing.

Forty years later, we no longer live in a society guaranteeing anything that resembles the American dream. Despite ongoing and systematic efforts to deny it, failure colors too many facets of life, from business to family and personal well-being, and the more it is denied, the stronger and more threatening it becomes. This chapter explores these insights through an eccentric mapping of error in the history of Western philosophy and modern American industry. I propose that error, failure, and accident are intimately related and have always been intrinsic to human life and communication. Further, in an era of information overload and frenzied pursuits of "innovation," these phenomena have become key constituents that can no longer be ignored or merely paid fashionable lip service. The chapter begins with a definition of digital signal processing (DSP), illustrating the centrality of noise in it. I do not return to digital processing until the end of the chapter,

but it is important to flag it here, because the relationship of signal to noise in DSP sets the tone for the archaeology of error in sections III–IV, from antiquity through the Enlightenment,[3] and foreshadows more recent economic and industrial developments analyzed in section V.

II. FAILURE AS ORIGIN MYTH

In Plato's origin myth, the *Protagoras,* the two brothers Epimetheus and Prometheus are given the task of distributing qualities to animals and men.[4] Epimetheus pleads to take control, assuring his brother he can review it upon completion. After allocating all the qualities—speed and skin to the "brute" animals, strength to the creatures without speed—he realizes he has forgotten humans, but he has no qualities left to dispense. To amend for his brother's mistake and repair humanity's state of "non-being," as Bernard Stiegler puts it, Prometheus sets out to steal the gift of skill (*tēn enteknon sophian*) and fire from Hephaestus and Athena (fire is the means [*amēkhanon*] to use skill). Stolen fire is therefore given to humanity as a prosthetic: a paltry pseudo-godlike power to compensate for what humans are without, but also, an eternal reminder of our fraught existence.

Together, *epimētheia* (foresight) and *promētheia* (afterthought) operate as twin existential concepts: a desire for improvement coupled with inevitable error and mistake. Like the origin myth of *Cura* noted in the Introduction, the *Protagoras* illustrates how human existence is eternally torn between a twofold struggle for perseverance, on the one hand, and the drive to amend for the guilt of being intrinsically error-prone on the other. Taken together, according to J. P. Vernant, we have a "competitive emulation at work," a drive for betterment, paradoxically born from the "lower" motives of jealousy or envy.[5] Human success and advancement are thus just as innate to our eternal wound. This is our primary condition of being in the world, predicated on a prior "défaut," corresponding to the French *défaut* denoting fault, fall, cut, or an originary guilt in being, which, Stiegler insists, is not to be confused with psychoanalytic "lack," or deconstruction's "super lack," but instead a kind of debt owed by virtue of having life at all.[6] Yet it is also possible to interpret this originary falling-short of Epimetheus as a stigma eternally sewn into the fiber of being human. Any attempt to cover over, steal back, or create a prosthetic for our fundamental hamartia is always already tainted by the knowledge that any compensatory gestures (technics and prosthetics) are only ever weak supplements. Under these conditions, we are always already in debt, in a "being towards death," as Heidegger puts it.[7] "Man does not merely stray into errancy," Heidegger writes elsewhere, "he is always astray" in it.[8] The myth's dynamic tension offers a refreshing alternative to our lopsided, goal-oriented, winner-take-all culture, epitomized by attitudes like Meyers's where "even thinking about the possibility of failure" makes one a loser.[9]

The origin myth also offers a metaphor for humanity's twofold struggle between failure and success in communications theory. Here, we find friendly ties with

John Durham Peters's eloquent analysis of the history of communication systems in humans and machines. At the beginning of his book *Speaking into the Air* (1999), Peters identifies an analogous dichotomy in metaphors of "the bridge and the chasm." The bridge model of communication denotes the "dream of communication as the mutual communion of souls," epitomized in conceptions of total mental contact and soulful immersion. Peters's examples include Jesus's teachings (and in particular, the Christian notion of agape); William James's empiricism; Hegel's idealism; nineteenth-century Mesmerism; the "Magic Bullet" theory of media, and, to which I would add, a special brand of techno-utopianism.[10] Like the myth of transparency discussed in the Introduction, techno-utopianism maintains that new media are clean, totally efficient, and exceedingly productive things, capable of delivering users (consumers, rather) to pure and sanctified spaces, free from the dirt and grime of the material world. Such one-sided belief systems are deeply rooted in American business models and the now global logic of commodity capital. As I argue here and throughout the book: ignoring the growing manifold of error simply fuels the problem. The richer the media content, the wider the bandwidth, and the higher the fidelity of images, the more glitch, error, and failure there is. Henry Kissinger once noted that in "high office competing pressures tempt one to believe that an issue deferred is a problem avoided; more often it is a crisis invited."[11] The same insight applies to communications technology.

In Peters's chasm, a "nightmare of mutual isolation" ensures that communication is "always breaking down."[12] Noise, error, accident, and disjuncture are the necessary and inevitable results of any communicative exchange, whether internal or external, human or machine, or otherwise. Adherents to this view include postwar information theorists and post-Kantians from Nietzsche through Heidegger, Levinas, Derrida, Serres, and non-philosophers in economics and politics. What would it mean to flip convention and adopt this view, wherein all forms of communication (with ourselves, with another, and with machines) would be formed *through* noise, error, and accident as the condition of possibility for innovation and growth? Would this grant a new kind of unforeseen freedom?

The two sides of Peters's dichotomy are inextricably linked, but the vast majority of survey histories of technology and triumphant narratives of Western progress seem to focus only on the former's connective bridge. In the spirit of media archaeology, this chapter focuses on the chasm. The first and perhaps most familiar example of this is found in the next section's discussion of noise in digital signal processing.

