EXPLAINING MANAGEMENT MORALITY: COMPLEXITY THEORY'S UNFINISHED AGENDA[1]

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How does one explain the plundering, thievery, moral corruption, swindling, and law-breaking displayed by rogues and scoundrels in the top executive ranks of several leading U. S. corporations as the new century dawned? This paper offers an explanation by combining concepts from complexity science, evolutionary biology, and cognitive-affective neuroscience. This conceptual framework provides a better grounded understanding of executive moral behavior than currently popular accounts of character failure, greed, rotten apples, profits-before-people, market imperfections, etc.

The argument proceeds through five main points, as follows:

* The business firm's main operations are a function of three intertwined biological processes: (1) negentropic economizing; (2) niche-taking and -defending; and (3) social exchange within a dominance hierarchy.

* Today's corporate organization/architecture manifests an underlying (primordial) order-creation process driven by thermodynamic work cycles.

* A corporation's behavioral pathways are modulated and constrained by diverse

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attractors: fixed-point, periodic, and strange/chaotic. These reflect and reinforce organizational commitments, which are equivalent to the corporation's core value set.

* Agent members of a dominant managerial coalition are carriers of ancestral neural algorithms that motivate organizational efforts to achieve the attractor-driven commitments/values of the corporation.

* A corporation's moral posture is a function of (1) mutually exclusive and contradictory corporate commitments/values expressed by the algorithmic brains of managerial agents; (2) the risks and dangers of competitive niche-taking and -defending; and (3) the necessities of engaging in collaborative, mutual-benefit social exchanges among internal and external agents.

The principal concepts supporting the argument include economizing as negentropic corporate operations (Frederick 1995), thermodynamic work cycles and natural games (Kauffman 2000), adaptive tension, agent entanglement, and order creation (McKelvey 2000, 2002), ancestral neural algorithms (Cosmides & Tooby 1999), and agent-based complex adaptive systems linked to strange attractors (Gleick 1988; Kaufmann 1995).

The Biological Fundaments of Business

Agent Economizing

Considered as an evolutionary/emergent phenomenon, the business firm is an

economizing adaptive entity responsive to thermodynamic energy flows in negentropic ways. It economizes by drawing resources from its environment and converting them to fungible products and services. All forms of life economize; they must if they are to sustain life by warding off entropy.[2] The corporation's economizing operations are energy transactions among agents inside and outside the firm. The firm itself is an aggregation of energy forms that make economizing possible: the organic energy of agent-employees; physical structures, buildings, and equipment; process materials; mechanistic and symbolic technology; organizational structure; and information/knowledge/data banks (Frederick 1995, 2002).[3]

Kauffman (2000: 4) speaks of "autonomous agents able to manipulate the world on their own behalf," saying that "an autonomous agent is a self-reproducing system able to perform at least one thermodynamic work cycle." That is precisely what a business corporation does when it economizes over successive quarters, trying to manipulate the world in its own behalf. These repeated thermodynamic work cycles keep entropy at bay

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[2] "Cells and organisms have achieved astonishingly ramified and subtle detectors that measure sources of energy, plus coupling devices, that extract work and use it to build rough copies of themselves" (Kauffman 2000: 95).

[3] "Economizing" as used here carries a more expansive connotation than the usual usage that emphasizes a careful, cautious husbanding of one's possessions. An economizing firm can, and usually attempts to, magnify the numbers and kinds of energy forms it commands. However, all firms confront the unavoidable and unyielding entropic pressures described in the Second Law of Thermodynamics, which motivates them to strike a positive balance between the capture and cost of energy and its "economical" use in production. For further discussion, see Frederick (1995); Burley & Foster (1994); Ruth (1993).

and thus serve an adaptive function. Economizing companies display "adaptive tension effects . . . aimed at moving a firm toward a more adaptively improved state relative to competitors and other forces and constraints in its competitive environment" (McKelvey 2002: 10-11). McKelvey suggests that a corporation can be understood as a Benard cell, with this "adaptive tension" emerging from the interactions of firm and environment (McKelvey 2002: 12). Reducing the thermodynamic energy gradients between organism and environment defines the meaning and origin of life itself, according to biologist Lyn Margulis (Margulis & Sagan 2002). Agent economizing by and through corporations is clearly one of nature's fundamental and essential processes.

The principal forms taken by corporate negentropic economizing---and therefore among the principal goals of a corporation---are the pursuit of economic rents (higher than average industry profits) and economic growth (made possible by productivity increases).

Niche-taking and -defending

Business agents and their companies seek and acquire economizing niches that support their adaptation and survival. This negentropic activity is what Kauffman calls a natural game. "A natural game is a way of making a living in an environment. That is, autonomous agents are able to act on their own behalf and regularly do so in order to make a living in an environment. . . . The winning games must be those that are

readily searched out by the very adaptive search procedures used by the coevolving autonomous agents themselves" (Kauffman 2000: 73, 74).

