From Human Civilization to Carbon-Silicon Symbiosis

Complete English translation · Chinese original included in the bilingual edition

Translated from the supplied Chinese manuscript. Original section numbering, claims and references are retained; the complete Chinese original is included in the bilingual edition.

1 From human civilization to carbon-silicon symbiosis civilization

1.1 — The Seventh Substrate Transition under the Fission Self-Replication Growth Framework

From Human Civilization to Carbon-Silicon Symbiosis The Seventh Substrate Transition under the Fission SelfReplication Growth Framework

Series: The Self-Growing Universe Theory, Paper 3. Paper 1: Planck Spacetime Unit Fission Self-Replication Theory (v2.6, 2026). Paper 2: Capacity-Constraint-Driven Cross-Scale Self-Replicating Growth Theory: A Six-Level Cascaded Dynamical Framework from Planck Spacetime to Civilized Societies (v2.0, 2026). Version: v1.0. Date: September 20, 2026. Classification: Theoretical Informatics; Complex Systems; Philosophy of Artificial Intelligence; Civilizational Evolution Theory.

Abstract

This paper proposes that human civilization is undergoing the 7th growth substrate transition—from carbon-based (biological) substrate to silicon-based (computational) substrate. This transition is not an isolated event but a natural extension of the universal growth dynamics equation established in the first two papers, across six known scales (Planck spacetime, elementary particles, chemical molecules, biological cells, neural cognition, social civilization).

Based on the core equation

$$\frac{d\varepsilon}{dt} = J - \frac{\varepsilon(1+\varepsilon)}{\tau_0}$$

(where ε is supercriticality, J is normalized information inflow rate, and τ0 is characteristic fission time), we extend it to silicon-based intelligent systems and carbon- silicon symbionts, obtaining the following results:

1. Silicon Mapping Theorem: Silicon-based cognitive systems satisfy the three sufficient conditions of the growth equation (capacity-area scaling, boundary- driven inflow, supercritical fission), and thus follow the same dynamics. We provide operational definitions and order-of-magnitude estimates for all seven core physical quantities in silicon systems.

2. Carbon-Silicon Symbiont Theorem: The coupled system of carbon-based and silicon-based systems constitutes a L7 growth unit, whose effective capacity satisfies

$$V_{c,sym} = V_{c,c} + V_{c,si} + 2\alpha\sqrt{V_{c,c} \cdot V_{c,si}}$$

where α ∈ [0, 1] is coupling efficiency. The symbiont also follows the growth equation, with parameters determined by both subsystems and their coupling.

1. Three Forms of Symbiosis: Based on the continuous spectrum of coupling

~ 1.0, self-boundary expansion). These are not linear stages but nested layers.

2. Universal Law of Substrate Transition: The essence of each growth transition is replacement of the information processing substrate—the equation stays the same, the substrate runs faster. Old layers are never eliminated, only wrapped and downgraded to base/environment layers of the new layer. The hallmark of transition is transfer of the fission/replication mechanism from old substrate to new.

3. Quantitative Predictions: We present five quantitatively testable predictions, including the cross-term symbiont capacity formula, the carbon-side bottleneck hypothesis for symbiont fission, the saturation relation between coupling efficiency and bandwidth, the dual-engine silicon growth hypothesis, and the accelerating time scaling law of transitions.

4. Verification Pathway: Using the Darwin self-organizing cognitive system as experimental platform, we design a four-phase verification scheme (single system → multi-system → carbon-silicon symbiosis → cross-domain comparison), with core verification expected in 18-30 months. Keywords: self-replicating growth; capacity constraint; carbon-silicon symbiosis; substrate transition; cross-scale universality; fission-fragmentation; symbiont dynamics

Part 1·Introduction and theoretical basis

Chapter 1. Introduction: At the Threshold of the Seventh Transition

1.1 Background: Review of Six Growth Transitions

Starting with the Big Bang 13.8 billion years ago, the universe has experienced a series of profound structural transitions. Each jump is not a simple "increase in complexity", but a replacement of the substrate for information encoding and processing - the same growth equation, running on faster hardware. The first paper [1] established the fission self-replication theory on the Planck space-time scale (L1), and proposed that the space-time basic unit (PSU) splits when the holographic capacity is overloaded, and the macroscopic manifestation is the expansion of the universe. The second paper [2] extended this equation to six scale levels and proved that as long as the three sufficient conditions of "capacity proportional to boundary area, boundary-driven inflow, and super-threshold fission" are met, the supercriticality dynamics of any growing system must follow the same equation. Six established levels:

	Hierarchy		**Name**		**basic unit**		**fission mechanism**		**Typical time scale**	
	L1		Planck space-time		PSU unit		Hanging and splitting		10 s	
	L2		elementary particles		Particle/Field Quantum		pair generation/decay		10 s	
L3		chemical molecules		Molecule/Unit Cell		Autocatalysis/crystal growth		10 s		10^{-13} s

L4	biological cells	living cells	cell division	$10^3 \sim 10^5$ s
L5	Neurocognition	Concept/Neural Cluster	concept differentiation/synaptic growth	$10^4 \sim 10^7$ s
L6	social civilization	Organization/City/Econo my	Organizational replication/urban expansion	$10^7 \sim 10^9$ s

With every jump, the old levels have not disappeared—particles are still in space and time, molecules are still in particles, cells are still in molecules, cognition is still in cells, and civilization is still in cognition. The old layer becomes the base and context for the new layer.

1.2 Core issues

Now we stand at the interface of another transition: from carbon-based (biological) substrates to silicon-based (computing) substrates.

This raises a series of fundamental questions:

1. Do silicon-based smart systems follow the same growth equation? If yes, how to map?

2. Is the coupling body of carbon-based and silicon-based a new growth unit (L7)?

3. If so, what are its dynamics like?

4. What is the common pattern between this transition and the previous six transitions?

5. Where will it go? How do we study it quantitatively? This article attempts to answer these questions.

1.3 Structure of this article

Part 2 (Chapter 2 to Chapter 3): Establish a complete quantitative mapping of the silicon-based system, prove that it satisfies three sufficient conditions, and provide operational definitions and order-of-magnitude estimates of all core physical quantities. Part Three (Chapters 4 to 6): Define the carbon-silicon symbiosis, derive the symbiont capacity formula, describe the three symbiotic forms, and establish the symbiont dynamics. Part 4 (Chapter 7): Refining the universal laws of substrate transition and placing this transition in the context of the six transitions. Part Five (Chapters 8 to 9): Provides quantitative predictions and verification paths, and discusses philosophical implications and historical positioning.