III. DIGITAL SIGNAL PROCESSING

As noted in the Introduction, noise, error, and failure can, in certain circumstances, qualify as accident, characterized as an unintended, nonmeaningful, chaotic, singular, unrepeatable, or unforeseeable occurrence. This chapter identifies a history of approaches to error and noise as just this kind of undesirable

event, arising in tandem with long-standing efforts to manage and control them. The unavoidable presence of noise in digital processing is a prime example. The core function of almost all modern computation systems involves digital signal processing (DSP). DSP is the primary way data travels to and from cell phones, HDTV screens, computer monitors, calculators, scanners, electronic toys, web pages, PDAs, and IMAX screens. Defined as the mathematical manipulation of discrete, informatic signals for the purposes of effective and efficient data transfer, at the core of DSP are signals, but also noise. DSP creates algorithmic numeric bridges for valuable data to travel across channels and between satellites, and noise intervenes as a necessary disruptive chasm. Signal and noise always coexist, like Peters's bridge and chasm.

The origins of information theory elucidate this inextricable relationship. It is by now well established that information theory emerged through Claude E. Shannon's innovative research, working with Warren Weaver, at Bell Telephone Laboratories in the 1940s. The pair drew on Norbert Wiener's studies in feedback and cybernetics to develop a radically new model of communication for telephone systems based on "on or off" pulses or "yes or no" decisions. Shannon referred to these as "bits," a term appropriated from the American mathematician John W. Tukey.[13] The system became known as "binary code," the most appropriate denotation given the way it could break down any kind of quantifiable data into the smallest possible number of discrete units, allowing for greater control and calculations. Shannon had introduced a radically innovative language for the computer age. Unlike other languages, his was an abstract, numerical language capable of communicating anything in the qualitative, phenomenal human world insofar as it could be turned into a series of numerical symbols.

Another major facet of Shannon's innovative system was its ability to optimize "signal to noise ratios," the level of a desired signal relative to the undesired background noise. Optimizing this relationship meant producing greater accuracy and consistency in the transmission and reception of information, regardless of contextual components.[14] Because Shannon's model used a standardized set of abstract numerical symbols (0s and 1s) to compress diverse kinds of data across several platforms, an increasing range of cultural techniques could be subject to the same form of binary-based, statistical reduction (compression) and strategic repetition.[15] For example, to illustrate a natural redundancy in the English language, for his definition of "information theory," Shannon wrote:

> MST PPL HV LTTL DFFCLTY N RDNG THS SNTNC

The obvious removal of vowels and certain letters provides an excellent illustration of statistical reduction's logic of compression. The sentence is not written in English proper, but it is intelligible in so far as the reader can, eventually, understand what he is trying to say. In order to ensure the fastest and most efficient transmission of symbols through time and space, the translation from data into

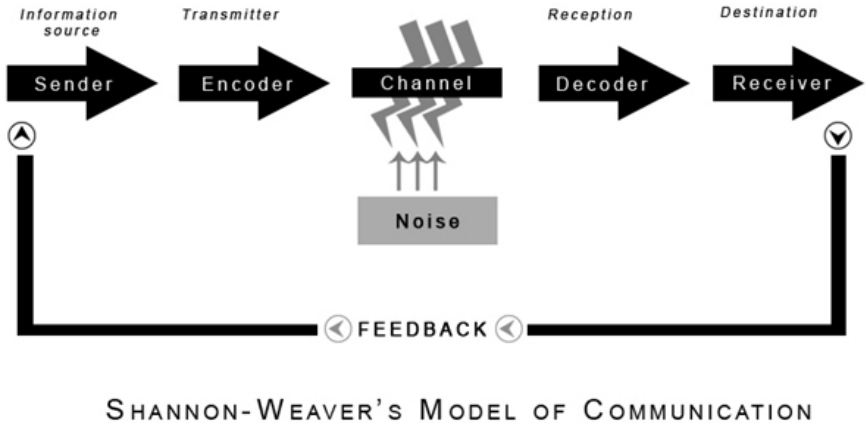

FIGURE 6. Claude E. Shannon's innovative model of communication for telephone systems, ca. 1948. Binary code was appropriate for the system because it could be broken down into the smallest possible number of discrete units. Figure adapted from communicationtheory.org.

signal was subject to increasing levels of statistical reduction. Any superfluous data was removed that might overload or slow down at channel, or be (perceived) as repetitious or redundant.[16] There are instances of this throughout the media environment, from compressed movie files and cellphone conversations, to "poor" images on social media feeds.[17]

Codecs

Only a few decades after Shannon's pioneering work, a whole range of related DSP compression techniques were standardized as "codecs," or, compression and decompression algorithms. Codecs are complex algorithms engineered into the core structure of digital file formats and they are rarely, if ever, seen. Generally speaking, codecs function to instruct a computer system how and when to display light, color, or sound, but because it is always an industrial engineer's goal to compress information when possible, while still delivering high-quality media (as with HDTV), digital codecs are consistently engaged in a struggle between technological innovation and perceptual comfort.[18] Chapters 3 through 5 return to issues of codecs and digital compression and the ways they have been used to engender a glitch aesthetic. For now, this preliminary definition of signal and noise will suffice.