Natural (business) games are played both competitively and mutualistically. Fierce battles for greater market share, industry dominance, technological superiority, etc., regularly occur. In such environments, the key to niche persistence for an individual firm turns on attaining a rate of internal, intrafirm innovation greater than those of its competitors plus keeping one step ahead of broad changes in the firm's operating environment. "To be effective in increasing the probability of creating rent-generating initiatives, microcoevolution rates must exceed technology, market, and institutional change rates as well as the microcoevolutionary rates of a firm's niche competitors" (McKelvey 2000: 3). Niches also may be won and defended by forming alliances and partnerships with putative competitors, by merging with or acquiring actual or potential rivals, by controlling standards and key network nodes, by penetrating and capturing the seats of political and governmental influence---essentially, by any search procedure that secures a firm's economizing capacity. Ken Baskin (1998) points out that competitive niche strategies can successfully dominate a market ecology (his example is the struggle between Microsoft and rivals Apple, Motorola, and IBM for dominance of the personal computer market). However, since "living things . . . exist by virtue of their ability to nurture mutually beneficial relationships in their environment . . . managers with organic models focus on using their products and services to build relationships with customers,

suppliers, and even competitors" (Baskin 1998: 63, 68-69).[4]

Whether market niches are sought, won, and defended either competitively or cooperatively, their acquisition is one of business's prime functions and a manifestation of its natural biological origins. McKelvey (2000: 2-4) draws a seamless picture of the coevolution of biological agents and the niche-seeking, rent generating activities of autonomous business agents. For Kauffman the evolutionary outcome of niche-taking and -defending---the playing of natural games by autonomous agents (such as business firms)---is the construction of both a biosphere and an economy, which for him is "a merely human extension of biospheres" (Kauffman 2000: 73-75). Frederick (1995: 153-162) also contends that the mutualistic economizing of diverse, interlinked life entities within ecosystems greatly multiplies (probably exponentially) the ability of such agents, including business firms, to make a living. All three scholars reach the same conclusion: business operations are only another form of biology.

Social exchange within dominance hierarchies

Business and the market rest solidly upon a long history of exchange. Before money-modulated exchange, there was barter, trade, and reciprocal exchange rooted in

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[4] For two current examples, see the joint venture plans of Prudential Financial and Wachovia to merge their brokerage units (Mollenkamp & Craig 2002) and GlaxoSmithKline's alliance with Exelixis Inc. to discover and develop biotech drugs (Pollack 2002).

family, clan, tribal, and social relations (Angell 1929; Einzig 1948; Polanyi, Arensberg, & Pearson 1957; Bohannan & Dalton 1965; Mauss 1967; Braudel 1979). Farflung trading empires based upon reciprocal exchange predate by several centuries the appearance of monetary economies (Dalton 1967). Early hominids, precursors of *Homo sapiens,* may have traded stone materials used for tool-making, and with certainty there is archaelogical evidence of ancient exchanges among members of our own species. One can go even further back in evolutionary time and discover reciprocal exchange behaviors genetically embedded in various hominoid primates, especially chimpanzees and bonobos (de Waal 1996, 2001). "Social exchange is not a recent cultural invention . . . [it] is universal and highly elaborated across human cultures, presenting itself in many forms" (Cosmides &Tooby 1995: 1202).

This ancient practice is a form of self-organizing among agents playing natural games, and the cooperation and collaboration it brings to relationships are selectively adaptive for the exchange partners. Many, probably most, problems encountered by humans living in groups require cooperation---finding a mate, birthing and nurturing offspring, getting food, defending against competitors and predators, sheltering from climate and environmental threats, etc. When repeated over long stretches of evolutionary time, such pressures generate common approaches, methods, and attitudes. More than that, these common pathways encourage and make possible the emergence of neural modules responsive to such adaptive challenges. The outcome is the presence in

today's human brain of sets of neural algorithms (i.e., hard wiring) matched to the types of special problems encountered in the course of human evolution. Our brains in this Age of the World Wide Web are ancestrally derived from the Pleistocene, shaped by selective pressures to attack Ice Age problems (Cosmides & Tooby 1989, 1999).

Among those evolved, adaptive neural modules, social contract algorithms are central to business (Frederick & Wasieleski 2002). Evolutionary social contracts undergird the modern marketplace. They set the terms of trade. They determine fair and unfair prices. They enable the playing of natural games among agents who pursue diverse interests and needs (Binmore 1994). Collectively, they constitute the core---the central substance---of a market exchange economy. Corporations are the natural game-playing agents of such an economy, seeking economizing goals while occupying and defending market niches.

Social exchanges are never "equal," though, except in the eye(s) of the engaged beholder(s). Social custom generates proxies (ritualistic symbols, monetary media of exchange) that are then accepted as "equalizing" agents; such is the history of money now used in market exchanges (Angell 1929; Einzig 1948; Malinowski 1953).

Even more important is the presence of power differentials among social exchange contractors. Social exchanges emerged among primates, including humans, living within dominance hierarchies, which necessarily shaped the reasoning logic of social exchange partners. As evolutionary psychologist Denise Delarosa Cummins puts it, "our reasoning

architecture evolved in response to pressures to reason about *dominance hierarchies*, the social organization that characterizes most mammals." This meant having a brain that could "recognize and respond appropriately to permissions, obligations, and prohibitions . . . [and could] circumvent the constraints of the hierarchy by dint of guile . . . ." (Cummins 1998: 30). From this stew of dominance and power comes a "deontic effect in human reasoning. Deontic reasoning is reasoning about what one is permitted, obligated, or forbidden to do. When reasoning about deontic rules (social norms), humans spontaneously adopt a violation-detection strategy: They look for cheaters or rule-breakers. . . . [This leads to] a robust deontic effect in human reasoning and [to] . . . cheater detection and rank discrimination . . . [as] core strategies for surviving in a primate dominance hierarchy" (Cummins: 39-40; 42). Within a corporate setting, these reasoning rules translate into a reward and punishment culture that defines who and in what amounts managers, employees, and owners gain or lose.

