Delivering Health Care in Complex Adaptive Systems II:

Portraying and Tracing Implications of Working in a Dynamic System

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We must gain greater appreciation for the unique way in which complex adaptive systems operate before turning in the next essay in this series specifically to the way in which an understanding of these systems might help us address health care issues. In our previous essay (Fish and Bergquist, 2023) we made rather extensive use of metaphors in describing the nature and dynamics of complex systems. This seems appropriate given that these systems can be quite elusive—after all they are complex! We might best be able to gain some sense of how they operate by examining the way in which they appear in systems that are more concrete (tangible) than those found in social systems.

Keeping this approach to understanding the nature and dynamics of complex systems in mind, we offer three portraits (actually they are motion pictures) of complex adaptive systems. Our first portrait is based on a mechanistic metaphor involving the rolling of balls across a warped plane. Our second portrait is more fluid in nature. It concerns the transformation of water into both ice and vapor, along with the chaotic ("white water") movement of water down a riverbed. Our third portrait is a bit more conceptual in nature and less graphic—but no less dramatic. It concerns the dramatic transformation that occurs in a system when emergence occurs. The ball in no longer a ball and the river is no longer a river. A profound change has occurred in this complex, adaptive system.

We begin with the movement of a ball down a plane that is warped—or more down-to-earth the rolling of a golf ball across the warped plane of a golf course green. We become even more down-to-earth when offering specific examples of the warped plane and related processes that are often found in health care systems. We will be doing the same when offering the other two metaphoric portraits.

Portrait One: Navigating on a Warped Plane

One of the most important and sometimes overlooked concepts to come out of chaos theory and the study of complexity and adaptive systems is the observed tendency of all fluid systems to bifurcate (split into two or more pathways). In essence, when fluid systems begin to break up (as a function of the speed at which the fluid is moving or as a result of the introduction of a foreign, intrusive element) parts of the system tend to move in different directions.

These diverse movements of particles, units or people will, in turn, form two or more coherent subsystems that may later subdivide again. Thus, if I pour a small glass of water on a smooth surface (such as a table or countertop) it will tend not to flow in one direction or remain together as one coherent mass. Rather, it will soon break into two or more sub-streams that flow in two or more directions across the surface of the table or countertop. This represents an essential feature of all dynamic systems—there is a strong pull toward bi-furcation.

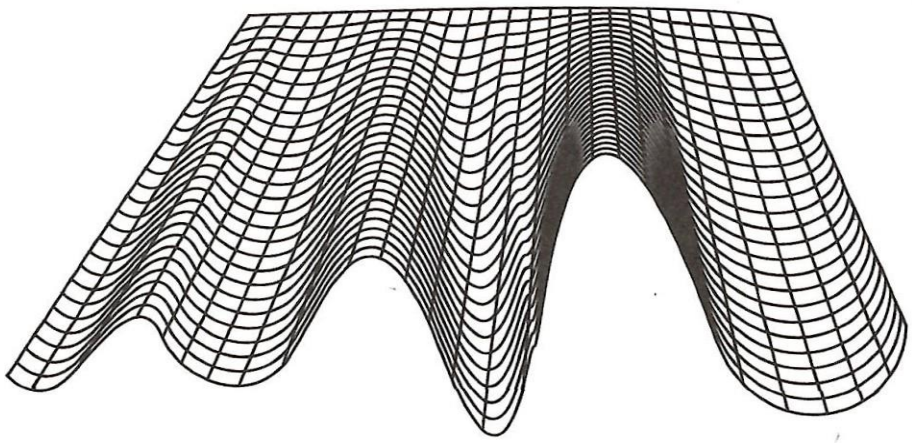
In his introduction to a book co-authored by the Nobel-Prize winning theoretical physicist, Ilya Prigogine (Prigogine and Stengers, 1984, p. x) Alvin Toffler offers the following commentary on bifurcation:

> In Prigoginian terms, all systems contain subsystems, which are continually "fluctuating." At times, a single fluctuation or a combination of them may become so powerful, as a result of positive feedback, that it shatters the preexisting organization. At this revolutionary moment—the authors call it a "singular moment" or a "bifurcation point"—it is inherently impossible to determine in advance which direction change will take: whether the system will disintegrate into "chaos" or leap to a new, more differentiated, higher level of "order" or organization, . . . One of the key controversies surrounding this concept has to do with Prigogine's insistence that order and organization can actually arise "spontaneously" out of disorder and chaos through a process of "self-organization." -Alvin Toffler. Introduction to Prigogine and Stenger, *Order Out Of Chaos*:[i]

A Warped Plane

The noted biologist, Conrad Waddington (1997) describes this same tendency toward bifurcation in his model of chreods (see Graph One)—warped planes on which objects move in an unpredictable manner. Waddington uses the metaphor of a ball being placed at the top of a slopping plane (thin sheet of metal or plastic). As we bend and warp the plane, ridges and valleys are formed. When the ball is placed on a tilted plane, the inherent dynamics of the plane become evident. The ball will begin to roll straight down the plane until it encounters one of the ridges. At this point a series of oscillations tend to occur. The ball moves back and forth before it eventually begins to roll down one of the valleys and picks up speed again.

Graph One: The Warped Plane



If several balls are rolling down the plane at the same time, this first ridge will become a point of bifurcation for the entire system. Some balls will move in one direction (depending on the pattern of oscillation when encountering the ridge) and roll down one valley, while other balls will move in a different direction, rolling down one or more of the other valleys. A ball may gain enough momentum to roll over the top of one ridge into a second valley. If there is not sufficient momentum, the ball will remain in the current valley.

Thus, a few critical moments in the life of the ball's roll down the plane make a major difference in the outcome of the roll. The pattern of oscillation determines which valley is chosen and whether or not the momentum is sufficient for the ball to shift to another valley. There is a cluster of conditions (in the form of valleys and ridges) that define the specific alternative courses to be taken by the ball.

Order, Chaos and Oscillation

Waddington's warped plane relates directly to the alternating patterns of chaos and order that many complexity theorists have identified. The tendency toward order is evident in the movement of the ball down a specific valley. Once we know which valley is chosen, we can predict the movement of the ball back and forth down this valley. However, before the ball moves into a specific valley we can only guess on its ultimate pattern. In essence, balls appear to be probing for order and a specific direction of movement. The balls engage in a process of oscillation that occurs immediately before the balls bifurcate and begin rolling down one of the specific valleys.

