



The Sixth Sun

THE CYCLE OF INTEGRATION
AND RUPTURE

William de France

ÉDITIONS CLEMENTINIUM

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*Five suns perished in their own light.
The sixth demands no victims; it requires memory.*

Epilogue

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PROLOGUE

THE AGES OF MEN

In the seventh century before our era, somewhere in Boeotia, a peasant who called himself a poet writes that the world has already lived through five ages. Hesiod names them in *Works and Days*: gold, then silver, bronze, the heroes, and iron at last, his own, the worst, the one in which one must toil. Each age knew its splendor; each age became corrupt; each age handed down a diminished world to the next. This is not the complaint of an old man. It is a cosmology: an assertion about the shape of time.

Elsewhere, on the Indian subcontinent, sages who have never heard of Hesiod, as he has never heard of them, set down the doctrine of the four *yugas* (Krita, Treta, Dvapara, Kali). These four ages decline one after another, together form a great cycle, then begin again. The vocabulary is different, the gods are different, the durations are counted in millions of years and not in generations. The motif, though, is the same down to the last stroke: a plenitude, a decline, a rupture, a resumption.

Long before them still, in Mesopotamia, scribes engrave in clay that the gods loosed the waters upon the world because humans, by multiplying, made a din the heavens could no longer bear: this is the poem of Atrahasis. Let us hold on to the cause, for it is strange and it will return: it is not vice that summons the flood, but *number*, density, the noise of a humanity too tightly bound to itself. The flood myth recurs in Sumer, among the Hebrews, among the Greeks with Deucalion, among the Incas. Everywhere the same structure: a human integration carried to saturation, a rupture by the waters, a saved fragment, and the world starting over from that fragment.

On the other side of the Earth, without the slightest contact with the foregoing, the Mexicas count time in *suns*. Four suns have already perished before ours: the jaguars, the wind, a rain of fire, the waters. We live, they said, in the fifth, and it will end in earthquakes. The Mayas hold a Long Count built on the same idea: successive creations, each closed, each followed by another.

And one could go on for a long time. The Greek Stoics awaited the *ekpyrosis*, the universal conflagration, followed by a rebirth of the world to the identical. The Norse awaited Ragnarök, the death of the gods, after which a new earth emerges from the waters. Chinese historians, since Sima Qian, have read their whole history as the cycle of the Mandate of Heaven: a dynasty rises, matures, becomes corrupt, loses the mandate, and yields it to another, which will begin again in the same way.

SO MANY VOICES, ONE FORM

Here are peoples who never spoke to one another, separated by oceans and millennia, with no shared language, no sacred text, no common god. And they all say, each in their own idiom, the same thing: that the world rises and falls, that it has already done so, that it will do so again. A coincidence of this scale is no coincidence. When independent minds converge so obstinately on the same form, it is generally because they have perceived, each on their side, something real.

This book contends that they were right. Not on the details (the jaguars, the gods, the durations are only images of their time), but on the form. At the scale of their experience, where a human life and the memory of a city could reach it, they had perceived a movement they could not measure at other scales. Contemporary science has not refuted this perception. It has generalized it. The same movement the *yugas* read in human destinies is read in the birth and death of stars, in the drift and gathering of continents, in the collapse of ecosystems, in the fate of living lineages, in the

fall of empires, in the financial cascades of today, and perhaps in the destiny of the universe itself. This last question is the most exposed these pages will dare to ask; they keep it for the end.

TWO ERRORS TO SET ASIDE

But at the threshold we must set aside two misreadings: this book falls if we yield to either.

The first would be to conclude that the ancients already knew everything, and that science merely rediscovers their wisdom. This is false. The myths perceived a *form*; they never held its *mechanism*. Karma is not the criticality of a coupled system; the anger of Enlil is not the thermodynamics of a saturated world. To see that a thing rises and falls is to know neither why, nor when, nor under what condition. Between seeing the form and explaining the mechanism lies the gap that separates a premonition from knowledge; this book resides entirely within that gap.

The second misreading would be the inverse, and just as lazy: to take these myths for mere naive projections, fears dressed up as stories, with no purchase on the real. This too is false. They render an accurate perception of the structure of the world, in the only language transmissible at a large scale before scientific writing: that of symbol and story. To despise this language because it is not ours is to confuse the rigor of a notation with the accuracy of an intuition. The two languages, the mythical and the mechanical, do not illuminate two worlds: they illuminate the same territory, from two sides.

To hold these two refusals together, yielding to neither, is the very discipline of this book.