Deontic reasoning acts as a regulator of power differentials that might be placed at risk by unequal social exchanges. While both dominators and the dominated stay alert for cheaters, they also closely attend to their respective "permissions, obligations, and prohibitions." Needless to say, the reach of a corporate chief executive's deontic duties exceeds those who hold lower rank. The same can be said of their power to break rules and modify social contracts, i.e., to be cheaters who dishonor social contracts with shareholders, employees, creditors, etc. Deontic reasoning can thus be used to stabilize a

rank-order system of unequal power where the way to survive is to know your place and play by the reward-and-punishment rules, while contrariwise permitting dominants to modify the terms of trade in destabilizing ways. Natural games, it seems are played for more than economizing prizes alone. Just ask WorldCom's Bernard Ebbers, Imclone's Samuel Waksal, Enron's Andrew Fastow, Tyco's Dennis Kozlowski, Adelphia's John Rigas, Enron's Kenneth Lay, and other such corporate dominants who chose personal power over company economizing.

Here then are three evolutionary building blocks of today's corporation. They define (1) an agent-driven economizing entity playing natural games (2) by fighting for and defending ecological niches, (3) where agent-reasoning conforms to reciprocal social exchanges that induce deontic effects while preserving a power-dominance hierarchy. Though subsequently elaborated by cultural custom, all three share naturological origins. On these grounds alone, one can confidently say that business is literally---not just figuratively, metaphorically, or analogically---pure biological process.

Corporate Order-Creation

The corporation achieves coherence and structure---becomes a recognizable, organized entity---*as* it economizes. It cannot otherwise play natural games or perform thermodynamic work cycles. Organization and economizing are reciprocal, self-

reinforcing forces, bound together in a co-creating, coevolutionary embrace. Kauffman (2000: 72) defines organization as "sets of constraints on the release of energy which constitutes the work by which agents build further constraints on the release of energy that in due course literally build a second copy of the agent itself." So, we have a coevolving feed-forward process: Sets of constraints (organization) ----> release work energy (economizing) ----> creates new organization ----> enables more economizing, and so on. "Precisely because an autonomous agent links exergonic [energy-releasing] and endergonic [energy-absorbing] reactions in work cycles, the breakdown of high-energy sources here can be used to build up structure here and organization there" (Kauffman 2000: 75). This amounts to saying that negentropic economizing and organization are interwoven and mutually reinforcing features of interacting autonomous agents.

For McKelvey, order creation follows essentially the same route. As entangled agents encounter Benard cell-like energy differentials in their environment, an "adaptive tension motivates the importation of negentropy and the emergence of adaptation fostering dissipative structures" (McKelvey 2002: 8). In other words, the firm acts as a Benard cell by developing structure and techniques that remove the energy differentials through effective economizing operations; hence, it becomes another feed-forward sequence. The resulting "efficacious emergent structure [fosters] adaptation that enhances [the firm's] survival [and] economic rents [i.e., profits above industry average]"

(McKelvey 2002: 8-9). These "adaptive tension effects are . . . aimed at moving a firm toward a more adaptively improved state relative to competitors and other forces and constraints in its competitive environment" (McKelvey 2002: 10-11). That is what corporate economizing (Frederick 1995) and, more generally, life (Margulis & Sagan 2002) are all about.

The particular *kind* of order and organization that emerges in any given corporation depends largely on the nature of the firm's operating environment, especially the existing level and quality of technological development and the prevalence (intensity and extent) of social dominance, class order, and status rankings within the surrounding sociocultural system. The firm's *economizing order*---its ability to reduce adaptive tension, import negentropy, and play a successful natural game---rests upon the congeries of tools, machines, skills, talents, cooperative teams, linguistic nets, information and knowledge data banks, inventive and innovative expertise that it can draw from its surroundings and effectively apply to economizing challenges. Ideally, a company's technologizing capabilities will match or exceed those of its competitors if it is to generate economic rents (McKelvey 2000).

But there is another kind of order and organization typical of corporations: *dominance-and-power order*, or command-and-control. A hierarchy of power, privilege, status-rank, and central control is interwoven with the firm's economizing order, conditioning and channeling policy, strategy, and decisions. On occasion, dominance-

and-power order overwhelms economizing order, tipping the balance away from negentropy toward entropic disorder and economizing decline. Overly ambitious mergers and acquisitions pursued by dominance-minded executives can produce this effect. "Entropy occurs simply from the merging of structures. Thus, despite the wishful aspirations of Wall Street gurus and CEOs, mergers and acquisitions are mostly entropic . . . ." (McKelvey 1997: 369). The resultant power arrangements create enormous, and enormously rewarding, value extraction opportunities for well-placed executives who, while touting "synergies" of the merged structures pocket gains only they personally both control and create (stock options, company loans, bonuses, golden parachutes, cars, travel, housing, lavish healthcare payments, personal services, etc.). Frederick presents "power aggrandizing" as a core value that "stands at the very center of business mentality. Few business practitioners vary from the belief that business must be organized and conducted by and through the instruments of power and dominance" (Derry et al. 1999: 640, quoting Frederick; Frederick 1995: Chapter 3).