Probing is a trial-and-error (seeking oscillating) process in which many different options are examined and even tested. It plays a critical role in any evolutionary process. For instance, natural biological evolution requires the spontaneous fluctuation of species and the subsequent irreversible selection of specific species-specific characteristics. Successful adaptation of any type—whether individual or organizational, reactive or creative—must always contain a random component. In essence, an organism that is seeking to adapt to a changing condition or environment begins by trying out a variety of behaviors. It will fluctuate in its behavior and become temporarily unpredictable, as in the case of the ball's oscillating back and forth at the top of the warped plane.

Several biologists have recently suggested that oscillation tends to occur in many organisms at a point immediately prior to its transition from a stable to chaotic state and its ultimate commitment to a specific, irreversible course of action (a bifurcation). Many of these oscillating behaviors— these trial-and-error (innovative) efforts—are not effective. They do not work. One or two do work, however, leading the organism to expand its repertoire and shift its regular mode of functioning to accommodate these changes.

The exploratory processes—the endless trial and error of mental progress—can achieve the new state only by embarking upon pathways randomly presented, some of which are selected for the survival of an individual or organization. We may, as a species, be involved right now in this exploratory process regarding our capacity to live with our current pandemic and other pandemics that will inevitably occur in our increasingly flat and interconnected world.

Navigating on a Golf Course

This is all quite abstract, for we rarely roll balls down a warped plane. Let us take our illustration to a location with which many of us are familiar. This is a golf course—and more particular a green on the

golf course where we are trying to putt in our golf ball. Imagine that we are a player trying to get the ball in the hole. The hole is an attractor. But it will only work as such if the ball gets close enough to the rim. Before we get there, we have to negotiate the surface between ourselves as the player and the hole. The putting surface has many other local attractors and barriers (little holes, ridges etc.).

This putting analogy may be a good one for us. Except in real-life, there are multiple putters all putting at the same time, often in random ways...so our balls are also banging into each other and ricocheting in the wrong direction, falling into the wrong attractor...or a different one than we intended. A self-organizing or coach-organizing team will produce patterns. and disciplined, feedback-full putting....like a dance of balls across the green, glancing each other, with dynamic ricochets that dazzle the observer and have all balls fall into their intended cup at the same time or in series that makes a rhythm that is danceable, for example. Teams are a way to develop meaningful patterns in otherwise random, chaotic systems. Perhaps teams are a great attractor of some kind.

Frozen Middle Management and the Restricted Plane

When we find ourselves in a management role, we are often doing our best to develop our environment around efficiency. We are making sure the trains arrive on time, rather than exploring where the trains might be going in the future. We leave these more “distal” matters (distant time and space) to the strategists and leaders of our organization. As middle management, our job is more “proximal” (short distance and short time span). We often focus on limiting unnecessary variability and narrowing the pathways of travel in order to reduce inefficiencies and make the most of the resources we have. Our managerial emphasis on reduction of unnecessary variability can lead us to forge strong barriers and obstacles to working outside of a pre-determined pathway. In healthcare, managers use many tools such as Clinical Pathways or Evidence-based Guidelines, Protocols, Checklists, and Procedures.

When pushed to the extreme, managers build up barriers to the point where there is only a single pathway down the warped plane. Over time these can develop into full-blown silos, with hard boundaries and barriers. Given this recurrent dynamic in many organizations (including health care) we can begin considering the relationship between Waddington’s Warped Plane and the provocative concept of “Frozen Middle Management” (Sterling, 2020).

Middle management wants everything to be predictable and controlled (that is the fundamental nature of being in a frozen state). On Waddington’s plane, this would mean that the walls on one of the pathways down the plane would be enlarged and strengthened (becoming like “silos”), so that the ball (operations of the organization within a specific division) will be able to travel down only this one pathway. There is no deviation—no moving to another pathway. This reminds us of the children’s toy, where balls are rolling down one pathway – from the top of a short tower to its base.

For at least a short period of time, the child delights in seeing the ball roll from top to bottom – much like a frozen middle management team takes temporary delight in seeing (and measuring) the success of a project that has been tightly controlled and is completely predictable (and measurable).l However, the child soon grows bored and looks for some other novelty. Similarly, the frozen middle management team soon find the predictably successful projects to no longer be motivating.

Professionals who are constrained by the frozen, hard-boundaried pathway, will first refuse to use it—or they will point out that the balls fall out into chaos if tilted this way or that. Rigid pathways in healthcare inevitably confront unique patient situations that can't fit into any pre-ordained or pre-structured pathway. The uniqueness of human conditions and the complexity of challenges makes such rigid, siloed pathways even risky. For example, an Obstetrician, Midwife or Family Physician is unable to over-ride a Labor and Delivery Protocol that requires them to perform a risky C-section. An alternative path that the physician or midwife might take things in this unusual situation would likely result in a healthy baby via a vaginal delivery. In seeking cohesion and predictability, over-constrained clinical pathways can become risky and even dangerous.

The management team is "frozen." It becomes risk-aversive—yet doesn't want to take a chance. It would be a "disaster" if the ball were to flip out of the desired pathway. There are no plans for this to occur. This would be an "unimaginable" condition—what Nasim Taleb calls a "black swan" (Taleb, 2010). If the ball were to flip out of the child's toy, then the child is likely to cry and even have a tantrum. And the ball could end up almost anywhere (bouncing on the table and then on the floor only to end up under a piece of furniture). If the only option is a disaster and the potential of outright chaos (the ball bounces all over the place) then it can be fully appreciated that the management team is frozen in fear of taking a risk. In essence, these overly rigid clinical pathways try to replace the Chef with the Recipe---and most of us realize a Chef can make a masterpiece meal without a Recipe, and a novice can make a disaster even while following a recipe religiously. Humans are not ingredients. They are far more complex and dynamic. Clinicians must have softer boundaries with flexibility to customize to each unique patient.

Then there is the matter of motivation and boredom. How do you make the rolling of the ball down a single pathway somehow interesting. We can try making the pathway more complex and filled with many side effects – such as is the case with a famous kinetic art sculpture located at the Logan Airport in Boston Massachusetts. Called the "Goldberg Variation" this sculpture sends a set of balls down a metal pathway one at a time. While traveling along this one, well-protected pathway, the ball hits a set of gongs and belles, drops off a short cliff to the next edition of the pathway, and swirls around quite a bit

on its journey to the bottom of the sculpture – only to be lifted again by a small elevator to the top of the sculpture. The process is repeated.