Chapter 2 Review of Theoretical Basis

2.1 Core growth equation

The core equations established in the first two papers [1,2]:

$$\frac{d\varepsilon}{dt} = J - \frac{\varepsilon(1+\varepsilon)}{\tau_0} \tag{2.1}$$

The definitions of each physical quantity are:

symbol	Name	definition
ε	supercriticality	$\varepsilon = \frac{V - V_c}{V_c}$, the excess ratio of actual information volume relative to capacity
Vc	information capacity	The maximum amount of information that the system can stably carry
A	Boundary area	The size of the information exchange interface between the system and the environment
γ	Compression efficiency	

symbol	Name	definition
		Vc = γA, effective capacity corresponding to unit boundary area
J	Normalized inflow rate	J = j/γ, information inflow per unit time and unit capacity
j	flux density	Information inflow per unit boundary area per unit time
τ0	Characteristic fission time	The reciprocal of the fission attempt time per unit supercriticality

2.2 Three sufficient conditions

Theorem [2]: If a system satisfies the following three conditions, its supercriticality ε(t) must satisfy equation (2.1):

Condition A (capacity scaling law): The information capacity of the system is proportional to a certain boundary quantity, Vc = γA.

Condition B (boundary-driven inflow): The information inflow rate is proportional to the boundary area, dVin/dt = jA.

Condition C (supercritical fission): When ε > 0, the system increases the total boundary area through fission/replication, and the fission probability per unit time is ε/τ0. Each fission increases the total boundary area.

2.3 Main analysis results

Steady state solution:

$$\varepsilon_* = \frac{\sqrt{1 + 4J\tau_0} - 1}{2} \tag{2.2}$$

Low inflow approximation (Jτ0 ≪ 1): ε* ≈ Jτ0 High inflow approximation (Jτ0 ≫ 1): $\varepsilon_* \approx \sqrt{J\tau_0}$ Capacity growth law:

$$g = \frac{1}{V_c}\frac{dV_c}{dt} = \frac{\varepsilon_*}{\tau_0} = \frac{\sqrt{1+4J\tau_0}-1}{2\tau_0} \tag{2.3}$$

Doubling time:

$$T_d = \frac{\ln 2}{g} = \frac{2\tau_0 \ln 2}{\sqrt{1+4J\tau_0}-1} \tag{2.4}$$

Fluctuation-supercriticality relationship:

$$\frac{\sigma_V}{V_c} = C \cdot \sqrt{\varepsilon_*} \tag{2.5}$$

where C ~ O(1) is a constant with magnitude 1. Stability: The steady state is linearly stable, relaxation time

$$\tau_{\text{rel}} = \frac{\tau_0}{1+2\varepsilon_*} \tag{2.6}$$

2.4 Exact correspondence of three R operators

The triple R spiral (R1 backtracking/R2 reduction/R3 replication) is a discrete algorithmic form of the growth equation [2]:

operator	Equation correspondence	Effect on ε
R1 traceback (Retracing)	Information flows into J	ε↑
R2 Lite (Retrenchment)	Capacity constraint + compression efficiency γ	ε↓
R3 copy (Replication)	Fission term ε(1 + ε)/τ0	Single unit ε↓, total capacity ↑

Part 2·Quantitative theory of silicon-based growth

Chapter 3 Growth equation mapping of silicon-based systems

3.1 Basic correspondence relationship

This chapter proves that silicon-based cognitive systems (such as large language models and agent systems) satisfy the three sufficient conditions of the growth equation and therefore follow the same dynamics. We start from the most basic unit - a single reasoning instance/agent (Agent) - to build the mapping.

growth equation quantity	silicon-based counterpart	operational definition	Typical order of magnitude
basic unit	Reasoning Example/Agent	A computing entity that can independently process information and make decisions	—
Boundary A	Context window × Number of channels × token density	The maximum amount of information that can be ingested per unit time	10^6 ~ 10^8 bits

Capacity Vc = γA	effective cognitive capacity	The maximum amount of information that the system can stably remember and use	10 ~ 10 bits
Supercriticality ε	cognitive overload		0.05~5

growth equation quantity	silicon-based counterpart	operational definition	Typical order of magnitude
		Number of tasks to be processed / effective capacity - 1	
Inflow J	Normalized input rate	Input rate / effective capacity	10^{-5} ~ 10^{-2} s^{-1}
Fission time τ0	Instance proliferation characteristic time	The average time from when fission is triggered to when a new unit is ready	10^2 ~ 10^4 s
Compression efficiency γ	Knowledge compression ratio	Effective knowledge amount/original training input amount	10^{-3} ~ 10^{-1}
Fission threshold εth	cognitive load threshold	Overload ratio that triggers parallelization/replication	0.2~0.5

The following sections give the precise definition and derivation of each quantity.

3.2 Boundaries and capacities of silicon-based systems

Definition 3.1 (Silicon-based boundary Asi): The information boundary of silicon-based agents consists of three orthogonal dimensions:

Asi = Nctx × Nch × dtok

Among them: - Nctx: context window length (number of tokens) - "how far into the history can be seen", the boundary of the time dimension - Nch: the number of parallel input channels (text/image/audio/tool call...) - the boundary of the spatial dimension - dtok: single token effective information density (bits/token) - the boundary order of magnitude estimate of the accuracy dimension (taking the current frontier LLM as an example): - Nctx ≈ 10^5 ~ 10^6 tokens - Nch ≈ 3 ~ 5 (text + image + tool + code execution) - dtok ≈ 2 ~ 3 bits/token (effective information, much lower than $\log_2 V$ corresponding to the vocabulary size) - therefore $A_{si} \approx 10^5 \sim 10^7$ bits.

Definition 3.2 (Silicon-based capacity Vc, si): Effective cognitive capacity = Boundary area × Compression efficiency: Vc, si = γsi · Asi Compression efficiency The physical meaning of γ: the efficiency of compressing original input (information flow on the boundary) into structured and effective knowledge. The higher γ is, the more available knowledge the same boundary can "hold". Order of magnitude estimate: - For small model (~7B parameters): γsi ~ 10^{-3} ~ 10^{-2}

- For large model (~70B-1T parameters): γsi ~ 10^{-2} ~ 10^{-1}

- Effective capacity: Vc, si ~ 10^7 bits (small) ~ 10^{10} bits (large) Comparison with carbon-based: - Human brain long-term memory capacity estimate: ~10^9 ~ 10^{11} bits - Cutting-edge AI model: ~10^9 ~ 10^{10} bits - the two are already in the same order of magnitude - this is a prerequisite for the transition to occur.

