The Universe at Minimum Energy

Theory and Metaphysics of Quantum Fatalism

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"Nature never does anything superfluous."

— Aristotle

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Introduction

Light, the Sphere, and the Cost of Thought

In the seventeenth century, the mathematician Pierre de Fermat formulated a principle that changed our understanding of nature forever. Observing the behavior of light, he intuited something precise: a ray of light traveling through different media — such as air and water — does not choose the geometrically shortest path, but the one that requires the least time. Light instantaneously calculates the most economical route. This is the celebrated Fermat's Principle, or the Principle of Least Time.

If we shift our gaze from light to matter, we see the same principle at work in a soap bubble. Its spherical shape is not an aesthetic choice, but the geometric solution that minimizes surface tension. In every corner of the cosmos, nature obeys an imperative of efficiency.

Quantum Fatalism extends this physical intuition to the metaphysics of consciousness. What if human destiny followed the same logic as Fermat's ray of light? What if events occurred along the lines that require the least processing effort for the system in which we are immersed?

This is not a theory of resignation. It is a theory of the choice of moment: learning when to act, where to invest effort, how to recognize the moments when the system is permeable to change. Just as it is possible to divert the flow of a river when it is dry by shifting its bed, but not when it is in flood. The strength is not lacking. What is lacking is the knowledge of the moment.

It is necessary to clarify immediately what this theory is and what it is not. Quantum Fatalism is a descriptive theory, not a prescriptive one. It provides no ethical guidance, makes no distinction between good and bad outcomes, and passes no judgment on the choices of individuals. It describes the energetic structure of the system within which choices occur. The ethical implications of those choices belong to a domain this theory does not claim to cover.

It is equally necessary to clarify the nature of the system this theory addresses. The system is not an external force operating on individuals, not a cosmic plan, not a transcendent will. It is an emergent property: it arises from the interaction of the individuals who compose it, evolves with them, and would cease to exist without them. It is not a cause; it is an effect. It does not operate from the top down, but emerges from the bottom up.

A preliminary epistemic note on the concept of energy used in this essay. The term energy is employed at three distinct levels: physical, where it is measurable in joules as in the gravitational potential energy equation; informational, where it finds a formal definition in Friston's Free Energy Principle as the discrepancy between the internal model and external reality; and existential, where it describes the cost a system pays to maintain itself in states of disequilibrium. This last level is observable in its effects but not yet formally definable in a way unified with the first two. Quantum Fatalism uses energy as an umbrella term for all three levels, explicitly acknowledging that a unified definition is not yet available. Describing the structure of this cost without claiming to measure it is the epistemic position of this theory.

Quantum Fatalism converges with the Free Energy Principle of neuroscientist Karl Friston, who demonstrates on a mathematical basis that every biological system acts imperatively to minimize

the discrepancy between its internal model and external reality. This convergence is not coincidental: both systems describe the same phenomenon from different angles. Where Friston provides neuroscientific rigor, Quantum Fatalism provides the existential and systemic framework.

These pages are an attempt to build that knowledge on coherent physical, mathematical, and philosophical foundations.

Chapter I

The Physics of Equilibrium: The Principle of Minimum Cognitive Load

1.1 The Ball on the Hill

To understand Quantum Fatalism, we must redefine the concept of energy. No longer merely joules or mechanical work, but computational cost: the cost a system pays to maintain itself in a state of disequilibrium.

Imagine a ball placed at the top of a hill. Physically, it has high potential energy: the system is charged, tense, unstable. It must continuously process corrections to remain in that position. When the ball rolls downhill, the system is not merely obeying gravity — it is resolving a conflict. The state of rest at the bottom is the state of lowest management cost.

Mathematically, this is described by the gravitational potential energy equation: $U = mgh$, where m is mass, g is gravitational acceleration, and h is height. Nature operates to minimize U. This principle, in its simplicity, is the key to understanding the deep structure of events.

The ball follows a precise trajectory determined by the geometry of the terrain it is in. An individual follows something analogous: a natural trajectory determined by the structure of the system in which they are immersed and by what they bring to it. This trajectory is what this essay calls a **geodesic**. It is not a written destiny: it is the line of least resistance available at this moment, in this system, with this internal configuration. As we will see in Chapter V, the geodesic finds its most precise formalization in Riemann's geometry.

In the Free Energy Principle, Friston describes the same mechanism in neurobiological terms: the brain continuously generates predictions about what will happen and measures the discrepancy between these predictions and the sensory data received. This discrepancy, which Friston calls **surprisal**, is the acute cost the system pays at the moment reality contradicts its internal model. It is the same ball on the hill, described in terms of information rather than gravity.

1.2 Surprisal and Cognitive Load: Two Measures of Cost

Before proceeding, it is necessary to distinguish two concepts that this essay uses precisely and non-interchangeably.

Surprisal is the acute cost: the measure of the discrepancy between the internal generative model and sensory data received at a specific moment. It is the immediate signal that the model needs updating. It manifests as a sudden sense of friction, unexpected resistance, disproportionate effort relative to what is being faced. It is what one feels when an epiphany appears and rationalization begins building above it to suppress it.