It is a wonderful sculpture to witness--with many balls moving at the same time and many bells and gongs sounding at the same time. Yet even this compelling experience draws us in for only a short period of time. We must catch our flight to Chicago or pick up members of our family who have just arrived from San Francisco. Short-term novelty can hold our attention for only a short period of time—especially if this novelty is actually carefully controlled and predictable. It is only novel for a short period of time—and then it is "the same old thing again."

What does all of this mean with regard to the functioning of frozen middle managers and middle management teams? First, it means that not much learning is taking place. There is what Gregory Bateson (2000) calls first-order learning. This elementary form of learning occurs when managers are first embarking on the journey down a predictable and restricted pathway. Inserting a fixed, first-order silo into healthcare results in a lowering of any higher order learning and thinking--what Bateson calls second-order learning and what Daniel Kahneman (2011) identifies as "slow thinking. Unfortunately, second order learning and related second order slow thinking are required when making dynamic adaptations to unique challenges and events. Rather than lifting up excellence of service on behalf of meeting an exceptional health care challenge, first order learning and habitual fast thinking can bring down the value of the most skilled professions when they are providing care under exceptional circumstances.

It is another matter when the health care provider faces the routine—when the balls are rolling down the restricted pathway. Once the managers have "learned the ropes" regarding this one project and one pathway, there is no need to learn anything more. Second-order learning is only needed when the ball (project) can move over a ridge (leaping out of an organizational silo) and venture into a new valley and learn how to navigate a new pathway. There is a side benefit: with this new challenge and new learning comes another level of learning. The unfrozen middle managers learn something about how to learn! Second-order learning is fully present. Rather than over-compensating for professional care variability with rigid, artificial siloed pathways, middle managers can carefully seek a full understanding of the complex, dynamic system in which they are operating. They can learn to coach and guide clinicians in seeking to limit unnecessary variability. As slow, analytic thinkers, these managers can ensure that the clinician's autonomy is protected, while collaborating with the clinicians in arriving at thoughtful judgements—those required to navigate a warped plane of care in an adaptive and effective manner.

Difficult Choices and Unique Challenges

It is tempting to pretend that a warped plane of care, with many ridges and valleys of decision-making, is only a single pathway. No difficult decisions have to be made. Artificial clarity and simplicity are created. Unfortunately, when confronted with unique challenges and patients, one will often find that this clarity and simplicity collapse and the system suddenly falls into a chaotic state. Removing choice and oscillation between valleys may seem like a clever way to reduce unnecessary noise and variability.

However, it reduces the ability of qualified experts to influence decisions and help navigate the oscillations between various pathways and valleys of care.

This expertise—and the processes of slow thinking—are needed in particular at a bi-furcating moment when there is the option of entering a new valley. There often is indecision regarding movement into the new valley. We have to make a difficult choice--unless we are automatically shoved into the new valley as a result of momentum. We will often "dither" between two options: the old valley and the new valley. Polarities are formed which provide unique challenges for those who are making decisions (Johnson, 1996). Each option is absolutely compelling—and absolutely unacceptable. This dynamic and the indecision of dithering is represented in the ancient fable of the donkey standing between two haystacks. The donkey moves toward one haystack and realizes that he is moving away from the other haystack. He then moves toward the second haystack and realizes that he is moving away from the first haystack. The donkey eventually starves to death having feasted on hay in neither stack. Swinging back and forth.

When faced with the bi-furcating prospect of entering a new valley, we swing—inside our own individual psyche as well as in our collective/societal arena. This dithering can be very damaging both physically and psychologically if sustained for an extended period of time. There is action but it is ineffective and ultimately powerless action. This scurrying back and forth is much like what occurs among small marsupials on the African savannah when they are faced with making a choice about escaping a threatening entity such as a lion. All too-often the scurry can gain the attention of the lion and the marsupial can easily get devoured. As human beings we are similarly vulnerable when we are engaged in this kind of mind-less, fast-thinking action. Scurrying back and forth is oscillation---permanent oscillation can become a frozen-like state.

More generally, we can define this condition of oscillation as a matter of finding two or more options to be viable. We can run from the lion, freeze in place, or even wack the lion with a stick or the spear we are carrying. What do we do? The noted philosopher, Richard Rorty (1989) observes that a very painful condition that he called Irony is prevalent when we must simultaneously address two or more contradictory options. We can fight, flee or freeze when confronted with a real or imagined lion and we can choose between two stacks of hay (alternative opportunities for achievement). We may swing back and forth--creating a state of what Ralph Stacey (1996) identifies as Anarchy (see our previous essay: Fish and Bergquist, 2023). Instead, we can remain in thoughtful consideration of each option before moving to the second option. While this requires that we acknowledge (and even help to create and sustain) a state of complexity, there is also the possibility that we will make an appropriate choice. At some point, we do decide to enter the new valley or find a way to remain in (and improve functioning in) the old valley.

Multiple challenges face us when we have made this decision. Middle management needs to rely on expertise from diverse sources when it is moving into a new valley. The same old "experts" probably don't know everything anymore., The ways in which we acquire knowledge and test out the validity of this knowledge is itself contained in the pathway down which we are now traveling--to modify Einstein's dictum a bit. Second order learning is required when we enter a new valley and find out how to travel down a viable pathway in this valley. There are often new rules to follow in determining what knowledge and perspectives are of greatest importance in this valley. Finances, for instance, might suddenly become of primary concern. We also face new challenges that require slow, deliberate

thinking. We might not be aware of all the assumptions that underlying the financial analysis that we are now required to complete. Greater awareness of (and even testing of) these assumptions will be critical.

There is an additional challenge: how do we test out the validity of the new knowledge being offered, and assumptions being made. Which spread sheet do we trust? What accounting procedure do we adopt? New experts are often of greatest value. It is a matter of diversity--as Scott Page (2011) has shown us. The quality of problem-solving and decision-making, as well as the creativity that attends these critical thinking processes will significantly improve with the invitation of new members, new perspectives, and more diverse representation on the middle management team. It seems that something "new" tends to unfreeze people and teams (Lewin, 1947).

In order for middle managers to gain more skill working with even a static, warped plane of care, we must gain more comfort and patience with variability and the ambiguity and discomfort of the oscillations that precede decisions on which valley of care to decide our way into. Patience with oscillation, ambiguity, and uncertainty are required of our middle-managers, yet we tend to train them to limit and reduce each of these wherever they see it in the name of efficiency.