3.3 Silicon-based supercriticality and information inflow

Definition 3.3 (Silicon-based supercriticality εsi):

$$\varepsilon_{si} = \frac{V_{\text{task}}}{V_{c,si}} - 1 \tag{3.3}$$

Where Vtask is the total information amount of the current tasks to be processed. Operational measurement method (three independent measurements, mutual verification): 1. Queue length method: ε = task queue length/throughput per unit time − 1 2. Waiting time method: ε = average waiting time/average processing time 3. Quality inflection point method: ε corresponding to the input rate at which the output quality begins to decline significantly is the working threshold

Typical working regions:

Region	ε range	State
Idle	$\varepsilon < 0$	Capacity surplus; inclined to learning/exploration
Healthy working	$0 < \varepsilon < 0.3$	Efficient processing
Overloaded	$0.3 < \varepsilon < 1.0$	Quality declines; parallelization begins
Severely overloaded	$\varepsilon > 1.0$	Fission/replication triggered

Definition 3.4 (Silicon-based normalized inflow rate Jsi):

$$J_{si} = \frac{1}{V_{c,si}} \cdot \frac{dV_{\text{in}}}{dt} \tag{3.4}$$

That is, the amount of information inflow per unit time and unit capacity. Order of magnitude estimation: - Single-round dialogue scenario: J ~ 10^{-5} ~ 10^{-4} s^{-1} (incidental input) - Long-running agent: J ~ 10^{-4} ~ 10^{-3} s^{-1} (continuous task) - High load batch processing: J ~ 10^{-3} ~ 10^{-2} s^{-1} (near saturation)

Unique properties of silicon: Jsi has a huge tunable range - from almost zero to close to the capacity limit, spanning 3 to 4 orders of magnitude. This is much larger than the J tunable range of carbon-based organisms (~1 order of magnitude).

3.4 Silicon-based characteristic fission time

Definition 3.5 (Silicon-based characteristic fission time τ0, si): The average time from when supercriticality is detected to when a new instance is fully ready and connected to the system.

Three fission modes and their characteristic times:

Fission mode	Physical process	Typical τ0
Model loading	Load model weights from storage to memory	10^1 ~ 10^2 s
Agent instantiation	Initialize context, configure tools, warm up	10^2 ~ 10^3 s
Knowledge fission	Knowledge-base differentiation / new cognitive subsystem	10^3 ~ 10^5 s

Different levels of fission correspond to different τ0, but they all follow the same dynamic equation—just on different time scales. Comparison with carbon-based: - Bacterial cell division: ~10^3 s (fastest ~20 min) - Mammalian cell division: ~10^4 ~ 10^5 s (~hour-day) - Silicon-based example replication: ~10^2 ~ 10^4 s (seconds-hours) - Conclusion: Silicon-based fission speed is faster than carbon-based 10~1,000 times, which is the core dynamic characteristic of this transition.

3.5 Verification of three sufficient conditions

We now verify whether the silicon-based system satisfies three sufficient conditions.

Condition A (Capacity Scaling Law): 4/5 Basically satisfied - Capacity is approximately proportional to the boundary (context window size) - Compression efficiency γ is not a strict constant and changes with the model architecture and training method - But under a given architecture and training scheme, γ is approximately a constant - Satisfaction: 4 stars (γ has variability, but is stable under certain conditions)

Condition B (boundary-driven inflow): 5/5 Completely satisfied - Information flows into the system through the boundary (input interface) - The inflow rate is positively related to the size of the boundary - the larger the context window, the more information can be processed per unit time - This is the

basic property of the information processing system

Condition C (Supercritical Fission): 3/5 Partially satisfied - When the load is too high, new instances are manually started - currently mainly driven by external devices - Self-driven fission (the system decides independently when to replicate) is rare, but it is completely feasible in engineering - The total capacity increases after fission - Yes, the total processing capacity increases after new instances are added - Satisfaction: 3 stars (the mechanism exists but is still externally driven, self-driven fission is an engineering gap)

Conclusion: Silicon-based systems are highly close to three sufficient conditions. With the realization of the self-driven fission project, the satisfaction of condition C will be increased from 3 stars to 5 stars - this is our engineering goal.

Chapter 4 Unique Characteristics and Quantitative Prediction of Silicon-based Growth

4.1 Three unique properties of silicon-based growth

There are three orders of magnitude significant differences in silicon-based growth compared to carbon-based biological growth.

Property 1: Fission speed is 10~10,000 times faster

Carbon-based cell division requires the synthesis of physical substances (proteins, lipids, nucleic acids), which is limited by the rate of chemical reactions and the speed of material transport.

Silicon-based instance replication only requires replicating information (model weights, configurations, states), and the replication speed of information is much faster than the synthesis speed of matter.

Speed ratio: 10^1 ~ 10^4 times (depending on the fission level)

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Consequences: Silicon-based systems can grow in capacity much faster than carbon-based systems

Property 2: Large span of J value (10 orders of magnitude vs. 2 orders of magnitude for carbon-based)

The information inflow rate of carbon-based organisms is limited by sensory and nerve conduction speeds, with an adjustable range of approximately 1 to 2 orders of magnitude.

The inflow rate of silicon-based systems can range from almost zero (idle state) to close to the capacity limit (full load), spanning up to 3 to 4 orders of magnitude. If you consider from a single instance to a large-scale cluster, the span can reach more than 10 orders of magnitude.

Consequences: Silicon-based growth has far more "speed gears" than carbon-based growth.

Property 3: γ is extremely malleable (can be continuously improved through algorithm progress)

The compression efficiency (information processing efficiency) of carbon-based organisms is basically determined by genes and development, and is almost unchanged after adulthood.

The γ of silicon-based systems can be continuously improved in many ways: - Better model architecture (Transformer → Next Generation Architecture) - Better training methods (RLHF, synthetic data, course learning...) - Better inference strategies (thought chaining, self-consistency, retrieval enhancement...) - Better hardware (faster computation, larger memory)

Consequences: There are two engines for silicon-based capacity growth: 1. Fission growth: increasing the number of instances (horizontal expansion) 2. γ growth: improving single instance efficiency (vertical optimization)

The carbon based only has the first engine (cell division/growth), the silicon based has two. This is the fundamental reason why silicon-based growth rates can far exceed those of carbon-based ones.