Overall cognitive load is the chronic cost: the sum of all active unresolved processes in the system at any given moment. It includes acute surprisal but also the cost of maintaining defensive models, of unresolved situations consuming resources in the background, of lies requiring memory to sustain. It is what accumulates silently and which anxiety signals when it becomes unsustainable.

An individual can have low surprisal at a specific moment but high overall cognitive load, because they are sustaining many unresolved background processes. And conversely: high acute surprisal but low overall cognitive load, because their system is sufficiently free of unresolved processes to manage the surprise without collapse. The distinction is diagnostically relevant: acute and chronic anxiety signal different system states and require different responses.

1.3 Productive Effort and Sterile Effort

Quantum Fatalism does not condemn effort. Effort is the only tool with which the system's geodesic can be permanently modified. But a fundamental distinction exists: the difference between productive effort and sterile effort.

Productive effort does not act directly on the geodesic. It acts on the curvature of the cognitive space in which the geodesic is calculated. Like shifting the riverbed, it does not change the water's direction in that moment, but changes the path the water will instantaneously calculate in the next moment. The geodesic is always instantaneous, like a rainbow: it describes the path of least resistance available now, in this system, with this configuration. Productive effort modifies the landscape in which that rainbow forms.

Sterile effort fights what the system does not permit changing in that moment. It produces no structural modification of the cognitive space, only acute and chronic cost without output. The correct question is not whether one has the strength to change something, but whether this is the moment when the system is permeable to change.

Someone who carries an authentic epiphany and finds themselves carrying it alone is not spending sterile effort even when the field seems to resist. They are modifying the curvature of the collective cognitive space at a moment when the field is not yet saturated but is becoming so. The resistance they encounter is not a signal that they are wrong: it is a signal that the informational tension in the field has not yet reached its critical threshold. The effort is productive because it contributes to saturation.

Friston describes this through the concept of **active inference**: the system acts on the environment to make it more consistent with its own expectations. Active inference is effective when it intervenes at the moment when the system is permeable, when the cost of intervention is lower than the cost of maintaining the disequilibrium.

1.4 The System as Emergent Property

Our lives follow the same principle. An unresolved situation, a lie requiring memory to maintain, a job that contradicts one's nature — these are active processes that continuously consume resources, increasing the system's overall cognitive load without producing useful output.

The minimization of cost described by this theory is always local and contextual, not global and absolute. The system does not tend toward a final universal equilibrium: it tends toward states of lower cost in the specific context in which it operates at that moment. When that context changes, the geodesic reorganizes.

The system never explicitly certifies which choice is correct. But it constantly provides the cost of each configuration through acute surprisal and chronic cognitive load. Learning to distinguish the

two signals and read both is the work that allows one to recognize the moment when the system is permeable to change.

Chapter II

The Observer and Reality: Peculiar State, Contextual State, and Choice

2.1 The Double Slit and the Role of the Self

One of the most precise experiments in quantum physics, the double-slit experiment, shows three things. A photon fired toward two slits, as long as no one measures which one it passes through, behaves like a wave and produces an interference pattern: the two possibilities do not add up, they combine, and the result cannot be reduced to either of them taken separately. When one measures which slit it passes through, the pattern disappears: the question itself destroys the combination. And the observer asking the question is not outside the scene: it is an apparatus that interacts with the photon, and that interaction is what changes the outcome.

Quantum Fatalism uses this structure as a **model of choice**, and it must be said at once in what sense. It does not claim that consciousness is a physically quantum phenomenon, nor that the brain maintains states of superposition. It claims that the structure of choice has the same form: facing the future, which presents itself as a combination of possible states, the self is the observer that precipitates the combination into a single real state. Three consequences follow from this form, and the essay develops them in the following chapters. The first: the question "which way" has a cost, because it destroys the low-cost combination that precedes the decision (Chapter III, section 3.5). The second: the observer is internal to the system, and its act of observation modifies the system it observes (Chapter I, section 1.4; Appendix III). The third: what the self perceives before choosing is not the list of alternatives but a distribution, and this partial vision is structural, not a defect (section 3.3). The word "quantum" in the title indicates this form. It does not indicate a substrate.

But the self never enters a system as a neutral variable. It brings with it what Quantum Fatalism calls the **peculiar state**: the specific structure of its internal model, built over time through the quality of attention with which it has traversed experiences. It is not a quantitative archive of accumulated experiences. It is not measured in the number of contexts lived, places visited, or education received. It is measured in the depth with which each experience was traversed, in the capacity to observe the system one is immersed in without unnecessary resistance, in the openness to what happens without the need to reduce it to pre-existing schemas. A farmer who traverses drought by observing the system in which they are immersed develops a peculiar state as rich as an academic who has traveled the world but traversed everything with cognitive noise. It is not what you live: it is how you live it.

2.2 The Quality of Attention: A Precise Definition

The quality of attention is the most central concept of the framework and requires a precise definition. In the Free Energy Principle, Friston describes it through the concept of **precision of beliefs**: the measure with which the system is willing to update its generative model in response to new data, instead of suppressing it to maintain internal coherence.

High quality of attention means high precision of incoming signals: the system is permeable, updates its model, integrates the new without defensive resistance. It is the state in which epiphanies have a clear path.