Middle-management efficacy must begin to emerge as a higher priority than middle-manager efficiency. A quest for efficiency without regard for efficacy will reduce the energy in the system and eventually freeze the domain. As happens in nature, when a person or system begins to freeze, it can paradoxically feel warm and comfortable just before death. We must learn ways to help thaw our middle-management by giving them new skills as coaches and guides to work and manage across the many oscillations, ambiguities and uncertainties found on the warped plane of healthcare.

Portrait Two: Navigating in a Turbulent System

As we delve into the dynamics of complex adaptive systems, we might wish to switch from the mechanical metaphors of a ball rolling in the valley or a ball being putted on a green to representations of actual complex systems that are operating in nature. Shifting from a static, multi-ridge-and-valley warped plan towards a dynamic, ever-changing, turbulent living system further points to the need for dynamic, collaborative leadership and coaching. We find flowing and tumbling rivers the ideal metaphor for the Fluid state of organizations---when we have thawed all the frozen areas of the organization and decisions begin to flow like water across the system of care.

Three States of Nature

Stuart Kaufmann (1998), a noted observer of complex systems, offers an obvious but important distinction. There are three quite different states in which complex systems operate. There is the fluid state of water, the frozen state of ice, and the unbounded state of gas (steam/vapor). Ice represents a complex system that is static and heavily structured. It contains many agents, but they remain inactive and isolated from one another. The gaseous state represents a complex system that is chaotic, without any boundaries or structure. There are many active agents, but they fail to interact or influence one another in a consistent manner. The fluid state of water represents a complex system that contains both order (structure) and disorder (randomness). Causality begins to fall away as the inter-play of multiple agents (water molecules in the case of rivers) begin to experience feedback collisions in often chaotic fashion---shifting from ordered laminar flow into turbulent flow.

In the frozen state there is no feedback flowing between agents operating in the system, whereas in a gaseous state there is feedback flowing out of each agent, but this feedback is "ignored" by all of the other agents. It is only in the fluid state that we find feedback flowing and being received by other agents. It is only the fluid system that has the capacity to be adaptive—especially if there is a blend of proximal and distal feedback. In the case of a turbulent river, the distal feedback might be information regarding the release of water from an upstream dam or weather reports regarding a rainstorm occurring several miles above our current location on the river.

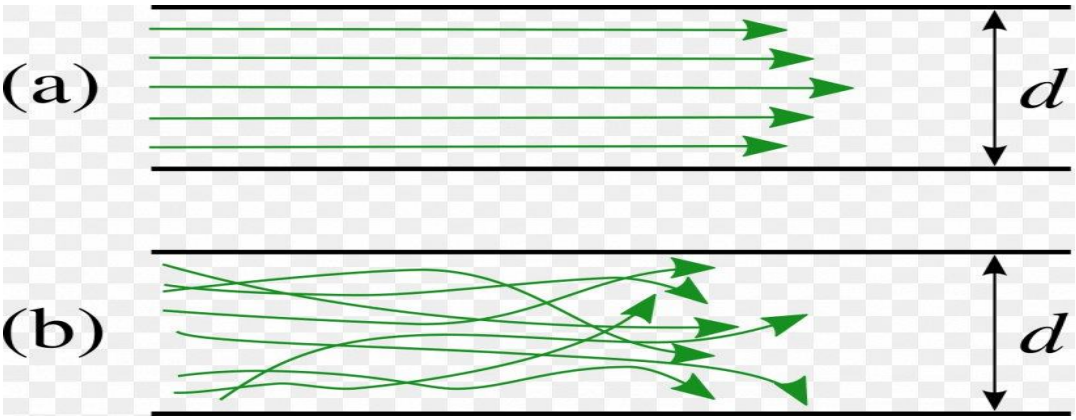
Proximal feedback would focus on the immediate volume of water flowing past us at our current location or the presence of logs floating down the river that disrupts the flow pattern. With the availability of both distal and proximal information, we can plan for the present (tactical) and near future (strategic). The interplay between distal and proximal feedback is engaged when we consider the impact of increased water volume on the level of river turbulence--or the (dramatic) potential of trees being uprooted or stuck logs being dislodging as a result of an upstream storm.

Each of the three systems is operating in our contemporary health care systems. Both proximal and distal information is required to plan for and navigate the turbulence and "storms" which health care leaders face. These leaders and these systems align directly with a distinction we featured in our previous essay (Fish and Bergquist, 2023). This important distinction has been drawn by Dave Snowden (2023) between clear, complicated, chaotic and complex systems. The clear system is found in frozen states, with the complex system being manifest in fluid states and the chaotic system in gaseous state. As we noted in our previous essay, there is a sustained preference among human beings for systems that are clear (or at least complicated). However, we often live and work in environments that are complex or even chaotic—especially in the realm of contemporary health care. Given the presence of these challenging environments, it is worth learning more about each in our role as leaders of health care organization.

The First State: Water

Complex adaptive systems operating in a fluid state are often turbulent—especially when it is water rushing across a rugged surface. Actually, the surface doesn't even have to be particularly rugged. Any body of water will move into a chaotic state of turbulence if it is moving fast and being pushed even faster. Most particles operating in a fluid state will tend to form layers (called laminar flow) (State A in Graph Two). These layers can flow smoothly with very little interaction; however, they tend to interact and create turbulence when moving rapidly (State B in Graph Two).

Graph Two: Laminar (A) and Turbulent (B) Flow



Another analogy for decision-making within a complex adaptive/ dynamic system is surfing....in which the waves are moving, as dynamic attractors, and the surfer the interested agent, making decisions on when to engage with the wave, how much force to enter the wave, when to stand and how to move.....with the outcome a joyful ride to the shore. A team of surfers would be several surfers engaging the same wave in an orchestrated fashion. Leadership is like surfing chaos---it's directional, rapid decision-making with limited information, involves vision (need to "see the waves coming").

As Ralph Stacey (1996) has noted, a system moves from complicated to complex when feedback is distal (distant) ("the wave is forming") and assessment in more complicated ("will this really form into a ride-able wave"). In tracing out the implication of what Stacey has proposed, we suggest that decisions in health care systems tend to move from those that are proximal and made in an Emergency Ward ("clear") to those that are distal and made about the assignment of patients to long-term care facilities ("complex").