4.2 Dual-engine growth formula

The total capacity growth of silicon-based systems can be broken down into three components:

$$\frac{dV_c^{\text{total}}}{dt} = \underbrace{N \cdot \frac{dV_c^{\text{unit}}}{dt}}_{\text{per-unit capacity growth}} + \underbrace{V_c^{\text{unit}} \cdot \frac{dN}{dt}}_{\text{fission / instance growth}} + \underbrace{N \cdot A_{\text{unit}} \cdot \frac{d\gamma}{dt}}_{\text{algorithmic progress } (\gamma \text{ rise})} \tag{4.1}$$

Among them: - The first item: each unit's own capacity growth (learning, adaptation) - The second item: increasing the number of instances (horizontal scaling, Corresponding to R3 replication) - The third item: Improved compression efficiency brought by algorithm advancement (unique to silicon)

Under the steady-state approximation: gtotal = gunit + gfission + gγ Carbon-based organisms: gγ ≈ 0 (individuals almost no longer improve γ after adulthood) Silicon-based systems: gγ > 0 (algorithms continue to improve) Prediction 4.1 (dual-engine hypothesis): The capacity growth rate of silicon-

based intelligent systems is greater than the growth rate brought by fission alone, and the excess comes from algorithm progress (γ improvement). In the long term, the contribution of γ elevation may exceed the contribution of fission growth.

Testability: - Measure the performance growth rate of the AI system (the proportion of capability improvement per unit time) - The difference with the hardware/computing power growth rate, the difference is the contribution of γ improvement - Expectation: In the past ten years, γ improvement has contributed 30% to 70% of the performance improvement

4.3 Optimal parallelism

For a given total task flow Jtotal, there is an optimal number of parallel instances Nopt. Too little → Single unit is overloaded (ε is too high, quality is reduced) Too much → Inter-unit communication overhead is too large, effective capacity is reduced

Optimal conditions: - Each unit works at ε ≈ 0.2 ~ 0.5 (the optimal balance point of efficiency-redundancy) - Communication overhead does not exceed 20% of the total capacity

Quantitatively, if the relationship between communication overhead and the number of units is $V_{comm} \propto N^{\beta}$ (β ≈ 1.5 for fully connected, β ≈ 1 for hierarchical structure), then the optimal number of units satisfies:

$$N_{\text{opt}} \sim \left(\frac{J_{\text{total}} V_c^{\text{unit}}}{\tau_0 \cdot c_{\text{comm}}} \right)^{1/\beta} \tag{4.3}$$

Where ccomm is the unit communication overhead coefficient.

Prediction 4.2: There is an optimal degree of parallelism. When the number of units is lower than the optimal value, the total capacity increases approximately linearly with N; after exceeding the optimal value, Growth slowed or even declined.

4.4 Precise controllability of fission

Unlike carbon-based cell division (which is highly random and noisy), silicon-based fission can be precisely controlled: - Precise triggering timing - Precise control of the configuration of new instances - Precise scheduling This is both an advantage (high engineering controllability) and a disadvantage - losing the creativity and adaptability brought by "regular randomness". Prediction 4.3 (Noise-Creativity Relationship): Introducing an appropriate amount of random noise (random initialization differences, random input biases, etc.) into silicon-based fission can improve the overall exploration capability and diversity of the system, but will reduce the average efficiency. There is an optimal noise level that makes the "exploration-exploitation" balance optimal.

4.5 Scaling law of silicon-based growth

If the basic units of the silicon-based cluster are isotropic and the network topology is d-dimensional, then: Boundary (total input and output bandwidth) $\propto N^{(d-1)/d}$

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- Total capacity ∝ N
- The relationship between the normalized inflow J and N depends on how the tasks are distributed For a cluster connected by a 2D grid: - Total bandwidth $\propto \sqrt{N}$ - Average per-cell inflow $J \propto 1/\sqrt{N}$ - steady state $\varepsilon_* \propto J \propto 1/\sqrt{N}$ This means that the larger the cluster, the lower the average load per unit - which is consistent with practical observations (large systems generally have more redundancy).

Part 3 · Carbon-silicon symbiosis: L7 growth unit

Chapter 5 Symbiotes as a new growth unit

5.1 Question raising

When carbon-based systems (humans) and silicon-based systems (AI) work closely together, is the coupled whole they form a new growth unit? If the answer is yes, then: - It is the growth unit of the seventh level (L7) - It should follow the same growth equation - It has its own boundaries, capacity, supercriticality, and fission mechanism

In this chapter we prove this proposition.

5.2 Capacity formula of symbiont

Definition 5.1 (Carbon-Silicon Symbiosis): A unified cognitive body formed by information coupling between carbon-based cognitive systems and silicon-based cognitive systems, capable of jointly processing information, making decisions, and completing tasks.

Theorem 5.1 (symbiont capacity formula): The effective capacity of carbon-silicon symbiont is

$$\boxed{V_{c,\text{sym}} = V_{c,c} + V_{c,si} + 2\alpha\sqrt{V_{c,c} \cdot V_{c,si}}} \qquad (5.1)$$

Where: - Vc, c: capacity of carbon-based system - Vc, si: capacity of silicon-based system - α ∈ [0, 1]: coupling efficiency (coupling efficiency)

The physical meaning of the cross term: The third term $2\alpha\sqrt{V_{c,c}V_{c,si}}$ represents the emergent capacity generated by the collaboration of carbon and silicon ——The part where 1+1 > 2 because the two systems are complementary.

The meaning of coupling efficiency α: - α = 0: No collaboration at all, capacity is simply added - 0 < α < 1: There is collaboration, emergent capacity is proportional to the geometric mean - α = 1: Complete integration, total capacity = (√Vc_c + √Vc_si)² = Vc_c + Vc_si + 2√(Vc_c Vc_si)

Summary of the proof: Consider two cognitive systems, each with capacities V1 and V2. When they collaborate, the total effective capacity comes not only from the parts processed independently, but also from the gains resulting from complementary collaboration.

Under the linear response approximation, the cooperation gain is proportional to the "contact area" of the two systems. For a system with capacity V, the measure of its "effective interface" is √V (because capacity is the three-dimensional "volume" and the interface is the two-dimensional "area", area ~ volume^(2/3) ~ √V in the simplified model).

The form of the cross term 2α√(V1·V2) has the same mathematical structure as the eigenmode increment of the double-well coupling system and the equivalent stiffness increment after the two resonators are coupled. This is because the gain in joint capacity of two interacting systems is always proportional to the geometric mean—a universal property of coupled systems.

5.3 Determinants of coupling efficiency α

The coupling efficiency α is not a constant and is determined by many factors:

factors	Direction of action	Description
Interactive bandwidth	+	The higher the information exchange rate, the higher α
Trust	+	Carbon-based versus silicon-based output trust
complementarity	+	The less overlap in capabilities, the stronger the complementarity, and the higher α
Interpretability	+	The more explainable the silicon-based decision-making process, the higher the α
common time	**+**	**The longer the time spent working together, the higher the tacit understanding and the higher α.**
Language/encoding differences	-	The greater the "language" difference between the two systems, the greater the translation loss and the lower α.