If we can accept that noise is fundamental to any and all digital communication systems, then we must also face the fact that the greater the range of digitization, the greater the uncertainty in the results. As former Bell Labs' researcher Harry Nyquist explains, when signal and bandwidth increase to allow more data to flow through a channel, the S/N (signal: noise) ratio also increases.[19] The S/N ratio is a standardized way of measuring the amount of signal (valued information) in a

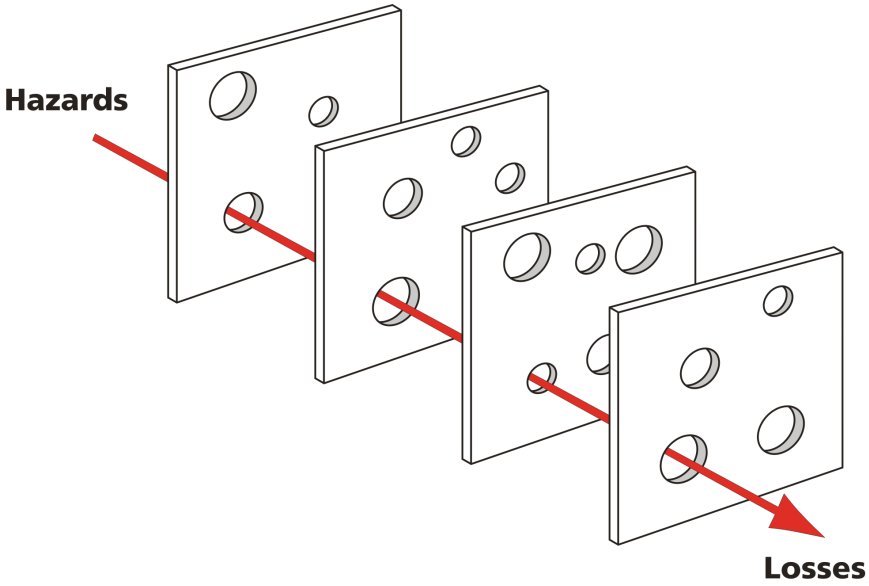

FIGURE 7. Dante Orlandella and James T. Reason's Swiss cheese model offers engineers a method for creating trapdoors to conceal the prevalence of error and noise in complex systems. Figure adapted from wikimedia.org.

system relative to the amount of undesirable noise, whether in the channel or elsewhere. On closer inspection, the inversely proportionate law of S/N also illustrates that signal and noise are actually the same thing, defined by arbitrary and contextually relative rules. That is, what counts as noise in one system may be entirely different in another. French information theorist Abraham Moles concurs, "There is no absolute structural difference between noise and signal . . . the only difference which can be logically established between them is based exclusively on the concept of intent on the part of the transmitter: a noise is a signal that the sender does not want to transmit."[20] In information theory, the problem of noise *is* the problem of information and herein lies the paradox of the "information" age: what comes to matter most is not information, but noise.

Swiss Cheese

Because consumers demand clear image and sound, engineers quite logically seek to increase signal and decrease noise in a communication channel. Dante Orlandella and James T. Reason's "Swiss Cheese" model for cyber security is one excellent example of a strategic endeavor to conceal errors in complex systems.[21] Developed in the 1990s, in the context of safety systems engineering, their model offers engineers a method for creating trapdoors to conceal the growing prevalence of error and noise in complex systems.

Swiss cheese is an apt metaphor because in a single slice there are only a few holes through which a potential error can pass. If several slices are vertically aligned, not all holes meet, making it much harder for an error to slip through all slices. By layering and repeating one's code in the basic design, the Swiss cheese model acts as a buffer to catch and conceal errors in a system, allowing only the most persistent ones to make it through. The genius of the model lies in the way it can conceal a magnitude of errors so that an end-user only registers an error after many have already been caught and only one single persistent one slips through. In sum, in order for a DSP system to succeed, engineers must create complex algorithms to conceal error.

Now consider that a similar logic rests at the heart of Western culture. In both culture and DSP, we find the same tension between the bridge and chasm; signal and noise; Epimetheus and Prometheus; and failure and innovation: two eternal and ambivalent forces inextricably bound to the nature of existence. I return to digital error in the penultimate sections of this chapter, where the centrality of noise in failure systems theory is found to be largely analogous to the role of error and noise in critical theory after the 1960s. For now, we jump to a very different tradition of error established in antiquity and active through the Enlightenment.

IV. ERROR IN ANTIQUITY

In this and the next section, I discuss holistic and binary conceptions of error in Western epistemology and philosophies of sense perception, from the Socratic era through the Enlightenment. Section V turns to our contemporary, albeit obfuscated, relationship to failure and noise in the industrial and postindustrial present.

According to Nicholas Rescher, the fifth-century B.C.E. Greek philosopher Parmenides of Elea proposed that error was connected to a dynamic sense of being, rather than nonbeing.[22] Error was a way of diverging from what already is, akin to Epimetheus's accidental forgetting in the *Protagoras*. As a natural part of being, error did not point to what was wrong or missing in life, but rather suggested only how things could be different from the way they were. In this way, error also creates possibility; an opening for the new and yet to be.[23] This early, integrative conception of error was later adopted in experimental media, as discussed in chapter 2, though it remains largely antithetical to philosophies of error in industry and technology. This holistic approach to error-as-facet-of-being is also foreign to the majority of Western philosophers, beginning with Plato and Aristotle.[24]

For Plato, the ambiguity of error was problematic. According to Rescher, Plato believed that error was characterized by "nonexistent non-facts," versus a more generous account, which might have viewed error as merely an "incorrect characterization" of actual facts. Rescher provides an example from *The Republic* where Plato's character Thrasymachus lands himself in trouble after "refusing to acknowledge the doctrine of sovereign immunity, which establishes that a true ruler cannot commit error."[25] While the claim is invalid from a logical standpoint

(anyone can commit an error), Thrasymachus's error, in this context, lay in his refusal to accept the letter of the law, which is to say, a deliberate negation of cultural and political hierarchy even *after* he is given "correct" knowledge of how and why it should be one way and not the other. Thrasymachus is of course a sophist so it is his job to be provocative, but nonetheless, his disobedience sets forth one of the first binaries between the erred human and so-called objective law.[26] Error is henceforth an epistemological and ideological tool for differentiation and judging one's failure to obey the law.[27]