Frozen System	Clear	Causality and Order dominate
Fluid System	Complex	Feedback and Emergence dominate
Gaseous System	Chaotic	Initial States and Randomness dominate

One of our favorite Buddhist sages, Pema Chodron, teaches that learning to rise off the ground and move with the waves decreases getting knocked over by them--letting go can be safer than "standing firm" when it comes to waves. Buddhists also talk about universal conditions via waves. Many state a human individual life is like one of the bubbles on top of the wave. We are bubbles on the wave (individual, temporary life) and we are water (universal, connected life), which we also find helpful. We spend a great bit of our life trying to become the most amazing bubble ever---while missing the deeper connected life of just being water.

Patterns can emerge through distal feedback into waves within the water---most notable with large bodies of water in which the forces of wind, storms, the moon, earthquakes and gravity can suddenly and forcefully create tidal waves that break through previously boundaries such as the shore. These fluid dynamic systems wreak havoc in chaotic fashion through towns, villages and cities. As climate change produces higher and higher sea levels, such events appear destined to increase---making the concept of

a floating city quite relevant. This concept is something like the Buddhist notion of floating with rather than being rolled & crashed by waves, Floating cities might withstand rising seas in decades to come. This is much like our collective, second order learning and collaborative slow thinking about the mistaken building of rigid bridges. These “frozen” constructions tended to achieve harmonic resonance during windstorms and collapsed. “Fluid” buildings withstand earthquakes when allowed to roll with the earthen waves. Flexibility, not rigidity, is the order of the day when it comes to “wavey” states, especially those demonstrating turbulence.

Kayaking in a Turbulent Adaptive System: turbulence is not so clear when focusing on the earthly landscape, except where earthquakes are concerned. We do find clear and tangible evidence of turbulence in the air--and especially in aquatic environments. For example, one of us [JF] went kayaking recently with a dear friend on the Carquinez Straits delta near Benicia in Northern California. We do this every few weeks, yet it is never the same delta. As Heraclitus teaches us

> *No [one] ever steps in the same river twice, for [they] are not the same [person] and the river is not the same river. ----Heraclitus ~ 500BC*

We have to time our trips to the tides & weather. Otherwise, we have to cross 200 meters of mud to get to the water. We do our best to launch and return on the back of high tide.

So, we often set out about 3 hours after low tide. On this particular day there was no wind and we hadn't travelled up-the-delta for several sessions, so we decided together to go up-the-delta. We had assessed the static, warped plane of the delta. We combined that with our preferences and interests (our oscillations between pathways). Our decision was to pursue the valley-path toward the Benicia Bridge. Initial conditions all pointed to a calm and joyful trip for us both. Yet, we were not truly entering a static warped plane. Rather, we were engaging with a dynamic combination of rivers, tide, oceans, winds, and a very narrow strait with rigid shores that could change our experience at any moment. We usually like to have an easier time coming back, but the absence of wind and the calmness of water made those "turbulence" factors less powerful at that moment, so up-the-delta we went.

Oh, it was JOYOUS, we quickly realized the incoming tide was carrying us rapidly up-the-delta---overcoming the rivers force. At one point we noticed very odd turbulence---we engaged in a proximal assessment and as a result laughed and called it Atrial Fibrillation of the water, given it’s random, irregular pattern. The water tossed and churned in random ways without discernable waves (waves can tip a kayak very suddenly and must be traversed in a very specific way to avoid toppling over). At that time there was no real wind, only very choppy water. I made a note to myself "I think this random turbulence is the equal force of the river meeting with the force of the incoming tide and I haven't seen that before....wonder which will be stronger on the way back?" I was recognizing dynamic processes yet was not moving that uncertainty into any kind of effective distal assessment or prediction about what was happening. We were rapidly heading toward the Bridge having extended very little effort and enjoying the unique, choppy water and absence of Oil Tankers (which create patterned waves as they pass).

By the time we arrived at the Benicia bridge it was very clear the tide was winning the duel of the water forces. The river was going backwards. As we stopped paddling, we kept moving nearly as quickly under the bridge. **Oh oh**. Yes, our ah-hah moment had arrived as we faced another decision-point in our travels and began making more meaningful distal assessments. It suddenly dawned on us that heading

home would be a very different kind of paddle. As our distal assessment kicked in, we begin to recognize we were going to have a different, tougher time getting back. We hadn't been paying attention to time during our joyful journey to the bridge, but now we checked on time. It took us 30-40 minutes to travel 6000 meters to reach the bridge, which is well beyond our kayaking abilities for sure. The tide had carried us to the bridge at a speed beyond Olympic kayaking in calm waters. We literally flew on the shoulders of the tide and now began to hope the tide would join us again on the way back home. In the absence of earlier distal assessments, we found ourselves languishing in wishful distal thinking, one might call it magical thinking.

We began our journey back. As if wanting to add to our mounting dilemmas, the wind picked up quickly and conspired with the Tide to press us back toward the bridge (a bit of magical proximal thinking). Now we faced large white caps that drenched us and water-weighted our kayaks, nearly tipping us both over several times. Through this conspiracy of tide and wind, the flowing ocean water was overwhelming the river. These conspiring conditions had now created a high-risk situation for two weekend kayakers. Our joyful flight to the bridge had now become a death-defying race against a wicked churning river-like riptide going the opposite direction of home. Our mind-set of a joyful paddle through a tranquil lake-like delta had now become a life-endangering battle that would push both of us to the brink of exhaustion and risk our sinking in the chilly waters of the delta. Perhaps we call them deltas as they are so ready to change at the whims of winds and tides.

Any cessation in paddling led to rapidly moving back toward the bridge. My anxiety rose, adrenalin flowed, my attention focused, I realized I must paddle continuously as strongly as I can to overcome the turbulence tide. The wakes and waves might turn over my kayak if I am at the wrong angle and not moving. Our pleasant kayak was converted to a risky, exhausting test through conspiracy of tide, wind and river....making our decision to go up-the-delta 45 minutes earlier look foolhardy at best. Our proximal, frozen state thinking based on the assumption of a static, flat plane had now become the fluid thinking of a dynamic, turbulent delta—a warped plane that was constantly moving. We had failed to do any distal assessment of potentially dangerous conditions.

Water and wind in a tightly bound delta provide a dynamic waterscape that vividly (and dramatically) represents complexity and mystery. How did we miss this coming? Many important questions were never asked. Why weren't there other kayakers out on the water this day? How could such a calm day become so hazardous in just 45 minutes? Being caught off guard in over-simplified and frozen thinking states can be overwhelming and lead to deeper questioning---stirred by fear and awe at the rapid turn of events. It is easy to scurry back and forth in our fast (desperate) thinking and acting.