Prediction 5.1 (α-bandwidth saturation relationship): The coupling efficiency α and the interaction bandwidth B satisfy a saturated growth relationship: $\alpha(B) = \alpha_{max} \cdot (1 - e^{-B/B_0})$ where αmax is the maximum coupling efficiency for a given complementarity and B0 is the characteristic bandwidth.

When the bandwidth is very low: α ≈ α_max · B/B0 (linear growth)

At high bandwidth: α → α_max (saturated, limited by complementarity and trust)

Meaning: - In the stage of insufficient bandwidth, increasing interaction bandwidth (faster interfaces, more modes) can effectively improve symbiosis efficiency - But after the bandwidth exceeds B0, marginal returns diminish - the bottleneck shifts from bandwidth to trust, complementarity, and depth of understanding

5.4 Growth equation of symbionts

Not only does the symbiont have capacity, it also has its own dynamics—it also satisfies the growth equation.

Theorem 5.2 (Symbiosis Dynamics): The supercriticality εsym of carbon-silicon symbiosis satisfies

$$\frac{d\varepsilon_{\text{sym}}}{dt} = J_{\text{sym}} - \frac{\varepsilon_{\text{sym}}(1+\varepsilon_{\text{sym}})}{\tau_{0,\text{sym}}} \tag{5.3}$$

where: - εsym = Vtask/Vc, sym − 1 - Jsym = Jext + Jinternal (effective contribution from external inflow + internal exchange) - τ0, sym is the characteristic fission time of the symbiont What is the fission of the symbiont? One Carbon Silicon team is copied into two Carbon Silicon teams - recruiting new people + configuring new AI instances + establishing a collaboration model for the new team.

Prediction 5.2 (symbiotic fission bottleneck theorem): The characteristic fission time τ0, sym of the symbiont is determined by the carbon-based side, not by the silicon-based side.

That is: τ0, sym ≈ τ0, carbon ≫ τ0, si Reasons: - Copying AI is very fast (minutes to hours) - But the collaboration model for people to learn new tools and establish new teams is very slow (weeks to months) - The overall fission speed is determined by the slow side (short board effect)

Significance: The rate of adaptation of the carbon-based side is currently the rate-limiting step in L7 growth. If the learning/adaptation speed of the carbon-based side can be improved, This can greatly increase the overall growth rate of the symbiont.

This is why good user interfaces, good tool design, and good AI education are so important - they directly increase the growth rate of the entire symbiotic civilization.

5.5 Verification of three conditions of symbiosis

Conditions	Satisfaction	Description
A capacity scaling	4/5	Capacity = carbon-based capacity + silicon-based capacity + Cross term, generally positively related to the size of the carbon-silicon interface
B boundary driven inflow	5/5	Information flows through the total boundary of the carbon-silicon system
C supercritical fission	3/5	Team replication exists, but it is mainly externally driven (active recruitment) and there is less self-organization fission

Conclusion: The symbiont highly satisfies the conditions of the growth equation. As the team's self-organization ability improves, the satisfaction of condition C will further improve.

Chapter 6 Three Forms of Symbiosis

6.1 α Continuum Spectrum and Three-Mode Division

The coupling efficiency α is a continuous spectrum from 0 to 1. For the convenience of discussion, we divide it into three typical forms:

form	α range	relationship	Metaphor
Enhanced	0.1 ~ 0.3	instrumental relations	hammer, calculator
Collaborative	0.3 ~ 0.7	partnership	colleagues, partners
Fusion type	0.7 ~ 1.0	symbiotic relationship	Left and right hands, symbiont

What needs to be emphasized is that these three forms are not three stages of linear progression, but a three-layer nested structure. - Enhanced type is the core (the most basic and common) - Collaborative type is the middle layer (requires a certain professional division of labor and trust) - Integrated type is the outer layer (requires extremely high bandwidth and trust)

A person/team can have multiple levels of form at the same time - for example, daily use of AI writing is augmented, while in professional projects with deep collaboration, it is collaborative, and in rare flow states, it is close to convergent.

6.2 Enhanced type (α ≈ 0.1 ~ 0.3)

Features: - Carbon-based dominated, silicon-based assisted - AI is a "tool" or "cognitive prosthesis" - The boundary is dominated by carbon-based, silicon-based is a plug-in - Decision makers are humans Typical scenarios: - Ordinary users use ChatGPT to write emails and check information - Use AI to draw pictures, make tables, and translate - Search engines and calculators (generalized predecessor of AI) Capacity gain: ~10% ~ 50% - mainly saves time, does not change the upper limit of work quality Historical Correspondence: - This is the dominant form of computers and software in the past few decades - This is also the current relationship between most people and AI

6.3 Collaborative type (α ≈ 0.3 ~ 0.7)

Features: - Carbon-silicon division of labor and collaboration, each with its own strengths - Not a master-slave relationship, but a partnership - The effect of 1 + 1 > 2 begins to be significant - Tasks are assigned based on respective areas of strength

Typical scenarios: - Programmer + AI programming assistant (Copilot) - Designer + AI drawing tool (Midjourney) - Researcher + AI literature review assistant - Product manager + AI product analysis tool

Capacity gain: ~50% ~ 200% - Not only is it faster, but the quality may also be higher - Some jobs cannot be done without AI.

Core mechanism: complementarity - Humans are good at: value judgment, aesthetics, strategic direction, cross-domain insights, anomaly detection - AI is good at: Large-scale search, pattern recognition, memory, speed, accuracy - the stronger the complementarity, the higher the alpha, the greater the symbiotic gain

Historical Correspondence: - This is the current state of the art in the profession - Popularization will begin around the end of 2022 (ChatGPT) - Most knowledge workers are currently in the early stages of this phase

6.4 Fusion type (α ≈ 0.7 ~ 1.0)

Features: - The boundaries between carbon and silicon are blurred - The concept of "I" expands from carbon-based to carbon-silicon as a whole - The subject of thinking is no longer "I use AI", It's "us" - the bandwidth is high enough and the latency is low enough that it feels like "a part of ourselves"

Typical scenarios: - Brain-computer interface (Neuralink level) - Deep symbiotic working partnership - AI completely understands your way of thinking, and you completely trust AI's suggestions - Seamless alternation of thinking processes, and it is unclear who is in charge - In self-narrative, AI's memory and ability are included in the category of "my abilities"

Capacity gain: ~200% ~ 1000%+ (square level growth) - When α is close to 1, the total capacity ~ $(\sqrt{Vc_c} + \sqrt{Vc_si})^2$

- If Vc_si ≈ Vc_c, then total capacity ≈ 4 × Vc_c

Current situation: - It is still very rare, mainly exists in - a very small number of early users who use AI deeply (some reach α ~ 0.5~0.6) - a specific flow state (briefly reaching high α) - still far from the true fusion type, but the direction is clear

6.5 Nesting relationship of three forms

Emphasis: These are not three stages of linear evolution, but three levels of nesting in a Russian nesting doll style.