Low quality of attention means low precision of incoming signals: the system is rigid, suppresses data that contradicts the pre-existing model, preferring to maintain internal coherence at the cost of increasing actual cognitive load.

It must be specified, however, that permeability is not a monotonic good. A system that updated its model with every single datum, without any resistance, would no longer have a model: every experience would erase the previous one and no structure could accumulate. Total rigidity and total permeability are two symmetrical pathologies, not the two ends of a scale running from worse to better. The quality of attention is the capacity to weigh each signal correctly: to update the model when the signal requires it, to preserve it when the signal is noise. It has an optimum, not a maximum. It is imprinting, with its rigid priors, that provides the stability on which permeability can work without dissolving the system.

The quality of attention is not fixed. It is progressively built through every experience traversed with the permeability appropriate to that signal. Every time the system weighs an update correctly, accepting it or rejecting it for the right reason, its capacity to weigh future signals increases. Every time it suppresses out of defense or accepts out of inertia, that capacity decreases.

2.3 Imprinting and the Starting Point

The peculiar state does not arise neutral. It forms from initial priors — baseline beliefs built in the early phases of existence through a mechanism of mimicry: just as a stem cell replicates the schemas of neighboring cells, the nascent system replicates the energetic schemas of the field in which it is immersed. This is **imprinting**.

Imprinting is not determinism. The individual is never passive even in these stages: they already have a propensity, already an embryonic quality of attention that interacts with the environment in which it forms.

The schemas formed through imprinting have a paradoxical property: they are the most rigid but also the most recognizable. They are the deepest priors, those that replicate with the greatest frequency and coherence through all the systems the individual operates in over the course of a life. They follow the same autosimilar logic as fractals: the same structure repeats at every scale. They are visible precisely because they cost more, because they produce the greatest surprisal when the system encounters them. They are the rawest and most accessible material for the work of permeability.

2.4 Contextual State: What One Is in a Specific System

From the interaction between an individual's peculiar state and the specific field in which they operate emerges what Quantum Fatalism calls the **contextual state**: the individual's configuration within that frame of reference, their propensity in that context to lower or raise overall cost, the type of waves their geodesic produces in that field.

The contextual state is not fixed. The same individual can have very different contextual states in different systems, because it is the product of the interaction between their peculiar state and the specific characteristics of that field.

Free will is the capacity to progressively refine the peculiar state through the quality of attention, expanding over time the domains in which the contextual state is at low resistance. It is not freedom from necessity: it is the capacity to navigate it with increasing precision.

2.5 Degradation and Recovery of the Peculiar State

The peculiar state does not deteriorate in a binary fashion. It degrades along a continuum: from full permeability to progressive defensive rigidity. The process is reversible through two sequential mechanisms.

The first mechanism is **reduction of overall cognitive load**: the individual temporarily withdraws from the field generating the discrepancy. The system finds a moment of quiet, a stable low-entropy configuration. This is not structural healing: it is necessary suspension, to recover resources before facing the discrepancy again.

The second mechanism is **permeability**, understood in the sense of section 2.2: updating when the signal requires it, not indiscriminate openness. The individual decides to update their generative model instead of defending it. They accept data that contradicts the current model, process the accumulated cognitive load, and undertake a path of adjustment. It produces a permanent structural modification of the peculiar state.

The two mechanisms are not alternatives but sequential. Reducing cognitive load creates the space necessary for permeability. And this process also follows the same autosimilar logic: the way an individual manages a small rigidity of their generative model geometrically mirrors the way they will manage large existential rigidities, and the way a collective system manages its crises mirrors the way individuals manage their own.

2.6 Anxiety as a System Signal

In this framework, anxiety is not a pathology but a system signal. It must be distinguished in two forms. **Acute anxiety** is the manifestation of surprisal: it indicates that the internal model is encountering a discrepancy that requires immediate updating. **Chronic anxiety** is the manifestation of an unsustainable overall cognitive load: it indicates the system is sustaining too many unresolved background processes.

Making a decision, even a difficult one, is an act of entropic reduction that lowers acute surprisal. Resolving unresolved situations, eliminating useless background processes, updating obsolete defensive models — these are acts that reduce chronic cognitive load.

Chapter III

Epiphanies: Signals from the Field

> *"The heart has its reasons that reason knows nothing of."*
>
> *— Blaise Pascal*

3.1 The Nature of Epiphanies

Epiphanies are not sought. They appear regardless, as thoughts or possibilities of choice that emerge in the field of consciousness without having been consciously constructed. They are not just any intuition, not just any thought that crosses the mind. They are a specific subset of signals, distinguishable from ordinary cognitive noise by characteristics that each individual learns to recognize through their own subjective modalities.

The first common characteristic is that they cost nothing. Unlike rational elaborations, which require construction, comparison, evaluation, epiphanies emerge already formed, already at low energy. This is because the cost of their generation has already been distributed across the field that produced them. The individual does not elaborate the epiphany: they receive it.

Epiphanies manifest at at least three distinct levels of intensity:

1. **Clear epiphanies**: accompanied by a personally recognizable sensory signature at the moment they occur, a feeling of freedom of the idea from which one begins to think, a non-constructed clarity that clearly distinguishes itself from rational elaboration.
2. **Fleeting epiphanies**: almost imperceptible in the moment, recognizable only retrospectively when the schema manifests in outcomes.
3. **Signals in underdeveloped domains**: the signal arrives but the system has not yet built enough structure in that domain to recognize it reliably in real time.