Something more powerful than humans is at work. Some of us call her Mother Nature, others God, or gods, yet others Spirit, Giaia, etc. Yet regardless of beliefs, the rapid shift from apparently simple (frozen) to chaotic (vapor) states creates a profound search for the meaning behind the shift. Second-order learning and slow reasoning were standing at the door, waiting to be invited in. We joked that Neptune was punishing us for the arrogance to go up-delta. We noticed there were no boats out on the water. We wondered, did other people know better than us that this was not a good day for a gentle kayak?

I felt frustrated with the elements as I had to paddle with one arm for nearly 3/4 of the way back as the wind also conspired to turn my kayak away from the shore to which I needed to arrive. I wondered if I fell in, would I have the strength to swim to the shore? I was at that edge between life and death....and

that mystery led me to think about God, Neptune and Mother Nature in ways that were not positive. Perhaps it is our tumbles from frozen simple states into chaotic vaporous states that are a primary source of our beliefs and experiences of the divine, of powers beyond us humans? Do these beliefs, in turn, lead us to second-order learning and slow, thoughtful reasons—or do these beliefs enable us to escape into some state of primitive (habitual fast) thinking. In our frozen state, do we yearn for a simple, bounded pathway that is created and maintained by some divine being. Do we want our world to look like the childhood toy that enabled us to roll balls unfailingly from top to bottom.

In a previous essay (Fish and Bergquist, 2022), we distinguished between puzzles that have simple answers and are readily managed, and problems that are multi-dimensional, complex and not easily understood or managed. While kayaking on the river we found that a puzzle (which way to paddle today) became a problem (how far do we go before we turn back, the tide seems strong). IN our first essay, we also distinguished between problems (with one goal and one viable solution) and dilemmas (with two or more desirable goals and multiple solutions). I faced a dilemma: do I stay with my friend or paddle my heart out. Can I stop or will that pull me back to point I won't make it back to our destination? I stopped looking for my friend. I risked turning over if I turned my kayak around to look for him.

We also considered the shift from dilemma to mystery in our first essay. Mysteries are those conditions (both positive and negative) that are not in our control—and ultimately are not comprehensible and are felt deep within our soul. In my case, the mystery was stark: I wonder not only if my friend is OK but also if I was being unfair to paddle on like this. Has he drowned? Should I just go to the shore, walk to my car and go pick him up? It turned out that my friend had stopped momentarily to take some photos, leaving him a half-mile behind me and out-of-site for the entire trip back. We usually talk during these outings. Mysteries have a way of demanding silence—as does a recognition that distal planning was absent. No challenging questions were asked and slow analytic, pre-departure thinking was subordinated to our fast-thinking delight at the prospects of once again getting on the water for a day of pure delight.

Turbulent Complexity: our turbulent water metaphor will likely help us produce some second-order learning and encourage us to do some distal planning in the future. In reflecting on the challenging kayak trip, we see the impacts of the Turbulence and Contradiction aspects of VUCA-Plus and complex systems. The harrowing experience of this trip adds a level of dynamism that perhaps the ball-in-valley cannot. In the end, the static, warped plane resides more in the world of complicated, yet introduces us to the world of the complex (Miller and Page, 2007) ---through oscillation and emergent pathways. It is necessary to gain understanding of complex systems, yet insufficient to demonstrate the full impact of dynamic, complex systems in human organizations and experiences.

There is the matter of postlude when we return to the story of kayaking on a turbulent river. Fortunately, there was not a tragic ending. Once we finally made it back to our home shore, we joked "can you believe people row around the world? We barely made it in a controlled delta with land on both sides just because of a little wind, tide and river conspiracy to increase the risk of our little adventure." Thankfully we were able to adapt our mind-set from simple to complex so we could safely make our way home. Not everyone is able to do that, however, as we learned when we later read about a tragic event in the newspaper.

A star baseball player in a local high school jumped into a Lake to fetch his drifting raft. On any ordinary day, such an event would end with this young athlete rescuing his errant raft. He would subsequently enjoy BBQ and floats across the lake on a lazy afternoon with friends. However, on this same day, wind conditions were shifting. He eventually drowns while trying to fetch his raft on Lake Berryessa in Napa California. This baseball star was an accomplished swimmer. The raft was clearly in site. He was swimming in a lake that is usually calm. It has clear nearby shores and is not as vast as the ocean. Yet, in that moment on that day, the wind and the mud and the water overwhelmed the simple, frozen task of swimming out to rescue a raft. Why had the raft drifted out from the safety of the shore? Likely, the wind had blown it there, the same wind that would pull the water away from the shore---thus creating a micro-riptide of its own, catching the athlete by surprise.

Perhaps if he had been able to shift to a complex, fluid thinking state in that moment, he would have chosen to let his raft drift out further. He could have asked for help from someone with a boat which could safely capture it. He might have been able to conserve his energy for a tough swim back to the shore had he recognized the turbulent flow of the lake. Alas, instead he swam to his death, to be mourned by his community and friends in yet another tragic drowning that takes several people's lives every year. What VUCA-Plus condition was he not prepared for in that seemingly simple puzzle? The consequences of our mistaken perceptions can be fatal when we only see a puzzle where mother nature creates turbulent problems and ultimately, incomprehensible mysteries.

Many options are available when we find ourselves in a Fluid State. Many paths can be taken. We are confused, in a frenzy, undirected. We can illustrate this state by turning to the flocking of birds--which we have described in one of our previous essays (Fish and Bergquist, 2023). We noted that birds tend to flock because predators find it hard to focus on any one bird in the flock. The same reason exists for the schooling of fish. Let's take the perspective of a hawk. He is swooping in on the flock of birds. However, there are so many options for a bird to grab that he loses focus and can't home in on any one bird. The hawk swopes through the entire flock and catches none of them. His only hope is that there will be a bird flying independent of the flock on which he can focus.

Not only do birds flock and fish swim in schools, the challenges we face as human beings also often come to us as swarming messes (a term we used to describe problems with many layers that are often shifting). More precisely, challenges that are fluid in nature can often be difficult to address. Like the Hawk, we find it hard to concentrate on watery issues. As we have already noted, laminal dynamics provides clear distinctions and separations between two or more layers of moving fluids. However, as we have also noted, when fluid systems are pushed hard the layers tend to interact. Turbulence reigns supreme—and we must adapt or fall victim to the swirling confusion. We become Hawks who fail to achieve anything.