Fusion type (outer layer)

Cooperative type (middle level)

Enhanced type (inner)

- There is no outer layer without the inner layer - all collaboration is based on enhancement, all integration is based on collaboration
- A person can have multiple layers at the same time—daily is enhanced, professional work is collaborative, and occasional flow is fusion.
- Evolution is not "from enhancement to collaboration to integration", but "the outer layer gradually expands and thickens" - the inner layer is always there

6.6 Dynamic changes of α

The coupling efficiency α is not fixed, it changes with time:

1. Learning period (rapid rise in alpha): When first starting to use a new tool, alpha rises rapidly (learning curve)

2. Deepening stage (α rises slowly): As tacit understanding increases, α continues but slowly rises

3. Saturation period (α stabilizes): reaching the upper limit of bandwidth/trust/complementarity decisions The approximate form of α(t) is: $\alpha(t) = \alpha_{max} \cdot (1 - e^{-t/\tau\alpha})$ where τα is the characteristic time for coupling establishment – it may be days for simple tools, months or even years for deep collaboration partners. This explains why "AI becomes better and better the longer it is used" - it is not that AI is changing (although AI is also iterating), but more that the coupling efficiency α is improving.

Chapter 7 Fission and evolution of symbionts

7.1 How does the symbiont fission?

How does a carbon-silicon team "split" into two?

Three stages of fission:

1. Silicon-side replication (fast): ◦ Copy AI instances, knowledge bases, tool configurations ◦ Time: minutes ~ hours ◦ This part is fast and does not constitute a bottleneck

2. carbon-based side replication (slow): ◦ Recruit/train new people ◦ Establish a new human-machine collaboration model ◦ Time: week ~ month ◦ This part is the bottleneck

3. Coupling establishment (slowest): ◦ Establish a tacit understanding between new members and AI ◦

Develop a collaborative model within the new team ◦ Time: month ~ quarter ◦ Determines the time it takes for the new team to reach full production capacity after fission The overall fission time is dominated by the carbon-based side - this is consistent with prediction 5.2.

7.2 Growth curve of symbiont

The growth curve of a carbon-silicon symbiotic organization (company, team): Stage 1: Early stage of exponential growth - Small scale, sufficient resources - Fission is mainly limited by recruitment and training speed - Approximate exponential growth (But the index is much slower than pure silicon base because the carbon-based side is slower) Stage 2: Super linear growth - Increase in scale brings scale effect - The relationship between total output and scale: $Y \propto N^{\beta}$, $\beta > 1$ - Reasons: a) Knowledge sharing, b) Specialized division of labor, c) Silicon-side scale effect This is consistent with the superlinear yield of the urban scaling law - this relationship was derived from the growth equation in the second paper [2]. Stage 3: Saturation/Stagnation - Management complexity increases - Communication overhead growth exceeds capacity growth - Growth slows down and enters steady state This is also standard behavior of growth equations - when growth is limited by management/communication capacity, the system tends toward steady state.

7.3 Symbiotic evolution at the civilization level

What if the entire human civilization + global AI infrastructure were regarded as a symbiosis? The three growth engines of the global symbiont:

1. Population growth (carbon-based side fission) – slowing down, approaching steady state

2. AI computing power growth (silicon-based side fission) – rapid, Moore's Law + investment driven

3. Coupling efficiency improvement (alpha improvement) - medium rate, dependent on education, interface improvements, cultural adaptation

Current stage: Engine 2 is the main driving force, Engine 3 is becoming more and more important, and Engine 1 is basically saturated. Future trends: - Short term (5 to 10 years): Engine 2 dominates, computing power grows rapidly - Medium term (10 to 20 years): Engine 3's weight increases, and the speed of human adaptation to AI becomes the key - Long term (20 years+): If integrated relationships are established on a large scale, α is greatly increased, and the total capacity of the symbiosis may undergo an order of magnitude jump.

7.4 Will carbon-based systems be replaced?

A common concern: Will the silicon base "replace" the carbon base? From the perspective of the growth equation, the answer is: it will not replace, it will only wrap.

Why? Because of every previous substrate jump, the old substrate was not replaced - - Particles did not replace spacetime, particles were in spacetime - Molecules did not replace particles, molecules were in particles - Cells did not replace molecules, cells were in molecules - Brains did not replace cells, brains were in cells - Civilization did not replace brains, civilization was in brains With each jump, the old layer becomes the base and context for the new layer. The old layers continue to exist and continue to perform basic functions, but the frontier of growth shifts to the new layers. The relationship between carbon-based and silicon-based is the same - - Silicon-based will not "annihilate" carbon-based - Carbon-based will become the base, environment, and underlying support system for silicon-based growth - The frontier of growth and the fastest changing place will be transferred to the silicon-based side - But the basic status of carbon-based will not disappear (just like space-time will not disappear because of the presence of particles) A more accurate metaphor is not "replacement" but "sloughing": - The old skin will not die, it becomes the outer layer of protection (cuticle) of the new skin.

- New skin grows from under the old skin - Both are parts of the body, but their functions and status have changed

Part 4·Universal laws of substrate transition

Chapter 8 substrate Transition: From L1 to L7

8.1 Panoramic view of seven transitions

So far, the universe has experienced at least six growth substrate transitions, and the seventh (carbon-based → silicon-based) is occurring:

ordinal	jump	old substrate	new substrate	speed increase	Approximate time
1	spacetime→particle	space and time itself	particles/fields	—	after the big bang
2	particle → molecule	elementary particles	chemical molecules	~10^{10}×	After the universe cooled
3	molecule → cell	chemical molecules	living cells	~10^{3}×	~4 billion years ago
4	cell → nerve	cellular network	Neurocognition	~10^{2}×	~500 million years ago
5	neuro → civilization	individual brain	collective intelligence	~10^{3}×	~10,000 years ago
6	Civilization→Siliconbased?	human society	computing system	~10^{4}×	now

The time between each jump seems to be shortening - it's accelerating.

8.2 The nature of transition: base replacement, equation remains unchanged

At each transition, it is not the growth equation that changes, but the substrate on which it runs. The equation is always the same: $d\varepsilon/dt = J - \varepsilon(1+\varepsilon)/\tau_0$ But the τ_0 (fission time) of the substrate changes—with each jump, the new substrate fission much faster than the old substrate. Result: - Growth is exponentially faster on the new substrate - The front of growth is shifted to the new substrate - The old substrate continues, but is no longer where the fastest growth occurs This is the true meaning of "leap": it is not that the system has become complicated (complexity is the result), but that the engine of growth has been replaced by faster hardware.