Both kinds of order establish a close bond between company and society. Both reflect not only the "law of requisite variety" calling for a rough match between firm and society but also the organizational and societal "histories of entanglement," i.e., embedded legacies and commitments, that condition and sometimes thwart managers'

efforts to guide their companies in adaptive ways.[5] "Entanglement pools" of autonomous agents coexist with numerous other kinds of societal pools or reservoirs such as the society's accumulated technological know-how and its social dominance-and-power systems. All three pools are drawn upon by managers as they seek economizing goals and economic rent for their firms.

Tripartite Attractors and Corporate Values

Corporate behavior is constrained and modulated by several kinds of attractors. These attractors are the corporation's values or, more correctly, the total value set that drives the firm's actions, decisions, strategies, and policies.[6] Although attractor is a mathematical expression describing a system's trajectories in phase space, attractors assume a tangible, substantive form and function within the business corporation. The

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[5] "Entanglement" refers to the linkages between autonomous agents in a self-organizing adaptive system. Thus, a company's "entanglement pool" may be "corrupted" by actions taken, and commitments made, in the past. These historical legacies then either help, or hinder, a company's pursuit of economic rents (McKelvey 2002: 8-12).

[6] The point is controversial, some believing that attractors are behavior, not values per se (McElroy 1998). Another on-line commentator (Arrow 2002) puts the case this way: "If, by attractor, we mean a region of state space toward which a system is drawn by the dynamics of system operation, then specific norms for behavior can usefully be thought of as attractors. . . . Such attractors would not necessarily be strange however---they could be fixed action sequences which could be thought of more as a point or a behavior loop." Moeller (1998) comments in the same vein: "[I]mplicit . . . organizational values may act as 'strange attractors' at times, providing competitive advantage." Richard Knowles (1998) concurs: "All organizations have strange attractors made up of our values, principles, standards, expectations, vision, and mission."

corporation's *systemic* value sets are adaptive responses to entropic pressures and to self-organizing impulses felt within the firm. Specifically, they include *economizing* that reduces adaptive tensions, *power-dominance* that seats control in a managerial elite, and *competitive and mutualistic social exchange* that secures the firm's market niches. This is not the whole story, however. *Nonsystemic*, nonlinear linkages and interactions among internal agents (employees and managers mainly) inject novelty and unpredictable behavioral rhythms into daily work life. Diverse behaviors and personal values intermingle and, in McKelvey's phrase, form "entanglement pools." Collectively, they comprise a vast clustering of values with potential (but largely indeterminate) influence on a company's operations. They might usefully be called *autonomous agent values*.[7]

Getting a handle on a company's value complex is a big assignment, given the vastly different ways economizing can be accomplished and given the sociocultural wrinkles embedded within any culture's phase space that can spawn value galaxies of great variety, not to speak of the virtually infinite subtleties that distinguish the personal

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[7] In *Values, Nature, and Culture in the American Corporation* (Frederick 1995), they are called "X-factor" values, with the X denoting the difficulty of knowing their numbers or qualities in any given corporation at any given time. Richard Seel (1998), an organizational consultant, has said that "there may be thousands of attractors 'within' an organisation. Most of these will be at the personal level . . . but others will be at team level, business unit level, and so on. . . . The wonder, as ever, is that there is any stability at all." Another on-line commentator agreed, saying that "I am suspicious that I may actually be a strange attractor in my organization. The impact of my arrival 2 years ago is manifest in a number of subtle shifts in the pattern of our organization's behavior . . . hence the suspicion of being a strange attractor, or a focal center of change" (Moeller 1998).

value commitments of the company's workforce. But it is this congeries of values that drives the corporation's actions, like it or not. To be a manager faced with such bewildering complexity calls for courage of the highest order. Some falter, others "get it" and move the organization along the channels carved out by the three biological fundaments: economizing, niche defense, social contracting. The firm's normative outcome depends entirely on the particular mix of the three behavioral impulses the managerial coalition chooses to emphasize.

Point attractors are common in the modern corporation: control and concentration of information toward defined roles or divisions, usually specialists of one kind or another; monopolization of key information by the managerial elite and refusal to share knowledge widely within the company; focusing decision- and policy-making at board or top executive levels; petty turf building and protection of vested management power by alpha males (and an occasional female); and in general "traditional control style management decision structures" (McKelvey 1997: 370). These "equilibrium points," i.e., fixed-point attractors, exert a conservative force on corporate operations, curbing their oscillations and pulling them in the direction of a desired managerial control. Such values are deeply and permanently embedded within the minds of organizational managers.

So too do *limit cycle, periodic attractors* affect performance. They can be seen in the requisite financial performance reports issued periodically, usually quarterly, as well

as year-end summaries and forecasts that appear as regularly as the rising and setting sun; also qualifying as limit cycle attractors are such transient pendulum swings as "recurrent shifts in the centralization and decentralization of decision making, or functional specialization vs. cross-functional integration" (McKelvey 1997: 370); and year-end performance evaluations of employees; plus year-end distribution of bonuses, sometimes skewed into a *saddle attractor* if profits or individual performance has faltered.