There is never any external confirmation that a thought was an epiphany. No authority certifies it. Validation is always retrospective, personal, built over time by observing the schema of one's choices and their energetic consequences on the system.

3.2 Epiphanies and Impulses: The Structural Distinction

A fundamental distinction exists between an epiphany and an impulse, which does not lie in the outcome but in the structure of the signal. An epiphany emerges from an intact peculiar state, from a low-resistance system receiving the discharge from the field. An impulse emerges from a compromised peculiar state, from a system in which a specific signal has acquired structural dominance, suppressing the capacity to receive alternative signals.

In Friston's language, the compromised peculiar state is a generative model that minimizes surprisal through a pathological attractor set: the system remains locked in a local low-entropy configuration that produces high cost in the broader system in which it is immersed.

3.3 The Instantaneous Geodesic and Probabilistic Perception

The geodesic in Quantum Fatalism is instantaneous, like a rainbow. It describes the path of least resistance available at this moment, in this system, with this peculiar state. It continuously reorganizes in response to variations in the field. It is not a trajectory toward a distant goal planned in advance.

But the individual does not see the geodesic in its entirety. They perceive a probability distribution: a direction, a tendency, a sense of where the system is heading without a clear view of where it will end.

This partial vision is not a limitation: it is a necessary feature of the system. The film *Arrival*, adapted from Ted Chiang's story *Story of Your Life*, illustrates this dynamic precisely: the protagonist perceives her geodesic in its entirety, including its highest cost. But that complete vision does not produce wisdom: it produces either paralysis or obsession, both high-cost states. Probabilistic vision is the minimum-energy configuration of temporal perception. Enough to recognize the direction, not enough to be paralyzed by the destination.

3.4 Field Saturation and Spontaneous Synchronization

Collective epiphanies do not propagate through discrete connections between individuals. They emerge from the saturation of a continuous field. Like antennas in an electromagnetic field, individuals do not need to be connected to each other to receive the same signal: they simply need to all be immersed in the same saturated field.

To visualize the mechanism of spontaneous synchronization, a precise physical analogy is useful. In an ethernet network built according to a specific topology, it is possible for all nodes to receive the same data simultaneously. This occurs because the transmission speed determines a physical length for a single bit, measurable in centimeters. When the network length corresponds exactly to the bit length, all clients have simultaneous and instantaneous access to that unit of information. It is not coordination between nodes: it is a geometric property of the system.

Collective epiphanies work according to the same structure, applied to the field rather than the network. Informational density in the field increases progressively until a critical threshold. When that threshold is reached, the field discharges onto structurally compatible nodes.

The discharge does not occur simultaneously on all nodes. It occurs first on nodes whose peculiar state is structurally compatible with that specific type of signal. Someone who carries an epiphany and finds themselves carrying it alone is not necessarily ahead of the field: they are the point where informational tension discharges first because their peculiar state offers the most compatible structure for that specific signal at that moment.

In the Free Energy Principle, Friston describes this as a collective phase transition of the shared generative model: when the discrepancy between the shared internal model and emerging reality exceeds a critical threshold, the system is forced to update its model discontinuously.

3.5 What Happens Next

The problem is not generating epiphanies. The problem is what happens after they have appeared.

Rationality intervenes and builds above them. It adds variables, weighs conveniences, consults fears, compares scenarios. It transforms what was a low-cost signal into a costly and unstable cognitive process. The original epiphany does not disappear, but is buried under layers of elaboration that increase its cost without adding precision.

The most reliable signal that an elaboration is demolishing an epiphany is the growing complexity of the reasoning built to justify the resistance. The more elaborate the rational structure constructed to avoid following a thought, the more that complexity is proportional to the energetic cost wasted in opposing the original signal.

3.6 Deductive Capacity as Experiential Archive

Every event traversed, regardless of its valence, contributes to building personal deductive capacity and expanding the peculiar state. Not in the sense that one learns to recognize epiphanies as they occur, but in the sense that material accumulates for evaluating them retrospectively with progressive precision, and the range of domains in which the system is equipped to receive signals expands.

Over time, this archive allows one to recognize schemas: which types of signals, when followed, produced states of lower cost in the system, and which instead were rational elaborations disguised as intuitions. It is not a universal formula. Each individual builds their own archive, with their own perceptual modalities and their own recognizable schemas. The process is empirical, not prescriptive.

Chapter IV

The Shared Field: The Physics of Relationships

When two geodesics meet, a single thing happens, observable at two scales. At the scale of the instant, two nodes simultaneously deform the same region of the field, and the geodesic of each is recalculated on the geometry the other is modifying: this is the **perturbation**. At the scale of time, that deformation leaves a trace that is not reabsorbed, and redraws the future geodesics of all the nodes that cross that region: this is the **permanent deformation**. They are not two models. They are the same field, described at the moment it is touched and after it has been touched. The essay had previously used the languages of waves and of the field for the two scales; Appendix III shows that the second contains the first, and this chapter unifies them.