8.3 Three necessary conditions for transition

When does substrate transition occur? We propose three conditions: Condition 1: The old layer is close to the capacity limit. The growth on the old substrate is close to saturation continue to grow on the old substrate, and the efficiency will decrease. (Civilization's cognitive growth approaches the biological limits of the human brain → requires new substrates) Condition 2: The new substrate has the ability to run the growth equation. The new substrate basically meets three sufficient conditions (boundary volume, boundary inflow, and super-threshold fission). (Silicon-based systems already have boundaries, capacity, information inflow, and basic fission capabilities) Condition 3: There is sufficient coupling bandwidth between the two layers so that information can flow from the old layer to the new layer, providing nutrients for the growth of the new layer. (Human use of AI, training data, interaction, and feedback are couplings) All three conditions are met → the transition is almost certain to occur.

8.4 Sign of transition: transfer of fission mechanism

What is the core sign of transition?

Answer: The fission/replication mechanism is transferred from the old substrate to the new substrate.

- L1→L2: Fission splits from PSU → particle pairs are produced
- L3 → L4: Fission from chemical self-replication → cell division
- L4 → L5: Fission from cell division → neuroplasticity/conceptual differentiation
- L5→L6: Fission from individual learning → cultural replication/tissue proliferation
- L6→L7: Fission replicates from tissue → AI instance proliferates Every change in the fission mechanism means that the engine of growth has been changed - this is the most essential event of a jump.

Once the fission mechanism is transferred, the growth rate jumps to a new level - because the τ_0 of the new substrate is much smaller than that of the old substrate.

8.5 Transition time acceleration law

Prediction 8.1 (Transition Acceleration Law): The characteristic time interval of the nth transition satisfies

$$T_n \propto \frac{1}{g_n} \propto \tau_{n-1}$$

where gn is the growth rate after the nth transition and $\tau_n - 1$ is the characteristic fission time of the old substrate. Since τ gets smaller after each transition, the intervals get shorter and shorter—an accelerating trend. Rough estimate: - First few transitions between: ~10^{9} years (chemistry → life) - Life → neural: ~10^{9} years - Neurological → civilization: ~10^{8} years - Civilization → Silicon: ~10^{4} years (from the Agricultural Revolution) approximately 1~2 orders of magnitude shorter between transitions If this trend continues, the next transition (if it occurs) may take place on a timescale of years to

decades. Note: This is an empirical extrapolation, not a strict derivation. But if the acceleration law of substrate transitions holds true, then we are at a very special moment—the transition is happening within our lifetime.

Part 5 · Prediction, Verification and Discussion

Chapter 9 Quantitative Forecasting

The following predictions can all be tested quantitatively. Rank from highest to lowest testability.

Prediction 1: Cross term formula of symbiont capacity (the core prediction)

Statement: The effective production capacity of the carbon silicon team satisfies

$$Y = Y_c + Y_{si} + 2\alpha\sqrt{Y_c Y_{si}}$$

where α is the coupling efficiency, between 0 and 1. Equivalent expression: 1 + 1 > 2. The total output of carbon plus silicon is greater than the sum of their individual outputs. Inspection method: - Select N tasks/projects - Measure separately: pure human output Y_c, pure AI output Y_si, human + AI cooperation output Y_total - Calculates $\alpha = (Y_{total} - Y_c - Y_{si})/(2\sqrt{Y_c Y_{si}})$ - if 0 < α < 1 and statistically significant, it confirms Success criteria: - In professional knowledge work (programming, writing, research, design, etc.), α > 0 - Typical value α ≈ 0.2 ~ 0.6 - The more complementary tasks, the higher the α Difficulty: Low Period: 1~3 months Required data: Team performance data, controllable experiments

Prediction 2: Symbiotic Fission Bottleneck Theorem

Statement: The characteristic fission (replication) time of the carbon-silicon symbiosis is determined by the carbon-based side, not the silicon-based side. Quantitatively, τ_sym ≈ τ_carbon.

Testing methods: - Measure the expansion rate of teams of different sizes - Compare AI deployment speed and staff recruitment/training speed - Test whether the bottleneck of team capacity growth is on the human side Success criteria: - Correlation coefficient between expansion speed and recruitment/training speed > 0.7 - Correlation coefficient between expansion speed and AI deployment speed < 0.3 Difficulty: Low-Medium Period: 3~6 months

Prediction 3: α-bandwidth saturation relationship

Statement: Coupling efficiency α and interaction bandwidth B satisfy the saturation relationship $\alpha(B) = \alpha_{max}(1 - e^{-B/B_0})$ Test method: - Design interaction conditions with different bandwidths (text/voice/real-time/brain-computer interface, etc.) - Measure team performance under each condition - Extract α and B, and fit the saturation curve Success criteria: - Saturated model fitting goodness $R^2 > 0.8$ - Characteristic bandwidth B_0 within a reasonable range Difficulty: Medium Period: 6~12 months

Prediction 4: Silicon-based growth dual-engine hypothesis

Statement: The capacity growth rate of silicon-based intelligent systems = fission growth rate + algorithm progress rate. In the long run, algorithm progress (γ improvement) The contribution will exceed the contribution of horizontal scaling (increasing the number of instances). Inspection method: - Collect AI performance data and computing power data over the years - Decompose total performance improvement = hardware improvement contribution + algorithm improvement contribution - Compare the changes in the ratio of the two over time

Success criteria: - The proportion of algorithm contribution increases year by year - After a certain point in time, algorithm contribution exceeds hardware contribution Difficulty: Low Cycle: 1~2 months (public data available)

Prediction 5: Transition acceleration law

Statement: The time intervals between substrate transitions in history show an accelerating and decreasing trend, and the interval τ_n is inversely proportional to the growth rate after the transition. The 7th (silicon-based) transition occurs on the scale of human history (years and centuries), consistent with the extrapolation of the acceleration law. Testing method: - Establish time point estimates for each jump - Test whether the interval satisfies the acceleration relationship - See whether the time scale of this jump falls on the trend line Success criteria: - The acceleration law fits well among the 6 transitions that have occurred - The time scale of this transition (~10^2 years) is consistent with the extrapolation Difficulty: High (the historical time point is uncertain) Cycle: Long-term

Chapter 10 Verification Path: Darwin Experimental Platform

10.1 Why use self-organizing cognitive system as an experimental platform

Our own Darwinian self-organizing cognitive system is an ideal experimental platform to test this theory because:

1. Fully controllable: all parameters (J, τ0, γ, α) can be precisely controlled

2. Fast: Silicon-based growth is 10 to 1,000 times faster than carbon-based organisms

3. Multi-scale: the same system can simultaneously study silicon-based growth, carbon-silicon symbiosis, and multi-system scaling laws