A second example of error is found in Plato's *Theaetetus* (369 B.C.E.). In a dialogue regarding the conditions that can lead to knowledge formation, Plato determines that knowledge can't develop through "self-production" or direct sense perception, but only as a "reflection" of these two.[28] The world imprints itself on a subject's senses and these imprints must then be refined through a learned process of reasoning that necessarily moves beyond one's (faulty and erroneous) sense perception. Skipping over the faultiness of perception as an initial step, yet simultaneously relying on it to produce knowledge thereafter bears an obvious contradiction that many poststructuralist and deconstruction theorists have noted. In Plato, we encounter the beginning of the decline of holistic notions of error as natural and integral to life and being. Plato provides a new foundation for error rooted in what would become the long-standing metaphysical gap between good and bad; true and false; and eventually, signal and noise.[29]

Aristotle was less concerned with Platonic epistemology, and in some ways, gestured back towards holistic, pre-Socratic views. In chapter 25 of his *Poetics,* he distinguishes between two kinds of error: poetic errors that intentionally break rules and accidental errors made in representing the world. In the latter, it is out of ignorance that a painter "portrays a female deer with horns."[30] In the former, a new frame of assessment is required, opening the door to rhetorical genres of persuasion, storytelling, and other forms of art and "sophistry." Here, error as an intentional practice is accepted as part of art-making, not as a false or failed attempt to "copy" truth from Form, but as a valid creative strategy. Granted Aristotle's theory of error is related more to classical aesthetics, it nonetheless illustrates a key pivot from the Platonic approach. If one were to pursue this trajectory further, through a genealogy of aesthetic representation, one could inquire into the history of the Western concept of the Beautiful, from Plato's discussion of the Good and Beautiful in the *Symposium,* through St. Thomas Aquinas's *Summa Theologiae* ("for beauty three things are required . . . integrity or perfection: those things which are broken are bad")[31] to its breakdown in modern thought.

V. ENLIGHTENMENT ERROR

In the years bridging antiquity and the Enlightenment, numerous ambiguous and religiously inspired philosophies of error emerged. One is found in the work of

St. Augustine who, in the fourth century C.E., argued that the "visible absence of perfection in the universe" comprises a negative space through which divine perfection and wholeness could be imagined.[32] Error, for St. Augustine, existed as that which could point to what was not. In the thirteenth century, St. Thomas Aquinas theorized three major "defects" in human cognition: "ignorance, error, and heresy," which meant that is was possible to be "ignorant without passing judgment on the things we are ignorant of," whereas with error, Rescher explains, we judge and incorrectly accept the false in place of the true.[33] The Scottish Franciscan friar Duns Scotus (1266–1308) believed all error was the result of human will, relative to the divine. In sum, the responsibility of error clearly fell on man and evidence of this abounded in our mistakes of judgment, false propositions, and human inadequacies.[34]

The ancient skeptics held that if we cannot confidently claim to know something, we should refrain from asserting it to be true. For Descartes (1596–1650), as for Plato, all sensory experience was suspect. This hard line, binary view of error acquired great momentum in Descartes's philosophy. In his *Meditations on First Philosophy* (1641), error is at once central to the discussion, and yet, also a liability in any aspiration to truth: "In so far as I am not myself the Supreme Being and am lacking in countless respects, it is no wonder that I make mistakes. I understand, then, that error as such is not something real which depends on God but merely a defect."[35] For Descartes, God is true and the "self" is fundamentally at fault. The irony—the presumed "I" who bears this insight is somehow mysteriously excluded from the "I" who makes mistakes—did not escape him. The logical contradiction, as John Roberts explains it, became the ground on which Descartes came to doubt all knowledge.[36] So while Descartes "inherited Plato's distrust of the senses," Roberts continues, the production of knowledge in the pursuit of pure thought was still "stripped back to a bare-boned skepticism."[37] To avoid error, Descartes would have had to withhold all judgment, which is to say, purport nothing at all. If philosophy ever saw an apogee of epistemological breakdown, this would be it. To reiterate, Descartes's contradiction is similar to Plato's, both are thick with self-doubt. Since they are also both icons in the Western tradition, their outright dismissals of error as a mere defect of reason has, unfortunately, affected the many legacies that have extended from them.

At the same time, and counter to popular accounts of the Enlightenment as the apogee of metaphysical separations between body and mind; subject and object, and such other binaries, David Bates argues the era was actually much more ambiguous than has been historically understood. On the one hand, the era's rejection of "first principles" created a void that was filled by finite philosophical systems and unfettered beliefs in progress and reason. And yet, figures like Hobbes, Spinoza, Leibniz, Locke, and d'Alembert, all key thinkers of the Enlightenment, ground their philosophical edifices on the precarity of error.[38] For Hobbes, error was not logically inconsistent, but a reasonable and coherent conjecture that only

turned out to be wrong in the future.[39] Similarly, Spinoza argued that error was not located in the perversity of human judgment, as it was for Descartes, but rather, in misunderstanding. "Being ignorant and being in error are two different things," he explains, a misnomer on the "canvas of knowledge" that could just as easily be adjusted with a new coat of paint.[40] Leibniz also "rejected the Scotist-Cartesian view of error" as a fundamental human flaw. For him, error was a mere stepping off the mark, which "does not depend on the will" but was an accidental "mis-judging rather than a mis-willing."[41] If one knew better, one would not have made the mistake. Likewise, John Locke theorized error as a "premature claim" unrelated to axiomatic truths, though he did connect it back to the divine. Without "divine inspiration," Bates explains, Locke believed that "the mind was prone to lose its way among the plurality of ideas" and would thus make inaccurate connections among them.[42]