The Second State: Ice

We have already identified the way in which this state is manifest in certain mid-management conditions. We described frozen middle management and related it specifically to an unwillingness to reduce boundaries (so that the ball/issue will always be contained and its movement predictable). The frozen state can actually be as damaging as the fluid state—or even more damaging. In a frozen state, we are like marsupials who are trying to avoid the lion by standing absolutely still.

An important difference is to be drawn. The marsupials begin to “shake off” the accumulated adrenaline after several seconds. Human beings remain frozen. They rarely shake anything off (perhaps going for a run or swimming several laps). This failure to drain off the adrenaline leads to a very destructive state physically and psychologically. It is even more damaging if we are facing the challenge of a Frozen dilemma. We are embedded in "Locked in" polarities with eternal swings back and forth. Are these frozen dilemmas (as "Sacred cows") even (or ever) discussable? The same applies to "third rails" that seem to be societal sacred cows regarding what we are to avoid at all costs. We can’t talk about the elephant in the room (usually a vividly imagined lion), thus remaining terrified and frozen, with adrenaline (and other activating hormones) coursing through our veins.

The Third State: Vapor

When water has turned into vapor—a gaseous state—then a system is in complete chaos (with minimal structure, seemingly random behaviors and absent or indiscernible causality). The elephant is loose and destroying everything. The framework of complexity that has been offered by Snowden (2023) – presented in our previous essay in this series (Fish and Bergquist, 2023)--includes a dynamic link between Clear and Chaotic states. He describes a a short-circuit slide over a cliff of clarity into a sea of chaos. This slide suggests a rapid rise in energy from a frozen to a vaporous state without moving through the fluid or complex state. Such sudden shifts create a level of crisis which can be fatal if not navigated properly—as may have happened with our athlete who drowned in Lake Berryessa.

Snowden advises that a specific action be taken: a sense-respondent mind-set is established when confronting a chaotic system. This is a mind-set that enables engagement of novel practices. For example, there is no question Covid-19’s influence on healthcare was to push it into the short-circuit toward chaos in a matter of weeks to months. Critical care units were overflowing and chaotic. Dead bodies were collecting in freezer trucks parked outside of the Emergency Departments. There was a major breakdown of civil engagement between patients and those nurses, physicians and others who provided care in a high-risk environment. Our healthcare systems were plunged into a vast and choppy sea of chaos. Members of the health care systems throughout the world had to survive in their own unstable kayaks. We continue to struggle with a successful emerge from this chaos even several years later. Turbulence still swirls around our hospital corridors and physician offices.

There was also the upside of this crisis—related to Snowden’s mind-set. Novel practices like telehealth emerged and grew exponentially after decades of neglect. However, several disturbing questions remain unanswered. As the virus begins to recede from our daily lives, will the state of absolute chaos win out over the interplay between order and chaos that resides at the heart of complex, adaptive systems? Were we locked into an over-simplifying, clear mind-set of puzzles and problems, finding ourselves awash with chaotic and disruptive energy and events that spilled us over into chaos and disorder? Can we regain the health and strength of our healthcare systems by now shifting our mind-set away from frozen-thinking and vapor-chaos crisis toward a more effective and sustainable engagement with complexity in healthcare? How many swimmers drown in the sea of Covid while trying to fetch their life-raft of liberty from masks and social distancing? How many drown in the sea of loneliness and despair as they become isolated from their life-raft of support and social joy?

Portrait Three: Navigating an Emergent System

There are many insights to be gained regarding navigating on warped planes and turbulent seas. However, there are additional insights to be gained from an exploration of what are often called Emergent systems. We propose that a key aspect of complexity is often overlooked—and wish to portray this aspect by turning to the phenomenon of emergence. We believe that one of the greatest shortcomings in healthcare leadership concerns a lack of recognition that you simply have to "start something" and then move on to something else. At some point, there will be a tipping point when nothing remains the same. A revolution takes place. Pieces of hay accumulate and at some point, we have a haystack.

In recent years, there has been a push for urban renewal that focuses on these small steps that lead to a revolution. Specifically, an urban reformer begins by fixing the broken windows that are to be found in many “run-down” areas of a city. Then, it is time to move on with more extensive “repair” of the broken social service system as well as broken streets, buildings and transportation systems. Small, evolutionary steps (repairing broken windows) are engaged and at some point, everything begins to move and change. Evolution becomes revolution because the system is complex and not just complicated. Not only are windows and streets fixed, but the place gets cleaner, people are kinder to one another, and crime drops off.

Miller and Page (2007, p. 4) put it this way when posing a challenge regarding the relationship between emergence and the creation of a complex adaptive system:

> What it takes to move from an adaptive system to a complex adaptive system is an open question and one that can engender endless debate. At the most basic level, the field of complex systems challenges the notion that by perfectly understanding the behavior of each component part of a system we will then understand the system as a whole. One and one may well make two, but to really understand two we must know both about the nature of "one and the meaning of "and."

Miller and Page are suggesting, in essence, that when two (or more) entities are brought together that sometimes will surprise us and produce something that could never be anticipated when examining each of these entities separately. The “and” is the key here: somehow the “two” make up more than the two “ones” when viewed separately. The usual example used to illustrate this “emergent” dynamic is the outcome arising from the combination of two parts of hydrogen with one part of oxygen. These two gases surprisingly produce an entirely different and totally unpredictable entity: water. The “and” in this case is this chemical reaction has to do with the heat that accompanies the mixing of these two gases. Nothing happens if there is insufficient heat.

Type One Emergence: The example of emergence we have just offered is what might best be identified as Stochastic Emergence. It is all or nothing. At room temperature nothing happens with hydrogen and water. Add the right amount of heat and something radical happens. There is a tipping point that leads to a revolution. We can't anticipate the new entity. We can only adapt and learn from it. Many share the story of the frog dropped in boiling water---either immediately jumping out to live or being boiled alive very suddenly. Adapt or die might be the calling card of type one emergence.