It is the corporation's *strange/chaotic attractors*, though, that account for most of the firm's criss-crossing, overlapping, never-repeating trajectories as it seeks adaptive niches. Pity the poor managers who believe they can "manage" this process. They confront the *systemically* embedded values and commitments devoted to economizing purposes and goals, plus what they perceive as the necessities imposed by the deontic duties and obligations incurred in a dominance-power pyramid, as well as the reciprocal expectations of a host of market-exchange partners. They also face a terror of unknown (and largely unknowable) dimensions that lurks hidden within the minds of the organization's workforce---the *nonsystemic, nonlinear* personal and role-conditioned value commitments that may or may not be compatible with the intentions and goals of the company's managers. A well organized union's strategy may be enough to deflect and defeat the most determined plans of top managers. Courage, indeed, is needed to grapple with such an uncontrollable behavioral monster. The best managers have learned they can only shape and cajole and channel, not "manage" or "direct," their company's

operations.

Is it any wonder that a corporation this year has no idea where it will be next year? Once set in motion, either by genetic predisposition or sociocultural conditioning, agents' values and commitments are not willingly relinquished. When thrown together within an organizational context, the hope of managers is they will work toward systemic economizing ends. Alas, the trajectories are deflected and warped by the totality of value commitments emerging from other sources---competitors, suppliers, customers, government regulators, warmongers, terrorists, et al.. The behavioral result is literally "strange" or bizarre or seemingly chaotic, as the company swings through successive but variable cycles bounded only precariously by an attractor basin full of diverse and often contradictory value impulses.

Such values hold the corporation to a recognizable order---organizational roles, standard operating procedures, permitted information flows, short-range goals, allocation of work responsibilities---while opening the company to innovations, new explorations, and discoveries that carry it along in diverse, varying, and unpredictable directions. That is precisely the function of any strange attractor of any complex adaptive system. "The long-term dynamics of a system is governed by its attractors, and the shape of the attractor determines what type of dynamics occur" (Stewart 1995: 117). That says it as clearly as can be said: values and attractors are identical. Nor is this a mere metaphorical or analogical flourish. Quite the contrary, the claim here is that value sets indeed

duplicate and carry forth the exact same function within human organizations as is found within the calculations of nonlinear differential equations that have produced the mathematical notion of strange attractor. In fact, the claim goes even further. A corporation's phase space should be seen as the total range of value variables and behavioral reinforcements available to any given corporate dynamic system; its phase portrait is a set of swirling values that represents all possible behaviors starting from all possible initial conditions (Frederick 1998). That it can maintain itself at all as an ordered system requires further explanation.

Managers and the Algorithmic Brain

The human agents who reside in corporations are responsible for its operations. They make decisions, set policy, carry it out as best they can, plan for the company's future, and find and live a life within corporate walls (Dilbert's cubicles?). Together, they comprise a coalition---an alliance, a collective, a consortium---of interacting agents whose collective goal is to economize in the name of, and for the benefit of, the larger whole that is the corporate body. This organic human core includes owners, directors, managers, employees, consultants, and all others who enable the firm to do its work. In most large companies, multiple coalitions exist, often with overlapping membership. Ideally, they cooperate in pursuing the firm's goals but frequently compete with each other for resources, pay, prestige, perks, favorable links to upper management, etc.

The key corporate coalition is, of course, the one at the top: the executive group with designated authority over policy and strategy, consisting mainly of top-level executives, directors, division or function heads, and a varying number of support personnel who execute directives and guidelines issued from the upper levels of corporate authority. Most large companies harbor numerous formal (departmental, divisional) and informal (ethnic, gender, water-cooler) coalitions that are expected to be submissive to the will of the dominant managerial coalition. Union coalitions, generally less malleable, sometimes can bring powerful counterweight to bear on management decisions and policies.

Now, consider the logic chain that connects these coalitions with the firm's biological fundaments, its order-creation process, and the behavioral patterns produced by its main tripartite attractors---all of these discussed above. *Members of the company's coalitions are the equivalent of McKelvey's entanglement pools of interacting agents, and Kauffman's autonomous agents playing natural games.* Their interactions are responsible for whatever order is present, for success or failure in niche-taking and -defending, and for the value-based behavioral patterns that trace the outlines of the firm's multiple attractors. The agents' actions in a very real sense *are* the corporation. They constitute its order, their actions are in response to the biological fundaments, and collectively their values comprise the operational equivalent of its multiple attractors.

These human, biological agents are products of a selection process extending far

back in evolutionary time, and their present behavior reflects much of that ancestral past. The same is true of the human brain and its cognitive-affective architecture. Evolutionary psychologists (Cosmides & Tooby 1992; Gaulin & McBurney 2001) posit that current human behavior owes much to the experiences of our hunter-gatherer ancestors of the Pleistocene (Ice Age) era 2 million to 50,000 years ago. It was then that the human brain took shape and became the computational tool we now possess. In confronting and resolving the many different kinds of survival and adaptational problems that arose, the hunter-gatherer brain became specialized, developing domain-specific neural algorithms that matched the challenges presented by Pleistocene environments (an early form of requisite variety?). Our modern brains bear the deep imprint of our ancient forebears. As evolutionary biologist Ernst Mayr (2001: 252) says, "the human brain seems not to have changed one single bit since the first appearance of *Homo sapiens*, some 150,000 years ago." Wired for Pleistocene times, the brains of coalition members of today's corporations confront an entirely different set of challenges. Therein lies the puzzle, and the tragedy, of management morality.[8]

Among all of the coalitions making up the modern corporation, some agents are "more equal than others" in shaping the corporation and its practices, so the focus here is on the managerial coalition. *The agent members of the dominant managerial coalition*

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[8] Contrariwise, developmental psychologists argue for a greater flexibility of brain function stemming from an interplay of genes, neural cells, organisms, and environment (Scher & Rauscher 2002).

are carriers of ancestral neural algorithms that are brought to bear on the challenges and opportunities encountered by their companies. The domain-specific neural algorithms of greatest interest are those that mediate *economizing, niche competition, power-dominance,* and *symbiotic social exchange*. Note their compatibility with the kinds of problems typical of ancestral environments that are now repeated within the arena of contemporary corporate operations.