In Jean le Rond d'Alembert's essays on the elements of philosophy and principles of human knowledge, he conceived of error as a "productive blindness." Any desire for direct illumination or foundational first truths were seen as the seeds of "intellectual aberration". As a precursor to Nietzsche, d'Alembert argued that the wandering mind was enticed by both the false light of error and occasional flashes of authenticating truth.[43] For his protégé Nicolas de Condorcet, unnecessary reflection led to error, but risking error was also what provided greater reward.[44] Errors stimulated exploration, wandering, and provided an opening to the new, in many ways the equivalent to a romantic muse.[45] Take Diderot, who regarded pure unmediated knowledge as impossible. Diderot also drew on dynamic metaphors of wandering and the peripatetic to describe his philosophical inquiries through a disorganized, unpredictable world. One "stumbles" into knowing, he argued, only by first wandering astray.[46] Étienne Bonnot de Condillac's late encyclopedia entry on error likewise argues that it is intrinsic to human nature. A man may be able to get over one illness or setback, but given his intrinsically "feeble temperament,"[47] he would inevitably only "fall into another."[48] One could never manage to fully separate oneself from error entirely, though one could exchange old errors for new ones.[49]

In sum, despite common conceptions of the Enlightenment as metaphysically rigid and truth-obsessed, we see from these cumulative perspectives that the issue of error was in fact widely considered by Enlightenment figures. Discussion of truth, rather, was rare, and made only "fleeting appearances."[50] Where Descartes contrasted error with reason, Locke and others of his generation modified it could serve as a new foundation from which a science of investigation and inquiry could be built. Accordingly, it was also error—not truth—that provided the necessary preconditions for the production of knowledge, just as noise in information theory is the necessary and unavoidable cost of processing a signal. How then did error and failure become so intensely stigmatized once again, associated today with debt and nonbeing? To answer this, we turn to the role of error and breakdown in Kant and Hegel.

Kant's Communication Breakdown

The prolific contributions to Western philosophy of Immanuel Kant (1724–1804) are beyond the scope of this or any single volume. Here, I examine only his systematic theorization of the gap between knowledge and error.

Often referred to as the "Copernican turn," Kant's formal intervention in Western philosophy reversed the classical privileging of claims to objective "worldly" knowledge with a more "modern" notion of the subject as the origin and source of (mediated) knowing. On the one hand, as John Roberts points out, Kant adopted the "anti-sense apparatus" of seventeenth-century epistemology, characteristic of Locke and Descartes.[51] He argued that a rational subject's knowledge is dependent on the world in which they exist in. That is, any inquiry into knowledge must begin with the question: how does one's experience of the world acquire any certainty at all, when existence is itself fragmented and precarious?

A subject begins the process through empirical, sense experience. Any proper knowledge claim can then only be acquired after, through the application of what Kant called "concepts," a priori cognitions that lie above the sphere of daily experience and that humans possess as imminent mechanisms of consciousness. Concepts are prerequisite for the formation of knowledge. Thus "the senses do not err," Kant writes, "not because they always judge correctly, but because they do not judge at all." Put differently, human *reasoning* errs, not sense perception. In the *Critique of Pure Reason* (1781), he expands: "illusory appearance[s] as the cause of error, are only to be found in a judgement, in the *relation* of an object to our understanding."[52] If a priori cognitions are the matter of consciousness, then the problem is not matter itself but the way in which we, as reasoning human subjects, are capable of organizing these sense impressions to make meaning of them; "in a cognition which completely harmonizes with the laws of the understanding, no error can exist."[53] Perception is thus freed from erring, though it remains incapable of generating objective truth. Many of Kant's radical interventions in the history of philosophy were not appreciated until well into the twentieth century (by Heidegger, Wittgenstein, Foucault, Deleuze, and Derrida, among others) and thus when we turn to Hegel in the next paragraph, it will appear as if we are taking a step backward, to mistrust the noisy and faulty senses once again.

G. W. F. Hegel

In 1793, idealist philosopher J. G. Fichte declared the French Revolution a "dreadful spectacle" that had gone too far. He leveraged a resentment that, according to Roberts, relegated such errors "back in[to] the realm of shadow darkness."[54] Shortly after Fichte, G. W. F. Hegel (1770–1831) drew on the French Revolution to expound an idealized theory of historical determinism that, ironically, Roberts points out, is structured on the concepts of error and failure.[55] Hegel saw error neither as an unfortunate human shortcoming, like Plato or Descartes, nor as innocent, as I have suggested of Kant. Instead, like many early Enlightenment thinkers,

he viewed it as a necessary "gateway" to the truth of being.[56] As a gateway, error was subordinate to truth as a stepping stone on the path to historical unfolding. This is clearly illustrated in Hegel's *Phenomenology of the Spirit* (1807), where—like Plato—he argues that one must always begin with the error and falsity of sense perception, only in order to surpass and overcome it (*Aufheben*) to reach truth.[57] Only in the negation of failure and error can truth and the more desirable ideals of abstract reason emerge as part of the larger apparatus of historical development. Error in Hegel is thus not to be avoided or denied, only miscounted and distrusted. Error—like noise in relation to signal, and color in relation to form—provides the fodder for reason's capacity to overcome it in the pursuit of seemingly more estimable goals.[58]