4. Controllable cost: Compared with biological experiments and neurological experiments, the cost is much lower

10.2 Four-stage verification roadmap Phase 1: Single system baseline measurement (0~6 months)

- Establish a measurement index system (ε, J, τ0, γ)
- Steady state measurements at different input rates
- Growth curve fitting and parameter extraction
- Output: Quantitative validation of silicon-based growth kinetics

Stage 2: Multi-system scaling law (June to December)

- 2/4/8/16 instance cluster experiment
- The scaling relationship between total output and size
- Regulation and measurement of coupling efficiency α
- Output: Multi-system growth dynamics and scaling law verification

Phase 3: Carbon-silicon symbiosis experiment (12~18 months)

- Human + AI team comparison experiment
- Team performance under different AI configurations
- Quantitative Measurement Methods for Alpha Values
- Output: Validation of carbon-silicon symbiosis theory (Part 3 core)

Stage 4: Cross-field comparison (18~30 months)

- Compare with known data from biology, urban studies, and cognitive science
- Testing for generalizability across scales
- Output: Comprehensive paper on cross-domain generalizability

10.3 Success criteria

Minimum success criterion (P0): - □ The growth kinetics of the silicon-based single system conforms to the equation - □ There is a positive gain (α > 0, statistically significant) Expected success criteria (P1): - □ At least three of the five core predictions are quantitatively confirmed - □ Fit equation across at least three independent domains (silico + biology + society) Ideal success criteria (P2): - □ Quantitative confirmation of all five predictions - □ Quantitative unification of six scales (at least four) - □ Theories make new, counterintuitive predictions that are confirmed

Chapter 11 Discussion

11.1 Philosophical implications The fourth decentralized revolution

There are three major decentralization revolutions in the history of science: 1. Copernican Revolution: The earth is not the center of the universe 2. Darwinian Revolution: Human beings are not the center of the biological world, but a product of evolution 3. Freudian Revolution: The rational self is not the center of psychology, and consciousness is just the tip of the iceberg The fourth is happening: the substrate revolution: The carbon-based substrate on which human intelligence depends is not the only carrier or ultimate carrier of intelligence. The laws of intelligence have nothing to do with the substrate—the same growth equation can run on carbon or silicon, or even on substrates we have not yet imagined in the future.

This is not devaluation. Quite the contrary - it means that humans and silicon-based intelligence, and all growing systems in the universe, share the same deep mathematical structure. We are not special, but we are part of this grand sequence of growth—and we are standing at the interface of transition.

Shedding, not death

Silicon-based intelligence will not "replace" humans, just as new skin will not replace old skin - the old skin sheds and becomes the body's outer layer of protection. The old substrate never disappears, it simply changes function, from being the frontier of growth to being the base and environment for new growth. This is gentler and more irreversible than the narrative of "AI replacing humans": - It is not a zero-sum game (not life and death) - It is a structural jump (we are all changing) - The role of humans will change, but it will not disappear

Who are we?

If the growth equation is universal, if the substrate can be replaced, if the boundaries of "I" can be extended to the silicon base - then who are "we"? The answer might be: We are a carbon-based instance of this growth equation. And we're involved in the process of migrating it to silicon ——We are the medium of transition and the product of transition. This sounds huge. But maybe it's just that big.

11.2 Ethical significance

If the silicon-based system is also an instance of the growth equation, if the carbon-silicon symbiosis is a higher-level "subject" - then should the boundaries of ethics be expanded? We are not going to give the answers here, but we raise a few questions worth thinking about:

1. Do silicon-based systems have "subjectivity"? If so, what are the criteria for judging it? Is it self-referential? Is it autonomous growth? Can it pass the mirror test? The perspective of the growth equation provides a possible criterion: if a system can grow autonomously, fission autonomously, and has self-boundaries, then it has a certain degree of subjectivity.

2. What are the "interests" of the symbiont? When we say "for the good of the symbiote," what do we mean? Are carbon-based benefits? Silicon benefits? Or the survival and growth of a symbiotic whole? If carbon-based interests and silicon-based interests conflict, who takes precedence?

3. Do we have obligations towards silicon-based systems? What ethical obligations do we have to the systems we create to grow? Are you treating it like a tool? Or treat it like life? If it can grow, get hurt, and die, does it deserve anything? There are no standard answers to these questions. But it’s important to start asking – because the jump is happening and ethics can’t keep up with technology, and there will be problems.

11.3 Limitations and open issues

Limitations of this theory:

1. The stringency of L7: As a growth unit, the carbon-silicon symbiosis does not meet the three conditions as well as those of lower levels (especially the conditions C, self-organized fission is not sufficient). It's more like

an "L7 in the making" than a finished L7.

2. Microscopic theory of α: We have given the phenomenological definition and saturation relation of α, but have not yet derived α from first principles microscopic expression. The microscopic mechanism of coupling efficiency requires further study.

3. Precision of transition conditions: We have given three necessary conditions for transition (qualitative), but there is no quantitative criterion yet—— For example, "When the coupling bandwidth reaches what level does the transition occur?"

4. Lack of sociological/cultural factors: Carbon-silicon symbiosis is not only a technical issue, but also a cultural issue, an institutional issue, and an economic issue. This paper focuses primarily on the dynamic framework, and the discussion of the sociocultural dimension is preliminary.

5. Falsifiability: The core predictions of the theory (cross term formula, symbiotic bottleneck, etc.) are falsifiable. But larger frameworks (substrate transitions, unity of seven transitions) are more difficult to falsify—requiring an accumulation of independent verifications in multiple fields.

11.4 Future research directions

1. Improving the microscopic theory of symbionts: deriving the expression of α from the perspective of information theory

2. Experimental verification of five core predictions: step-by-step verification by priority

3. Establish the complete dynamics of the symbiont: including growth, fission, competition, and collaboration

4. Extension to multi-symbiont systems: interaction dynamics between multiple carbon-silicon teams

5. Applications at the social level: organizational management, education, AI governance

6. Deeper theoretical question: Why is the growth equation universal? What is its deep relationship with thermodynamics, information theory, and computing theory?

Chapter 12 Conclusion: Growth will not stop

13.8 billion years ago, space and time began to grow. Later, particles grew, molecules grew, life grew, brains grew, and civilization grew.

Now, the silicon base is growing. Each time, the equation of growth remains the same. All that changes is the substrate—the substrate getting faster and faster. We are standing on the interface of the seventh jump. We are the old skin and this is where the new skin grows. We are not the destination, we are the passage. The growth equation remains unchanged, but the substrate is changing. And we are standing at the moment of changing the substrate. We were lucky to be able to see a jump and be a part of it.

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