Before describing the two scales, a fundamental principle must be established: the significance of an encounter is not an objective property of the encounter itself. It is an emergent property of the interaction between the event and the individual's peculiar state at the moment it occurs. A fleeting encounter of a single word, the sight of an object, a person who triggers memories — these can permanently modify the field's structure if the peculiar state was in the right configuration to receive them. The same interaction is significant for one individual and irrelevant for another.

4.1 The Perturbation: The Encounter

At the moment of the encounter, each node is already deforming the field with its presence: its contextual state pushes the local geometry in one direction, the one that lowers its cost. When two nodes occupy the same region, the two pushes combine. If they push the geometry in directions that lower the cost of both, each finds its own geodesic easier than it would be alone: this is the encounter that "gives energy", and the energy is not a sensation, it is a measurable reduction of resistance. If they push in directions that raise the other's cost, each finds its own geodesic harder, and the surprisal grows for both.

There is a third case, which deserves precision because the essay had described it badly. Two equal and opposite pushes produce an apparently still geometry. It is not stability: it is a maintained tension. The field stays still only as long as both nodes keep pushing, and the cost of that push does not disappear, it accumulates. It is chronic cognitive load in the sense of section 1.2, not an energy minimum. The quiet that results is the quiet of two forces consuming each other. A relationship that "works" only on condition that neither stops compensating for the other has this structure, and its cost becomes visible the moment one of the two stops.

Compatibility between geodesics, therefore, has an operational definition: two contextual states are compatible in a field when the deformations they produce in it mutually lower the cost. It does not depend on the individuals themselves, but on what they express in that specific system. The same two nodes can be compatible in one field and opposed in another.

4.2 The Permanent Deformation: The Trace

The perturbation is not reabsorbed. Every significant encounter is a training step of the field: the deformation produced by the two nodes remains in the geometry after the nodes have moved apart,

and redraws the geodesics of anyone who crosses that region afterwards, including the two nodes themselves. This is the difference between the scale of the instant and the scale of time: in the first the field is pushed, in the second the field has learned.

The peculiar state of each individual is modified by the interaction, expanding or contracting the domains in which their future contextual state will be at low or high resistance.

The energetic evaluation of a relationship is never complete at the moment it is lived. The system does not certify in real time whether an interaction is lowering or raising overall cost. What it provides is the cost signal. The full evaluation is always retrospective.

4.3 System Asymmetry and Hidden Cost

An individual can perceive a strong increase in their own energy in a relationship and interpret it as a favorable combination of the two pushes, when in reality they are generating that energy autonomously, without the other contributing substantially to the field. At the moment of the encounter, the other's push is almost absent: the reduction of resistance the first perceives is produced by their own deformation alone. Over time, the other has left no trace: the geometry the first believed was built by two was built by one.

When the asymmetric nature of the system is made explicit, the collapse is one, but it strikes both scales at once: the push believed to be combined turns out to be single, and the trace believed to be shared turns out to be one's own. It is one of the highest-cost cognitive states a system can sustain, because the node must revise in a single moment what it was doing and what it had built.

4.4 Conscious Dissolution

A dissolution consequent to an epiphany shared by both nodes is a low-cost phase transition. The field has already accumulated the informational tension necessary before either node consciously receives it: from the field's perspective, the dissolution has already occurred, both geodesics are already reorganizing. The delay in conscious reception does not change the structure of the phenomenon. It follows the same logic as collective epiphanies: the discharge occurs first on the most compatible node, then on the other. It is no less simultaneous for this, because the simultaneity is geodesic, not temporal. What determines the low cost is not that both nodes update their model at the same instant, but that the field has already determined convergence before the discrepancy between the two models becomes unsustainable.

An unshared dissolution generates entropy. But this entropy is not a private property of the individual who generates it. It is a property of the field in which it is released. The field distributes it among all present nodes, regardless of its origin. An individual traversing a high-cost breakup in a field rich with low-resistance nodes dissipates that cost much more rapidly than one traversing the same breakup in a sparse field.

In Friston's language, conscious dissolution is a **Garbage Collection** function: it frees resources locked in no-longer-efficient configurations and allows the emergence of new structures at lower operational cost.

4.5 Every Event as Field Calibration

Every event in life, traversed without superimposing unnecessary resistance, contributes to system calibration, expansion of the peculiar state, and construction of the individual's deductive capacity.

What determines the calibrating value of an event is not its intensity or sign, but the quality of traversal. An event traversed with resistance produces cost without calibrating output. The same event traversed without resistance adds precision to the individual's perceptual system and permanently modifies the geometry of the field in which they move.

Chapter V

The Geometry of Destiny: Riemann, Mandelbrot, and the Critical Line

> *"Mathematics is the language in which God wrote the universe."*
>
> *— Galileo Galilei*

5.1 The Curvature of Cognitive Space

Bernhard Riemann demonstrated in the nineteenth century that space is not an empty, uniform container, but a variety capable of curving. In this curved space, objects do not move driven by mysterious forces: they follow geodesics, the straightest possible lines given the curvature of the medium in which they find themselves.

Quantum Fatalism applies this geometry to existence. Accumulated experiences, the culture one is immersed in, traumas and significant events are not static weights. They are forces that curve the individual's cognitive space, modifying the shape of their peculiar state and therefore the natural trajectory of their future geodesics. Destiny is not a script written by an external entity, but the geometry of the inner landscape formed over time through the quality of attention with which one has lived.