Hegel relocated Kant's valuation of the relationship between sense impression and reason to the domain of history. Kant's notion of error systematized the anti-Cartesian break and moved towards an inclusion of the world in theories of knowing and being, in many ways remaining "locked in the cognitive constraints of the autonomous subject." By contrast, in Hegel, error is contrarily "removed from the auspices of the autonomous rational subject" and "placed in the realm of history proper."[59] That the actual, material events of war, revolution, and trauma inspired Hegel's idealism is not surprising or unique. Horror and bloodshed have time and again evoked radically new visions of a better society to come.[60]

Thus far, this chapter has charted theories of error in early Western thought and digital communication systems. Much of this has concerned theoretical developments only, failing to consider the cultural, psychological, and technological contexts shaping these developments. The remainder of the chapter amends for this as the next three sections address the advent of new technology and the way in which they led to a quasi-Hegelian shift in the theorization of error and failure, from the inadequate human subject to the wider registers of history and techno-culture.[61]

VI. FAILURE IN THE "CONTROL" REVOLUTION

Prior to the industrial era, social, economic, and political change happened gradually. New ideas and new technologies stuck around for millennia. Adam Davidson notes that a type of hand axe devised in Africa 285,000 years ago still maintained its basic shape and use 250,000 years later.[62] Likewise, during the Middle Ages, major advances in agriculture, warfare, and building technology remained in use for up to a century at a time. Even the largest and most developed economies ran "at a human pace," James R. Beniger observes, with processing speeds enhanced only slightly by animals, wind, and water power.[63] A dominant technology remained unchallenged for many years, like the African hand axe that became one of the longest "fail-proof" human technologies, consistently resisting obsolescence relative to newer devices.[64]

The stability and longevity of a technology, Davidson also perceptibly points out, is intimately connected to a culture's appetite for risk. Demands for growth and innovation during the agricultural era were minimal because people needed to rely on offspring and the land's consistency as a source of income. To abandon this and attempt some new and "untested innovation" was too great a risk.[65] Insofar as a technology is "fail-proof," it has proven itself in a culture that either experiences minimal levels of innovation, or simply has no interest in it. What does this say about our era, ostensibly so full of innovation and "game-changing" developments, but still somehow locked into the same few platforms (Google, Amazon, and Apple)? As to whether or not we are in an age of actual innovation or merely inflated discourse about it is a complex question. One way to determine this is to compare our situation to the culture of innovation from a century ago, again with a focus on truth, error, and failure relative to innovation and success.

During the golden age of entrepreneurship (1908–20), developed nations experienced massive growth and change in such a short period of time, it is difficult to focus on any one development without concurrently addressing another. During the Industrial Revolution, inventors like James Watt (1736–1819) and Eli Whitney (1765–1825) helped establish key mechanical technologies for mass reproduction and automation, leading to a host of innovations: the steam engine, the spinning jenny (1764), the Bessemer steel-production process (1856), and the telegraph. New industrial methods improved the accuracy and speed of production, unleashing a cultural ethos of unfettered progress. Accordingly, cycles of failure and innovation quickened, and the slow culture of nineteenth-century agriculture transformed into an economy of streamlined efficiency, perpetually and fatally dependent on the introduction of new things and techniques.[66] Beniger refers to this shift as the "control revolution," epitomized by Frederick Winslow Taylor's reprograming of the most basic human movements to conform to an idealized "system-level rationality." Mechanizing, quantifying, and fine-tuning the minutiae of human work and isolating assembly-line gestures seemingly allowed a factory owner to produce at maximum efficiency. One could break down activities into "elementary operations and motions" and then control them, "eliminating all false movements."[67] In the same way that redundancy and noise are removed to optimize signal processing, superficial gestures were systematically removed in the Taylorization of industrial labor.

Not surprisingly, in practice, Taylor's ideals of total efficiency failed. How could they not when error-prone humans are the object of mechanical standardization? His processes were eventually deemed repressive and led to a number of problems resulting in the system's downfall. Moreover, Taylorization was immersed in a broader culture colored by new forms of mechanization ranging from cinema to cars, trains, and the marketplace. The radical shift to mechanical logistics in work and home life forced the sudden adoption of new behaviors and perceptual experiences, often leaving masses of people fearful and uncertain of what or whom

they could rely on. As growing numbers of people found themselves facing social and financial insecurity, the industrial era witnessed new levels of poverty, labor exploitation (child labor in particular), noise and air pollution, and eventually, the Great Depression.

As a remedy, citizens were advised to seek stability in economic registers. They were instructed to measure and gauge themselves in relation to financial growth models, providing an indication of their relative success or failure.[68] Credit-reporting agencies (agencies that determine the "worthiness" and capacity to "trust" an individual) were developed in response to the United States' first economic crisis, but as early as 1837, Sandage explains, New York's Mercantile Agency (later Dun & Bradstreet) had already begun offering a new service to help unfamiliar businesses and individuals decide who was trustworthy or not. As a result, more and more people came to identify their "worthiness" by credit ratings.[69] Unlike pre-Enlightenment notions of error or failure, where wandering and wavering away from a goal was to some degree accepted, error and failure were henceforth ingrained as existential stigmas attached to an individual's self-worth.

The reification of the modern subject in the form of a credit report was not lost on Karl Marx, Max Weber, Daniel Bell, Émile Durkheim, and Arnold J. Toynbee, all of whom explored the growing dangers of subjective failure in these new socioeconomic systems.[70] Marx wrote extensively about the eclipse of the human and diminishment of social values in the mechanical age, and Durkheim identified the cost of transitioning from an intuitive, qualitative world to one ruled by bureaucratic machines, statistics, and algorithmic optimization.[71] Even Sigmund Freud (1886–1939) resisted reducing the richness of human experience to systematic and controllable laws. In his 1910 essay on "Errors," he recounted three mistakes he had made in his own book: "I was responsible for a series of errors in historical, and above all, material facts, which I was astonished to discover after the appearance of the book. In a closer examination I found that they did not originate from my ignorance, but could be traced to errors of memory explainable by means of analysis."[72] Freud identifies error as integral to modern experience and seems to enjoy doing so. At the same time, he does so only in so far as they do not belong to his "knowledgeable" self but rather, to "the suppressed fantasy [that] falsified the text of my book."[73] At least he took responsibility for them.