The hunter-gatherers' pursuit of quarry is now the corporate manager's quest for economic rents: both are types of negentropic natural games. The brains of both players send the same message. *Economize, they must!*

Securing a Paleolithic gatherer's niche on the savanna or in the rain forest finds a counterpart in the corporation's fierce competitive struggles for market niches across the globe. Again, an algorithmic kinship works toward the same end. *Compete, they must!*

The alpha males of Pleistocene times would easily recognize today's ego-bloated CEOs who hold sway over their corporate tribal kingdoms. The message goes out to ancient clan and modern tribe alike. *Dominate, they must!* So too does a reciprocal message echo up from the lower ranks: *Submit, they must!*[9]

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[9] According to *The Wall Street Journal*, WorldCom's director of general accounting, a third-level position in the management hierarchy, admitted he helped carry out the company's massive accounting fraud that had been "approved at the highest level of WorldCom management," although it was reported that he had "'strenuously objected' to making the accounting adjustments" that came from on high. His lawyer told *The Journal's* reporter, "[He] did not orginate this idea. He did not agree to it." Yet, submit, he did: "[H]e followed orders from supervisors to manipulate the company's books to

The hunter-gatherer mind dimly perceived the necessities and advantages of social exchanges if group life was to be preserved, just as the corporate executive mind is quick to see the benefits derived from today's market exchanges. The algorithmic brain telegraphed what was called for. *Contract,*[10] *they must!*

The corporate executive mind is ruled largely by such algorithmic imperatives. It seeks adaptive advantage for the company (economic rents), for the dominant managerial coalition (power, privileges, perks), and for the individual executive self (pay, bonus, golden parachute, etc.). Managerial mentality additionally seeks to influence relevant stakeholders within and without the company, including employees, unions, government officials and agencies, and various community associations (universities, foundations, civic groups, public and private schools).

Neural algorithms are not completely imperious, and they need not dictate specific behaviors. Rather, they are dispositional in their effects on behavior; they dispose an agent to act in ways consistent with Pleistocene habits and culture. It could be said that they constitute a "basin of attraction" that predisposes their human carriers toward deeply embedded impulsive behaviors, while leaving space for alternative, interpretive behaviors

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reduce expenses, create illusory profits and satisfy Wall Street expectations" (Markon 2002). *Submit, they must!*

[10] "Social contract" here refers to any exchange that produces benefits for the exchange partners, including all kinds of money-mediated market exchange, psychological contracts between employer and employee (D. Rousseau 1995), exchange of services within kinship groups, etc.

around a central tendency. This behavioral escape valve plays a key role in forming a company's moral posture, as will be subsequently told.

But first, note the interplay between managerial algorithms and the company's attractors. The algorithmically-driven will of the dominant managerial coalition is to act out the company's commitments to economize, secure niches, and best its rivals in market exchanges---the three biological fundaments underlying business operations. Those organizational commitments in turn become top management's core values, which comprise the set of tripartite attractors pulling the enterprise along varying paths on the economic (fitness) landscape. The executive algorithmic brain, shaped ancestrally, is the active agent striving to match attractors to commitments, behavioral predispositions to actual behavior, entangled agents to corporate goals.

Warring Attractors, Algorithmic Imperatives, and Moral Contradictions

Each agent that inhabits a corporation is a product of natural selection and genetic variation; hence, no two are expected to be or to act the same. However, agents comprising the dominant managerial coalition appear to exhibit overlapping evolved predispositions rooted in ancestral neural algorithms and can therefore act in concert. They seem driven, both as individuals and as representatives of the firm, to promote and pursue negentropic economizing goals and to do so from a power-dominance organizational posture. These two attractors give direction to corporate strategy, policy,

and decision making and are consistently selected for over evolutionary time, thus giving a characteristic tone and design to the business corporation (Frederick 2002).[11]

Each impulse and predisposition---one to economize, the other to dominate---emerges from a distinctive domain-specific neural module and carries no guarantee of harmony or consistency with the other. At times, power-hungry executives drive their companies into mergers and acquisitions of ruinous proportions, while simultaneously trumpeting the (imagined) economizing virtues of the combination and pridefully displaying a captive "trophy" company.[12]

Contradictions like these are inherent in corporation operations. They stem from a kind of warfare between adaptively inconsistent signals sent by different neural algorithms within the executive mind. The most common and ruinous firefights arise from overweening attempts to economize at all costs, regardless of the impacts on company, competitors, and host community. Economizing neural circuits drive the firm and its members to fend off life-threatening entropy, although these very actions generate an increasing wave of ever-greater entropy and disorder that disrupts and sometimes tears

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[11] It is possible but not empirically established that a self-selection process recruits agents who are especially attracted to the two kinds of challenges and opportunities. One leads to personal wealth, the other to power grandiosity.