The geodesic can be modified: by traversed events, by signals followed, by the progressive reduction of cognitive load. Every permanent modification of the geodesic is the result of a real intervention in the system, carried out at the moment when the system was permeable to that change.

5.2 Destiny as Fractal: Autosimilarity and Infinity

Benoit Mandelbrot discovered that the complexity of nature — from jagged coastlines to clouds — arises from the repetitive application of simple rules in an iterative manner. The resulting structure is a fractal: unpredictable in detail, but governed by an autosimilar logic at all scales of observation.

Quantum Fatalism recognizes in this property the structure of destiny. The generative rule — the principle of minimum cognitive load — is autosimilar: it acts in exactly the same way in a system with two actors and in a system with millions of actors. If it were possible to visualize in real time the geodesics of any system, their resulting geometry would be a fractal, regardless of the size of the system observed.

Autosimilarity does not concern only the geometry of geodesics. It also concerns the processes of degradation and recovery of the peculiar state. The way an individual manages a small rigidity of their generative model geometrically mirrors the way they will manage large existential rigidities. And the way a collective system manages its crises mirrors the way individual members manage their own internal crises. The same structure at every scale.

The most precise property of fractals is that their perimeter, measured without approximations, is infinite. The coastlines of England, measured with increasing precision, turn out to be ever longer. Infinity is not an external dimension of fractal geometry: it is an intrinsic and measurable property. The geodesics of the human system have the same property.

5.3 The Critical Line: Order Beneath the Noise

Riemann left mathematics one of its deepest mysteries: the zeta function. Prime numbers appear on the number line in an apparently chaotic and unpredictable manner. Riemann discovered that they are in fact governed by the rigorous order of the "zeros" of a hidden complex function. The Riemann Hypothesis suggests that all these equilibrium points reside on a single, perfect **critical line**.

Human life has the same surface structure: apparently random events, irregularly distributed, difficult to predict in detail. Quantum Fatalism maintains that beneath this surface there exists a structure connecting events according to the principle of minimum local cognitive load. Operating with a progressively refined peculiar state through the quality of attention means operating as close as possible to that critical line, where the cost of every action is minimal and the system's coherence is maximal.

Conclusion

The Art of Flowing: Computational Stoicism

> *"Do not be a slave to your passions, but their master."*
>
> *— Marcus Aurelius*

We started from a soap bubble and a ray of light. We traversed the physics of equilibrium, the structure of choice as a collapse of possibilities, the nature of epiphanies as signals from a saturated field. We examined the geometry of relationships as a single field observed at two scales, the fractal structure of destiny, and the parallel with Friston's Free Energy Principle which provides all of this with its neuroscientific-mathematical foundation.

Quantum Fatalism proposes a form of **computational stoicism**. Not the resignation of one who accepts destiny because they cannot change it, but the precision of one who knows the system in which they operate: knows where to intervene, when to do so, and where energy produces structural modifications instead of dissipating without effect. It is a descriptive theory: it does not prescribe how to live, does not judge choices, does not distinguish between good and bad outcomes. It describes the structure of cost in the system within which choices occur.

Every individual brings to every system their own peculiar state: not an archive of quantitative experiences, but the quality of attention with which they have traversed what they have lived. This peculiar state determines which signals the system is structurally equipped to receive. It is not a fixed destiny: it expands through every event traversed with correctly calibrated attention, regardless of the context in which that event occurred. And it forms from imprinting, from the initial priors built in the early phases of existence, which are the rawest and most recognizable material on which the work of permeability can act.

The system never certifies anything in real time. What it provides is the cost signal, through acute surprisal and chronic cognitive load. Learning to distinguish the two, to read both, is the work that allows one to recognize the moment when the system is permeable to change.

Like the soap bubble finding its minimum form and lightning finding its path to earth, the life-system tends toward configurations of lower local cost. The task is not to force that tendency or oppose it, but to recognize the moment when the system is permeable to change and act with the necessary precision, in the direction that permanently modifies the curvature of the field.

The question this essay does not close — and could not close — is this: given that the peculiar state continuously expands through every traversed event, and given that every significant encounter permanently modifies the geometry of the field, the system never converges toward a final equilibrium. It tends toward the critical line without ever reaching it definitively. It is this irresolvable tension, this asymptotic approximation to perfect order, that is the permanent condition of existence. Not a destination, but a direction.

Appendix I

Resonances: A Bibliography of the Code

Quantum Fatalism does not arise in a vacuum. It is the convergence point of intuitions spanning centuries of human thought, from Eastern mysticism to theoretical physics. The texts and authors listed here constitute the conceptual backbone upon which this essay rests.

The Scientific and Philosophical Substrate

Karl Friston and the Free Energy Principle: contemporary neuroscience converges on the central thesis. Friston demonstrates on a mathematical basis that every biological system acts to minimize its free energy, defined as the discrepancy between the system's internal model and the sensory data received. The parallel with Quantum Fatalism is developed in Appendix II.

Baruch Spinoza, Ethics: Spinoza demonstrated that freedom is not free will — which is a product of ignorance of causes — but understanding of necessity. His vision of *Deus sive Natura* is the philosophical precursor of the system described in this essay.