Writing before Freud in the 1880s, Nietzsche argued that all truths and so-called objective facts were fabrications, proposing instead a radically new way of understanding human language and culture through metaphor.[74] His work, as noted in the Introduction, clearly paved the road for poststructuralism in the 1960s, and deconstruction in the 1980s. Nietzsche also inspired Heidegger's work and in particular, his nuanced views of error and truth. In his 1930 essay, "On the Essence of Truth," Heidegger proposed that epistemological errors were "the most superficial" ones; only one facet of a much larger phenomenology of failure and declension. Humans do not fall into error, as they would "into a ditch," he

argued, rather, all life "start[s] from error . . . errancy belongs to the inner constitution of Dasein."[75] Heidegger's German verb *irren,* "to wander," from the Latin root *errare,* means "to wander from the right way," and only secondarily to "fall into error," as David Krell contends. By proposing a nonbinary, holistic meaning of error, Heidegger reclaims its Greek origins in the modern context. Void of guilt, shame, or subjective lack, Heidegger's phenomenology runs orthogonal to hegemonic accounts of error as sin (biting the apple, being tempted by woman, or opening Pandora's box); epistemological lack, as argued by Plato, Descartes, and Kant; or subjective failure (Sandage, Davidson, Marx). This is also why his elegant yet romantic humanism has influenced numerous philosophers since, including the theories of error offered by Michel Foucault and Bernard Stiegler.

Foucault's brazen acceptance of error colors his Introduction to the work of the biologist Georges Canguilhem (1904–95). "Life is what is capable of error,"[76] Foucault writes, summarizing his insights into Canguilhem's work in establishing a theory of evolution organized through the concepts of failure and mutation. Canguilhem argues that all biology depends on genetic change, which is to say, anomaly and the mistranslation of code. The ongoing capacity for a species' adaptation in order to sustain life is contingent on the capacity for errors to emerge. "Error," Foucault concludes, is "at the root of what makes human thought and its history."[77]

In sum, humanity is perpetually caught between a fallen world of base matter and an intrinsic but unfulfilled desire to go beyond it. Modern philosophers of error no longer viewed it as a shortcoming in the pursuit of a single truth, but rather as this dynamic, nonlinear mode of exploring our complex being-in-the world.[78] As digital technology progresses, however, simply acknowledging this existential ambivalence is not enough. In our post-industrial climate, we have witnessed how the factory has transformed into an "open concept" workspace, in which machines are responsible for assessing their own shortcomings—independent of and alienated from human contact. We humans are no longer the sole focus or exclusive scapegoat for error, rather, our new social and economic responsibility is not to own error, but to manage it.

VII. FAILURE MANAGEMENT

Managing error extends to humans and machines alike, but by far the greatest "risk-mitigating institution," Adam Davidson argues, was the midcentury corporation.[79] The corporation introduced a safety valve against personal and cultural failures in the postwar era. A steady job meant a company or corporation agreed to pay its employees regularly and provide them with a sense of stability and security. General Motors was the first modern corporation to introduce pensions and retirement accounts, made possible through stricter management. The corporation created a consistent consumer base for its goods, ensuring a win-win for both parties. As individuals learned to capitalize on the buffering system of the

corporation, they hedged their bets in entrepreneurial ventures that minimalized chances of work-related accidents or career failures. What the Swiss cheese model is to failure systems engineering, the corporation is to economic safety in midcentury America.

Why, then, did this model fail? For one thing, large corporations tend to view innovation as too risky relative to the stability of products that have already been tested on the market. This conservativism leads to another problem: truly transformative, "game-changing" innovations are far less likely to transpire in a culture prioritizing security and safety over experimentation. During this midcentury moment of "Great Compression," as Davidson calls it, when the wage gap between the rich and poor was at an all-time low,[80] prosperity abounded but experimental R&D budgets were cut and safe bureaucratic order became the name of the game. Innovation dissipated. This is a lesson learned time and again in the annals of the history of technology. The fates of once-experimental think tanks like Bell Laboratories, DuPont, and Xerox in the late 1970s and 1980s are all cases in point.[81] In this ethos, corporate success depends on "safe" and "conservative" ventures, high product turnover, and shareholder profit.

By the late 1960s and early 1970s, another factor came into play. Unstable cycles of innovation and failure were unleashed through the Nixon administration's detachment of the U.S. dollar from the gold standard, resulting in higher risks on the international market. The dramatic abstraction of the U.S. dollar, as David Harvey has shown, earmarked a new age of flexible accumulation characterized by the removal of stable jobs from the labor market, replaced with temp work; less regulated financial markets through the circulation of "fictitious capital"; and a general a shift in employment from manufacturing to service.[82] Furthermore, cheaper and sometimes better products began to emerge from other countries around the world, global trade continued to flourish, and domestic companies, Fred Turner explains, "began to rely on temporary workers" and "project-based labor forms," alongside emergent tendencies to "outsource production, causing massive deindustrialization across states like Michigan, Ohio and Pennsylvania."[83] The innovation-and-failure loop was shortened again, this time from generations to a decade or less. And even so, the greatest challenge to personal and financial security during this time, Davidson argues, came from computers.[84]