THE ORDER OF THE WORLD

This book is a cosmology, in the primary sense of the word: a discourse on the order of the world. But it goes about it against

the usual grain. A cosmology ordinarily begins with the universe, the gods, or the origin; this one will begin with the slowest and oldest cycle that has ever turned, that of a star, where it plays out without witness or legend, billions of years before the first eye capable of seeing it. Then it will descend toward us, following ever briefer cycles: from stars to continents, from continents to the living, from the living to empires, from empires to the decade in which we stand. At each level, the period of the cycle shortens and the stakes draw nearer. Only at the end of this descent, with the credit earned level by level, will it ascend in a single stroke to the vastest question of all, the one the Aztecs already asked but could not solve: is the universe itself a sun among others? And if so, what must we preserve for the sixth?

For there was, long before the first man capable of making a myth of it, a first world that rose, charged itself with its own end, and broke, with no one there to remember it. It is with this world that we must begin.

I

THE STELLAR CYCLE

There was a time, and it lasted for a long time, when the universe had formed almost nothing yet. Long before the humans who, everywhere, would tell stories of the world rising and falling, long before the first rock, the first sea, or the first atom of iron, there was a universe whose only matter consisted of the two simplest elements. To make everything else (the planets, the oceans, the bones, the reader of these lines), it had to wait for a first generation of structures to be born and to die. The first of these structures is a star. Before seeing it die, we must see it born; and to be born, for a star as for everything that will follow, is to integrate.

THE FIRST CLOUD AND VARIETY

Three minutes after the beginning, the universe manufactured its matter in a few moments, then stopped. It produced only the two lightest elements: hydrogen and helium (approximately three-quarters hydrogen and one-quarter helium, by mass, plus a pinch of deuterium and a trace of lithium). These two elements were everywhere, in immense quantities. But of all the rest (carbon, oxygen, iron, gold, all the heavy elements), it made nothing, or so little that it did not count.

Let us understand clearly what is missing, for it is from this absence that everything else flows. It is not matter that is lacking; matter is there, abundant. It is *variety*. The newborn universe is rich in two elements and empty of all others; and it so happens that everything of which a planet, a body, or a thought will one day be made is precisely composed of these others, the heavy ones, those that do not yet exist.

Why does it stop at helium? Not out of exhaustion, but because it hits a structural obstacle. No stable nucleus is made of exactly five particles, nor of exactly eight: the chain that assembled nuclei one step at a time faces two missing steps, which no reaction, in the brief instant where everything is decided, can cross. The universe forms only light elements; it cannot, on its own, climb higher. The heavy elements, and therefore the matter of worlds and of the living, would have to be forged later, elsewhere, by something else. This "later," this "elsewhere," this "something else"—the answer lies in a single word: stars. But there are no stars yet.

For a few hundred million years, there is nothing to see, because there is nothing that shines. No stars, no galaxies, no chemistry; nothing but immense cold clouds of hydrogen and helium, almost perfectly uniform, drifting in an expanding darkness. This is the first cloud. It has none of the qualities we associate with a beginning: neither warmth, nor brilliance, nor visible promise. It has only one thing, and it will suffice: it is not entirely uniform.

INTEGRATION BY GRAVITY

Somewhere in this cloud, matter is very slightly denser than elsewhere. Almost nothing: a tiny discrepancy, inherited from the first seconds. But where there is a little more matter, there is a little more gravity; where there is a little more gravity, a little more matter is attracted; and this attracted matter further strengthens gravity. The process closes in on itself and runs away. What was dispersed gathers; what gathers heats up by falling in upon itself; and the temperature, at the heart of the collapse, rises, rises, until it crosses, at around ten million degrees, the threshold where hydrogen nuclei overcome their repulsion and begin to fuse. At that instant, something that did not exist exists. The cold, featureless cloud has become a star.

Let us give what we have just seen its exact name. This is not a metaphor; it is a literal description. Dispersed components

have become *coupled*, through a self-reinforcing feedback loop, until they reach a critical mass beyond which an entirely new structure appears and sustains itself. This is integration. It will be, transposed, the story of a supercontinent assembling, of an ecosystem densifying, of a global economy tightening. Each time, parts that owed nothing to one another end up unable to do without one another, and from this knotting arises something that did not exist before: a wealth, a power, a star.

The star thus ignited will hold for millions of years. It will hold because it burns, and by burning it supports itself against its own gravity. Everything, so far, is ascension: a rise toward order, warmth, and light, starting from a cloud that had nothing. But there is a harder reality: it is the rise itself, and not an accident from the outside, that prepares the fall. The star has just been born; it has, in the same movement, begun to manufacture what will kill it.

THE STAR, A DISSIPATIVE STRUCTURE

The star will live for ten million years. During its adult life, it is what Ilya Prigogine calls a *dissipative structure*: an order that maintains itself only by allowing a flow to pass through it. The flame of a candle is one: its shape, its tip, and its stratified color are perfectly stable as long as the wax rises and the air arrives, and they disappear the instant the flow is interrupted. The star is the same thing, on a scale where the flow is measured in fusion energies. At the center, hydrogen nuclei fuse into helium. Each fusion releases energy, which rises to the surface and escapes in the form of light: this is the radiation of the star.