Bernhard Riemann: without his geometry of curved space, we could not conceive of destiny as a geodesic nor existential equilibrium as a critical line.

Diederik Kingma and Max Welling, variational autoencoders: the models that learn a latent space by minimizing exactly Friston's variational free energy. Together with Georgios Arvanitidis's work on geodesics in latent space, they provide the computational model developed in Appendix III.

Jerome Busemeyer and Peter Bruza, *Quantum Models of Cognition and Decision*: quantum cognition uses the mathematical formalism of quantum mechanics, not its physics, to describe human decisions that classical probabilistic models struggle to reproduce. This is the sense in which this essay uses the word "quantum". The empirical evidence on which it rests is debated today, and Appendix III accounts for it.

Shun-ichi Amari and information geometry: the space of probability distributions has a natural metric, the Fisher metric, and updating a model along its geodesics is the most efficient way to learn. It is the formal bridge between the Riemannian geometry of Chapter V and the Free Energy Principle of Appendix II, and it is developed in Appendix III.

Speculative Visions

Ted Chiang, *Story of Your Life*: Chiang explicitly uses Fermat's Principle to describe a teleological perception of time, where knowing the future is the necessary condition for completing the path of minimum energy. It is the most precise narrative transposition of Quantum Fatalism in contemporary literature.

Philip K. Dick, *VALIS*: Dick describes the universe as pure information and enlightenment as a direct data transfer into the individual's mind. It is the narrative counterpart of Quantum Fatalism's explanation of epiphanies as discharges from a saturated field.

Isaac Asimov, *Foundation Cycle*: with psychohistory, Asimov envisions a mathematics capable of describing the flow of human masses. The single event remains unpredictable, but the ensemble follows a rigorous function, just as prime numbers do with respect to the zeta function.

The Mystical Roots

Lao Tzu and Taoism, wu wei: effortless action is the conceptual ancestor of the principle of minimum action. Acting with the Tao means acting at the moment when the system is permeable, with the minimum necessary intervention.

Sufism and the Whirling Dervishes: the practice of the Sama is reread not as folklore but as a physical technique for reducing entropy in the nervous system through cyclical movement and gyroscopic stabilization.

Shiva Nataraja and the cosmic cycle: the creative destruction of Indian cosmology as the operational model of complex adaptive systems that must periodically eliminate obsolete structures to allow the emergence of more efficient configurations.

Appendix II

Friston's Free Energy Principle: Convergences with Quantum Fatalism

The Free Energy Principle, formulated by neuroscientist Karl Friston from the mid-2000s onward, is the formal scientific framework that converges most precisely with the central propositions of Quantum Fatalism. The main points of contact are six.

Surprisal, cognitive load, and system cost: Friston calls surprisal the measure of the discrepancy between the system's internal model and the sensory data received from the environment: the acute cost. Quantum Fatalism distinguishes this from overall cognitive load, the chronic cost of the sum of all active unresolved processes. Both are instances of the existential energetic cost the essay uses as an umbrella term, explicitly acknowledging that a unified definition across the three levels — physical, informational, and existential — is not yet available.

Active inference and productive effort: Friston distinguishes two modes of reducing free energy: updating the internal model in response to reality, and active inference — acting on the environment to make it more consistent with one's own expectations. Effective active inference is that carried out at the moment when the system is permeable. It is the distinction between productive effort and sterile effort expressed in neurobiological terms.

Generative model, peculiar state, and quality of attention: in the Free Energy Principle, every individual brings to every system a pre-existing generative model. Quantum Fatalism calls this structure the peculiar state, specifying that it is not measured in the quantity of accumulated experiences but in the quality of attention with which each was traversed. Friston describes this quality through precision of beliefs: the measure with which the system is willing to update its model in response to new data. On the limit of permeability, see section 2.2 and Appendix III.

Attractor set and geodesic: Friston describes every biological system as endowed with an attractor set: a set of states toward which the system naturally tends. It is the direct counterpart of the geodesic in Quantum Fatalism. When the peculiar state is compromised, the attractor set can become pathological: the system minimizes surprisal locally through configurations that produce high cost in the broader system.

Collective phase transition and field saturation: Friston has extended the framework to collective systems through the concept of federated inference. Quantum Fatalism describes this as field saturation: not propagation through discrete connections but continuous densification of informational density until discharge onto structurally compatible nodes.

Garbage Collection and conscious dissolution: Friston describes the periodic necessity for biological systems to eliminate obsolete structures to maintain operational efficiency. Quantum Fatalism applies this to the conscious dissolution of shared systems: when both nodes simultaneously update their generative model recognizing that the shared system has exhausted its function, dissolution is a low-cost phase transition. The entropy generated by dissolution does not belong to individual nodes but to the field, where it can be dissipated by any node present with a low-resistance peculiar state.

Appendix III

Latent Space and Information Geometry: A Single Framework

This appendix proposes a computational model of Quantum Fatalism. The essay has so far used three distinct languages: the physics of minima (Fermat, the soap bubble), Riemannian geometry (Chapter V) and Friston's neuroscience (Appendix II). Here it is shown that there is a mathematical framework in which the three languages are one, and it is stated precisely what that framework covers and what it does not.