[12] Frank (2002) reports that "well over half of all mergers and acqusitions fail to enhance shareholder value or live up to their promises. . . . [One study] analyzing 700 of the most expensive deals from 1996 to 1998 found that 53% actually reduced shareholder value." For specific company examples where executive hubris outran economizing possibilities, see (Orwall & Peers 2002) and (Frank & Sidel 2002).

asunder a community's symbiotic ecosystem linkages. With a corporation's increasing, almost ravenous economic expansion in search of new market niches, its host communities become sinks where entropic wastes are dumped---obsolete technology, resource tailings, downsized employees, broken and bankrupt competitors, unpaid debts, diminished stock values, urban decay, impoverished local governments, devastated landscapes, grievously wounded ecosystems.

Already mentioned are the addictive appeals of power-wielding by key members of the dominant managerial coalition who magnify their power, prestige, status, and privileges at the expense of shareholders from whom they may steal surreptitiously or brazenly, extracting wealth for themselves while showing little regard for employees who may lose their jobs, healthcare benefits, and retirement pensions as a result of power-hungry executives answering the call of genetically embedded command-and-control algorithms. Today's media channels are rife with story after story of these executive depredations, too numerous and well known to require specific citation. Sometimes, the perpetrators themselves appear to be bewildered by what they have done, believing they signed on for their economizing skills but discovering a latent penchant for power maneuvers and the rewards they bring. Little do they realize they are pawns of behavioral impulses laid down in the neural substrate of their Paleolithic ancestors resurfacing now in the modern corporation's executive suites.

Moral uncertainty also arises from the exercise of social contract algorithms,

which elicit the needed cooperation and collaboration of employees, suppliers, creditors, and others if the firm's economizing operations are to succeed. Natural game playing contractors seek personal and group advantage from which is woven an organizational skein of duties, obligations, and permissions embedded in negotiated social contracts. Deontic reasoning (Cummins 1998) drives these negotiations toward what are generally expected to be moral outcomes. Most would agree that social contracting, cheater detection, and a reputation for honesty and integrity constitute the moral seedbed of fairness and justice in social and market exchanges. Thus, the morally corrupted social contracts negotiated by top executives at Enron, WorldCom, Tyco, etc., betrayed this central moral principle underlying social contracts forged by algorithmic deontic reasoning.

Popular views to the contrary, such algorithmically-inspired moral transgressions are not to be explained simply as instances of personal greed, or character failure, or criminal intent, or rule breaking. *They are natural, expected behaviors*. Here one encounters the moral tragedy of the modern corporation. *Its principal actors possess, and give operational expression to, the conflicted behavioral potentials of their algorithmic brains*. For these reasons, the corporate firm is not only its own worst enemy but cannot avoid moral condemnation by others both inside and outside the company. The corporation is reflexively immoral for reasons beyond the control of its participants while simultaneously preserving and promoting what is arguably the firm's central moral

principle---economizing---on which all life and a society's ecosystem depends.

Enron-like moral reasoning displayed by top-level corporate executives produces an array of algorithmic contradictory behaviors that, while not new to the business scene, are impressive for their audacious magnitude.

- *Dominants versus submissives*, where employee job losses and pension wipeouts were the price paid for executive gain through cashouts of stock holdings and stock options.
- *Executive pay/perquisites versus company assets*, where executive loans, salaries, stock options, and personal expenses looted company treasuries, often with board approval.
- *Executive coalition versus shareholders/investors*, where top executives took advantage of privileged information and engaged in insider trading at the expense of external shareholders.
- *Company versus community*, where energy traders illegally boosted the price of energy sold to California customers.
- *Coalitional collusion versus stock markets*, where auditors signed off on questionable financial condition reports, thereby misleading investors and undermining trust in stocks and markets.

Shocking and ugly as they are, such behaviors are entirely consistent with what is otherwise a normal agent-environment, self-reinforcing, feedback interaction. All agents

confront environments filled with adaptive opportunities, which then stimulate and activate embedded algorithmic impulses. The combination of investors' "irrational exuberance" during the stock markets' runup, the easy availability of self-financing stock options, boards' oversight laxness, and corporate cultures primed for and committed to expansive growth and gain created an environment of unparalleled opportunity for executive exploitation. Executive behavior at Enron, WorldCom, Tyco, Global Crossing, Adelphia, and others was precisely what one can expect of adaptive agents responding to environmental opportunities on their "fitness landscapes." No one should be surprised, least of all complexity theorists.

In seeking a way out of this algorithmic trap set by nature, one can be comforted by knowing that these mental modules represent statistical averages and probabilities generalized over many evolved generations. As noted earlier, they induce predispositions to behavior, not precise behavioral regimes. They outline possibilities, not certainties or rigid routines. For any given person, their operational effect is unpredictable except in a very general sense. When multiplied by the numbers and types of people found within any given business firm at any given point of time, the lack of predictability of their moral state is magnified by several orders of magnitude. They are indeed an entanglement pool of morally diverse agents---a rich source of independence, moral imagination, resistance, and even rebellion.