Older media paved the way. Long-distance technologies (telegraphs, telephones, railroads, and automobiles) pioneered the abstraction of social life into rationalized systems of economic assessment, from credit exchanges used as standards for measuring progress and success, to the delivery of media and entertainment.[85] In finance, face-to-face encounters, handshakes, and social interaction were supplanted by a credit agency's reductive, binary choices and a project's success or failure was negotiated using the same intangible statistical systems of

analysis, blind to context and the nuances of humanness.[86] Where people in agrarian cultures were directly connected to visible phenomena like war, weather, and diaspora, factory and office workers' predominant access to the world was through media screens, reports, and other abstractions. More and more people began to experience the "booms and busts" in personal and economic life as mysterious events with undefined origins. The mass media (cinema, television, magazines, and radio) only exacerbated things by focusing on attention-getting spectacles of crisis, reaffirming a new climate of fear and insecurity.[87]

The introduction of computer automation and network communications in the 1970s not only intensified these abstractions from real world events and face-to-face communications, they also began to replace jobs. As discussed at the outset, because digital machines calculate and analyze numbers in ways far superior to human capacity, their implementation has thus led to an uprooting of professional jobs and related forms of job security. The loss of human jobs to new forms of computer automation was first experienced by those in so-called low-skilled, low-pay jobs, like factory workers and secretaries, or bookkeepers, who had to compete with the machines. Many responded with Luddite-like vitriol, but at the end of the day, they were still rendered powerless. The gamut of professions uprooted by computer automation has since expanded to higher-paid "white-collar" professions from accounting to design, editing, and publishing. As recently summarized on National Public Radio, if your job can be taught to someone else in only a few minutes, chances are it will eventually be replaced by a robot.[88] If so, then who is really managing failure?

If corporations introduced stability and consistent growth in the early and mid-twentieth century, in the last quarter of the century, computers were doing the opposite. Decentralized, flexible computer networks made innovation precarious. Demand now turns on the capacity for ever newer networks like Facebook, Instagram, Uber, or Kickstarter to connect individuals through flexible and decentralized hubs.[89] In high-tech, cycles of innovation and failure spin at astounding speeds, fueled by currently fashionable metrics—from Google stats and big data analysis for brand awareness, to "Influencer" likes, sustainability issues, and vanity platforms (Facebook "likes," YouTube "views," and Twitter "followers"). If cycles of failure and innovation in the twentieth century could be measured in decades,[90] in the current era of hyper-accelerated media, Davidson notes, many entrepreneurs will work years to face a product lifespan as short as a season.[91] The internet aids in the acceleration of these cycles in everything from policy, law, and health care, to self-care and international relations. Widespread economic and political volatility ensure heightening forms of mass fear, anxiety, and a lack of confidence in oneself and one's job, or what used to be called a career. As soon as a product or company is no longer valued in the marketplace, thousands of workers may potentially be laid off, raising unemployment, divorce rates, and forcing unwanted moves and

career stagnation. In a culture that defines success through economic prosperity, but eliminates the circumstances for achieving it, we are all "born losers."[92]

VIII. CONCLUSIONS: FAILURE IS HERE TO STAY

In summary, two general models of progress fueled changing conceptions of error in the history of Western philosophy and modern industry. In the late eighteenth century, the development of radically improved machinery for factories coincided with the diffusion of Enlightenment notions of history as a record of progress.[93] Here, science and technology were seen in the service of liberation from political oppression. In the late nineteenth and early twentieth centuries, this changed. In the modern notion of progress, improvement and innovation were intrinsically linked to technology again and the Enlightenment values of justice, freedom, harmony, and self-fulfillment become secondary to technocratic ends. As the technological model of progress severed connections to holistic registers of life and being, it landed us in a new pseudo-scientific practice of measuring (things and ourselves) as indications of value and success. Put differently, improvements in power, efficiency, and rationality become ends in themselves, typified by figures like John D. Rockefeller, Andrew Carnegie, Thomas Edison, Frederick Winslow Taylor, and Henry Ford.[94]

Henry Adams, Thorstein Veblen, and a host of others objected that this means-ends industrial model fell short when imposed on actual life and practice. Taylor's theory of scientific management, Leo Marx observes, "embodies the quintessence of the technocratic mentality" and "'the idea,'" he continues, quoting the economic historian Hugh G. J. Aitken, "'that human activity could be measured, analyzed, and controlled by techniques analogous to those . . . applied to physical objects.'"[95] Inevitably, such idealized mechanisms fell asunder when applied to the eternally forgetful and accident-prone human being.

Unsurprisingly, we now find ourselves inundated with human *and* machine failure. Lauren Berlant offers a valuable critique of the prevalence of failure in the present, articulated through her concept of "cruel optimism." Since the 1990s, she argues, optimism has held "less and less traction in the world." There is less professional and personal success, but conversely, more desire for it.[96] We cling to fantasies of what it means to be happy, but the reality of acquiring it is increasingly scarce. This defines the condition of cruel optimism, experienced when the "thing that you desire is actually a problem in terms of its practical attainment." This is life as usual for an increasing number of Americans (and people around the world) and yet, Berlant observes, a remarkable number of people, institutions, and public bodies fail to see it, clinging to anachronistic visions of freedom and the American dream. For Berlant, Davidson, myself, and many others, failure is no longer an exception but the norm. Can we accept this as the starting point for life in the years to come, and learn how to "fail again" and "fail better," as Samuel Beckett once

suggested?[97] Could doing so somehow appease our relentless appetite for material "success" and force a reconsideration of our personal and cultural values?

The next five chapters offer answers from experimental media art, beginning with chapter 2's analysis of error and noise in the twentieth-century avant-garde. Here, we see an active embrace of error (rather than its rapid denial) as the condition of possibility for the progeny of media art histories.