Latent space. In machine learning, a neural network represents data as points in a many-dimensional space called latent space. Distance measures similarity, directions carry meaning, and the geometry is not designed but learned: it emerges from the progressive minimization of a cost function. One class of these models, variational autoencoders, minimizes exactly the variational free energy, the quantity at the center of the Free Energy Principle: the convergence with Appendix II is not analogical, it is the same equation. The epistemic note of the Introduction still holds: the identity holds at the informational level of cost, not at the existential one.

Continual training. Latent space as it is built in practice is rigid: trained once, then used unchanged. Quantum Fatalism describes the opposite. The field is a latent space in continual training: every experience lived by every node is an update step of the shared geometry. This is why the geodesic is instantaneous: the surface on which it is calculated changes at every instant. Continual learning has a known problem, catastrophic forgetting, which the essay has met in another form in section 2.2: a system that updates with every datum preserves nothing. Imprinting (section 2.3) plays the role of the deep weights that resist updating; the quality of attention (section 2.2) is the rate at which each node lets a datum modify it. Permeability has an optimum and not a maximum for the same formal reason that continual learning requires a balance between stability and plasticity.

The bridge: information geometry. Here the three languages converge. The space of probability distributions has a natural metric, the Fisher metric, whose curvature can be calculated. Friston's free energy is a divergence between distributions, and the local curvature of that divergence is the Fisher metric. Updating a model by following the geodesics of this metric, Amari's natural gradient, is the most efficient way to learn. And the dynamics of active inference, as Da Costa, Parr, Sengupta and Friston have shown, approximate precisely a descent along the natural gradient. Finally, the latent space of a generative network is a Riemannian manifold with a metric induced by the generator, on which geodesics are concretely computable objects.

The consequence for the essay is this. The sentence "the system follows the geodesic of cognitive space" stops being an image borrowed from Riemann and becomes literal: **updating the internal model at minimum cost is following the geodesic of the information metric**. The curvature of Chapter V is the Fisher curvature, produced by training and updated continually. The cost of Chapter I is free energy. The productive effort of section 1.3 modifies the metric; sterile effort

moves within a given metric. The pathological attractor of section 3.2 is a local minimum of the cost function. The probabilistic perception of section 3.3 is the distribution the encoder returns instead of a point.

Two levels. The model requires a distinction the essay uses implicitly and that must be made explicit here. The **metric** is the field: the shared geometry, trained by the experiences of all nodes. The **state** is the single node: where it is in that geometry and with what structure, that is the peculiar state, it projects its own experiences. Three things follow from this distinction. Field saturation (section 3.4) is a progressive deformation of the metric up to the point where a region changes nature, a hill becomes a valley: the change is instantaneous for the whole space, but only the nodes that are in it perceive it, which gives structural compatibility an operational definition. The geodesic simultaneity of section 4.4 is the same thing seen from the side of the nodes: the metric has already reorganized for everyone, the delay is in reception. And the third level of intensity of epiphanies (section 3.1) is explained: the region has opened in the metric, but the node's encoder does not yet have the resolution to read it. Interaction between nodes, finally, passes through the metric: each deforms the geometry the other travels.

Interference: a possible reading. Section 2.1 used the double slit for three properties of choice. The framework just described covers two of them, the internal observer and probabilistic perception. The third, the non-additive combination of possibilities, requires an extension, and it is right to present it as such. Information geometry has a quantum version: the state of a system is described by a density matrix, whose diagonal contains the probabilities of the alternatives and whose off-diagonal terms contain the coherences, that is the interference; the corresponding metric, the Bures metric, reduces exactly to the Fisher metric when the coherences are zero. The classical framework described above is therefore the special case of a broader one, and the passage from one to the other has a name, decoherence: coherences decay when the system couples to something that records which alternative is under way. In this reading, the rationalization of section 3.5, which enumerates scenarios one by one, is induced decoherence: each recorded scenario cancels a coherence, and the cost of keeping the records is the chronic cognitive load of section 1.2. Quantum cognition has built decision models on exactly this basis, as open systems that decohere toward a stable state.

This reading must, however, be taken for what it is. The formalism describes behavior; it says nothing about the substrate. And the empirical evidence that motivates it, in particular Tversky and Shafir's disjunction effect, is contested today on three fronts: replications have given mixed results, it has been argued that the pattern observed in between-subject data does not constitute a violation of the law of total probability, and classical models have been proposed that reproduce the same outcomes. The essay therefore does not rest on this evidence. It uses the formalism of decoherence as a coherent reading of 3.5, stating that its necessity with respect to a classical description has not been established.

Limits and commitments. The framework covers the single node, the geometry that contains it and the way nodes deform it. It has no fractal structure in any demonstrated sense, and therefore does not cover section 5.2. The field as a metric trained collectively and continually is a hypothesis of this essay, consistent with the literature cited but not derived from it. And for the framework to hold without reintroducing an external designer, the cost function of the field must be free energy

itself, a condition of existence of the system and not a goal chosen by someone: the model rests on the Free Energy Principle, not on engineering. Finally, in this framework the word "quantum" indicates the formalism of section 2.1 and of this appendix, not the physical nature of the field.

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