This radiation is not a simple production: it is what the star *discharges*. Fusion produces energy, but it also produces disorder, entropy, a quantity that measures the extent to which energy has degraded into unusable heat. A stable star maintains its internal order (a precise stratification, a hot core, colder layers in onion

skins, an exact balance between the outward push of the fire and the inward fall of matter) on the sole condition of permanently expelling outward the entropy that its own combustion manufactures. Radiation is the channel for this discharge. As long as it functions, the dissipative structure holds. This is the dissipative flow: the path by which an internal constraint, constantly renewed, is continually cast outward before it accumulates.

IRON ACCUMULATES: THE HIDDEN VARIABLE

Here is where the trap of ascension closes. The hydrogen in the core eventually runs out. The core, deprived of thermal pressure, contracts; by contracting it heats up; and at a higher temperature, a reaction that was impossible becomes possible: the accumulated helium begins to fuse into carbon. When helium is exhausted in its turn, the same movement is repeated: contraction, heating, ignition of a heavier fuel. Carbon fuses into oxygen. Oxygen into silicon. Silicon into iron. In the end, the star is made of concentric layers, like an onion, each burning its own fuel, the lightest outermost, the heaviest innermost, and at the center a core of iron.

Each depletion is not a failure: it is the condition for the next step. It is because hydrogen is lacking that helium ignites. The star does not perfect itself despite its local crises; it perfects itself through them. Each crossed threshold is exactly the threshold that makes the next one passable.

But iron is unique: it possesses the most tightly bound atomic nucleus in nature (along with nickel). Beyond it, fusion no longer yields energy; it costs energy. Iron is the ash of a fire that can no longer burn its own ash. The star has spent its life climbing the scale of elements, drawing energy from each rung; arrived at iron, it discovers that there is no rung above.

Meanwhile, iron continues to accumulate at the center, poured in by the combustion of the silicon layer. This iron core grows,

becomes heavier, and dissipates nothing: it does not fuse, it does not radiate. This is the *hidden variable*: a constraint growing at the heart of a flourishing system, which dissipative flows do not carry away, and whose accumulation is invisible from the outside. From the surface, the star has never been brighter. It succeeds magnificently, and it is its very success that loads its center with the mass that will destroy it.

THE THRESHOLD AND THE SUPERNOVA

As long as the iron core remains below a certain limit, it holds, supported by the degeneracy pressure of electrons. This is a rigid quantum support, but it is limited. Beyond a critical mass, the Chandrasekhar limit (approximately 1.4 solar masses), this pressure capitulates. The iron core crosses this limit without warning: stability was metastable.

The collapse takes less than a second. The core, which was the size of the Earth, shrinks to that of a city. Electrons are crushed into protons to form neutrons of colossal density. The matter of the outer layers falls onto this rigid core, rebounds, and rushes outward as a titanic shock wave. This is the supernova: the star flies apart, shining for a few weeks like an entire galaxy, leaving behind a neutron star or a black hole. The dissipative structure that had held for millions of years has ceased to exist, destroyed by its own ash.

THE NUCLEOSYNTHETIC LEGACY

One final thing, opening the path. When the star explodes, it does not disappear into nothingness. It disperses into space everything its life has manufactured: carbon, oxygen, silicon, iron, and, in the furnace of the explosion, elements even heavier, which it had not had time to forge during its lifetime. These ashes are not

an end. They integrate into the interstellar medium, enriching the gas clouds that will give birth to the next generation of stars. This is the direct material memory of the cycle: the increasing metallicity of stars from age to age (from Populations III to I). Without the death of this first generation of stars, organic chemistry, rocky planets, and living beings could never have existed. The rupture bequeathed variety.

WHAT INTEGRATES, WHAT ACCUMULATES, WHAT BREAKS, WHAT IS TRANSMITTED. *Integrates*: the dispersed matter of the first cloud, coupled by gravity into a star, then the scale of elements climbed up to iron. *Accumulates*: iron at the core, inert ash that no flow dissipates, growing even as the star shines. *Breaks*: the Chandrasekhar limit crossed without warning, leading to gravitational collapse and the supernova. *Transmitted*: the heavy elements dispersed into the interstellar medium, which will enrich future clouds. The form is bare: no agent, no strategy; only matter, a threshold, and a memory.

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*A star on the last day of its life, seen from afar: a light that
still holds, and holds precisely because it has almost finished
burning. The image does not show an end, but the point
where integration tips: the moment, common to all scales,
when what built everything begins to undo everything.*