Even members of the inner core---the dominant managerial coalition---may display

a diversity of algorithmic inheritance that deflects the firm from a strict economizing focus. WorldCom's vice president of internal audit, assisted by a staff auditor and a senior manager, uncovered $3.8 billion in phony accounting entries authorized by the company's chief financial officer (CFO), refused to back down when told not to continue, reported the fraudulent entries to the board of directors, who then fired the CFO.[13] Enron's top-level officers were similarly warned by a high-ranking officer about unwarranted accounting and financial procedures that hid costs and inflated revenues. In earlier years, Johnson & Johnson's CEO bucked strong opposition from key officers and ordered a costly recall of all Tylenol stocks after contaminated packages had fatally poisoned a number of people. The varying algorithmic patterns of a company's biological agentry permit diverse moral themes to be injected into policy, thereby acting as a kind of moral safety valve in face of unbridled economizing and maniacal power-aggrandizement.

America Inc. in Nature's Dock

Can corporations be morally judged---put on trial, so to speak---when the all the

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[13] *The Wall Street Journal* reported that this internal audit team "took their commitment to honest financial reporting to extraordinary lengths." They were "time and again . . . obstructed by fellow employees, some of whom disapproved of WorldCom's accounting methods, but were too frightened to contradict their bosses or thwart the company's goals" (Pulliam & Solomon 2002: A1). Clearly, the auditors' algorithms attuned to honesty differed from those of their submissive colleagues.

evidence and witnesses come solely from nature? In seeking an answer, most would surely agree that the natural processes of adaptation, survival, development/growth, generational replication, and cultural flourishing have normative weight for the human species. We value, indeed cherish and promote, these evolutionary outcomes for ourselves and increasingly for other species as well. It is arguably true that only humans consciously "have" values and make moral judgments, although some of our close primate cousins act out what would in a human group be called "moral" behavior (de Waal 2001), though perhaps it is more appropriately labeled a kind of protomorality.

Such human values and normative judgments can be seen as extrusions---a human molding---of naturally evolving processes. Values emerge from and reflect human experience in coping with nature. Values are not rationally or deliberately "invented," although they do reflect human intelligence. Values and the judgments they inspire exist in pragmatic form and function long before they are recognized and called "values." Though end-products of a long evolution, values and nature are not often conceived as linked together because by the time emergent values take cultural form their initiating provenance in nature tends to be forgotten (Frederick in Derry et al. 1999: 636-642). Nevertheless, values are sewn seamlessly into nature's grand fabric.[14]

The corporation's "original purpose"---complexity theory's "initial condition" to

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[14] At this point, some will worry about the "naturalistic fallacy," not realizing that it is itself a fallacy and an ethnocentric misinterpretation of nature implying its opposite, namely, that "oughts" can be made into "is-es."

which subsequent development is so responsive---is its negentropic economizing function that sustains firm and society alike. Little wonder it is watched so closely and with such concern that its life-supporting operations may go awry. The Dow Jones average, long a staple of network news and daily newspapers, is a (rough) national barometer of corporate economizing prospects and hence permits both private and public judgments about how well individual companies and the economy are faring.

Economizing, executive power aggrandizement, and symbiotic social contracting are products of nature constituting the corporation's core functions and also acting as sources of value judgments about corporate performance. Additionally, corporations both negate and sustain the moral/normative dimensions of ecosystem dynamics---nature's wondrously diverse symbiotic mutualisms that enable interspecies flourishings. Complexity theorists quite possibly can bring greater clarity to explanations of corporate behavior by exploring the chaotic moral order hidden among the entangled agents whose collective self-organizing actions define the whole. Investigators will find that moral outcomes vary with the kinds and relative strength of attractors present and active, the particular mix of neural algorithms driving decisions and policies of the dominant managerial coalition, and the countervailing influence of attractors and algorithms operative among competitors and stakeholders.

As today's corporate titans and their companies stand in the dock, charged with betrayal of public trust and breach of social contract, the trial could handily be filed as

America, Inc. vs. Itself, with Nature being judge and jury.

A Challenge and Invitation

Complexity theorists rarely venture into normative terrain, an ironic mirroring of the positivism one finds in the oft-criticized mechanistic sciences. It is an odd omission, all the stranger because of complexity theory's potential for normative analysis of organizational (and in this paper, corporate) life. In an on-line discussion, complexity theorist Stanley Salthe (2003, emphasis added) remarked that "complexity is an attitude toward subject matter . . . [that embraces] a desire to include meaning (*for some this includes values*) in our models of natural systems." Continuing, he said, "[O]ne could conclude that complexity is a philosophical approach, not science at all . . . . As an important example: some think that a more complex approach to technology/economics . . . would obviate the devastating pollutions that are accumulating apace as a result of applying the classical simplifying scientific attitudes to this basic sphere of social activity. But---how to do it?"

One answer to Salthe's challenging question is displayed in this paper. Let complexity concepts---natural games, adaptive tension, entangled agents, attractors---be joined with insights, perspectives, and research initiated in other disciplines---evolutionary psychology, cognitive-affective neuroscience, thermodynamics, ecology, and others. It's time for complexity scholars to confront and clarify the normative questions

that mean so much to human well-being. The potential is there. As Shakespeare's Hamlet, at a moment of hesitation, mused to himself, "This thing's to do, sith I have cause, and will, and strength, and means to do 't."

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