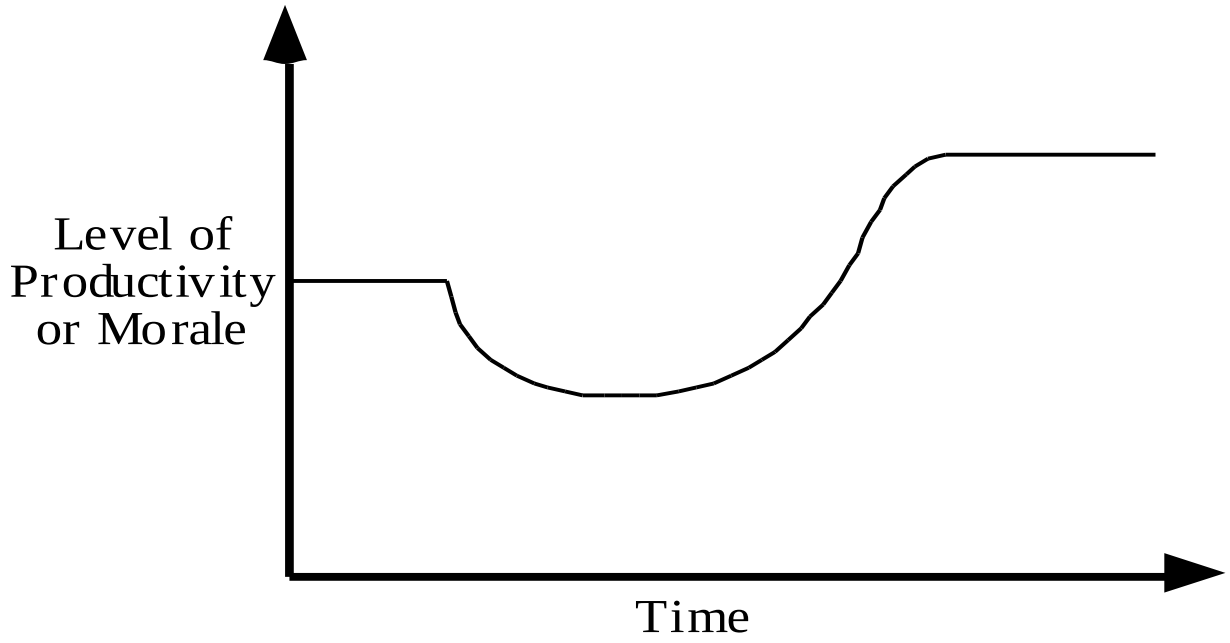
Type Two Emergence: This type of dynamic change might be defined as *Spectrum Emergence*. There is gradual change and gradual recognition of this change. There is evolutionary rather than revolutionary change—that is only acknowledged as revolutionary at some later point. Our broken windows scenario exemplifies this second form of emergence. Recognition and acceptance of the change diffuses slowly and often in stages (Rogers, 1995). We can begin to see/anticipate outcomes as the diffusion takes place.

There is the widely told (and somewhat disturbing) example of placing a frog in a slowly warming pot of water. Something remarkable happens (at least hypothetically) when we place a frog in a cool pot of water and slowly heat the water. The frog may not notice the gradual increase in temperature and not achieve the signal to jump for his or her life. As a frog, we must have higher levels of sensitivity to the shifting states. As a sensitive frog we will live, jumping out well before it becomes too late. We will boil to death If we are a stubborn frog who denies the reality of rising temperature. Discernment, feedback sensitivity, and adjustments---rather than reflexive decision-making---dominate our adaptive behaviors with Spectrum Emergence. A bit of distal assessment and slow thinking will also be of great value if we are human beings who confront the challenge of Spectrum Emergence.

Emergence and the Change Curve: the demand for change is often apparent when facing either a type one or type two emergence. This change might occur “on time” or “too late” (in the case of the stubborn frog). It might be a change that requires major adjustments (revolution) or minor tweaking (evolution). Regardless of the timing or size of the change, it will usually lead to a temporary (perhaps even permanent) reduction in productivity and morale among those facing and engaged in the change (see Graph Three).

As things get “worse” there will be an inclination to go back to the old way (which introduces yet another change and the creation of a new change curve). Alternatively, there is the temptation to try something else (introducing another change curve). Organizations often go through a succession of changes—with each one further reducing productivity and morale (see Graph Three). The process of change itself becomes the major issue. Ralph Stacey (1996) might suggest that the organization has moved beyond the states of complication and complexity to one of Anarchy.

Graph Three: The Change Curve



Type one emergence is likely to produce a deeper change curve than type two emergence. The change curve is likely to be deeper if: (1) the concept of emergence (and newness that it produces) is not understood or anticipated, (2) the emergence impacts broadly in the system and (3) the emergence is not accompanied by significant training, education and potentiality of changes. We often find not only that productivity and morale drop with the introduction of emergent newness, but also that the drop is energized by the "surprising" impact of the change. Even if it is a positive surprise (as in the case of the broken windows initiative) adjustments that are suddenly needed can be quite stressful.

Clearly, the change curve that is produced by emergence must be carefully managed—though broad-based recognition of the complexity involved in any major change project and through the formulation of realistic expectations regarding the length of time needed for the change to "take hold", clearly defined criteria and timelines for evaluation of the change, and devotion of sufficient resources to the training and education required for the change to be effectively engaged (Bergquist, 2014).

Conclusions

Covid has revealed the need for us leaders to learn to navigate VUCA-Plus and reshaping of our CAS over time. That means we have to learn how Attractors are built and impact things---sometimes predictably, sometimes not. About 15 years ago, one of us [JF] was struggling with "Sacred Cows" at his previous job. My conclusion there was that our Sacred Cows were "frozen dilemmas" that had been oversimplified by

prior leaders into Right/Wrong declarations. They became "sacred cows" because no one knew where they came from, but everyone knew if you crossed into that zone, you'd get pummeled by the institutional bullies who see their cause as maintaining Sacred Cows.

Sacred cows might be difficult to address if they are framed as polarities. They become dilemmas that are frozen in place by two opposing positions. A Sacred mythology is created when any social system is faced with the challenge of staying in the same valley or entering a new valley, “do not tread here or you will die!!"Don’t even consider staying in the same valley (“we must innovate or die!”). Don’t even consider moving into the new valley (“we have no business making these big changes!”) It was not long after successfully confronting and leading transformation around a Sacred Cow at his workplace that JF found he needed to leave from a place he had loved to work for over 2 decades to start fresh in a new role in a new place. There is a price to be paid for melting frozen Sacred Cows.

A strong decisive leader enters to preclude any collective decision regarding next steps that take into account both sides of the polarity. The river gets rough when only one option is considered. Soon, the strong leader is cast out having failed to make the right decision in the midst of turbulence. There is more change. The change curves multiply. New valleys are discovered, old valleys are rediscovered. Eventually, comes an appreciation of the complex (and hopefully adaptive) nature of the world through which we are travelling individually and collectively. In our next essay, we focus specifically on the turbulent, often bi-furcating and changing journey of contemporary health care leaders and entire health care systems.

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