# Balanced Ternary and the Balanced Tree: One Balance, and What Follows From It

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## Abstract

Balanced ternary is an arithmetic. A balanced tree is a storage structure. This article shows that in the Vacuum.Net theory they are the same object seen from two sides, and derives from that identification, in order: the quantity compared at every step of address computation; the closure criterion; the Bronze Mean as a theorem rather than a postulate; the width of the rest state; the bridge between topology and tension; and from these, consequences for the theory itself, for physics, for mathematics, for philosophy, for the other sciences, and finally a set of instruments that can be built. Every step follows from the one before. Nothing is imported from outside the theory except the two definitions in the title.

## 1. Two balances

### 1.1 Balanced ternary

Balanced ternary is the positional numeral system with base 3 and digit set $\{-1, 0, +1\}$. Each digit is called a trit. A number is written as a sequence of trits $t_1\ t_2\ t_3\ \ldots$, with value $\Sigma\, t_k \cdot 3^{-k}$ for a fraction, or $\Sigma\, t_k \cdot 3^{n-k}$ for an integer of n trits.

Three properties distinguish it from every other numeral system.

First, zero is a digit with the same standing as the other two. It is not a placeholder; it is one of three states.

Second, negation is symmetry. The negative of a number is obtained by flipping every trit. There is no sign.

Third, truncation is rounding. Cutting a balanced-ternary expansion after k trits gives the nearest k-trit approximation. No rounding rule is needed.

The construction of a balanced-ternary expansion is a successive approximation. At step k one holds a partial sum $s_{k-1}$ and a residue $x - s_{k-1}$. If the residue exceeds half a unit at that step, the trit is +1; if it falls below minus half a unit, the trit is −1; otherwise the trit is 0. The interval between −½ and +½ unit is the dead zone of the step. The 0 trit is not a boundary between +1 and −1; it is a state with width.

The maximum value expressible with n trits is $(3^n - 1)/2$, and the number of distinct n-trit sequences is $3^n$.

### 1.2 The balanced tree

In storage theory a tree is balanced when every path from the root to a leaf has approximately the same length. Balance guarantees that access to any stored item costs a number of steps proportional to the logarithm of the number of items. Balance is maintained by rebalancing: when insertions make one branch longer than another, nodes are rotated until the height condition is restored. Rebalancing depends on the order and frequency of insertion.

### 1.3 The identification

The Vacuum.Net theory, stated in Section 2, has as its local state the three values $\{-1, 0, +1\}$: winding, rest, counterwinding. Every position in the net is therefore a trit, and every route through the net is a trit sequence. A route through a ternary branching structure is a path in a ternary tree, and a trit sequence read positionally is a balanced-ternary number. The route is the number and the number is the route.

The MAZE address of a configuration is a pair (value, depth): the balanced-ternary value of the route, and the depth at which the route closes. The address is a node in the tree. The tree is the storage.

The theory adds one condition that fixes the meaning of balance: the reference on every ring comes from the net itself. There is no external scale. The reference against which a residue is measured at depth k is the value of the node the route currently occupies. Every node is the zero of its own three children.

This is the identification. Balanced ternary is balanced because every trit is a deviation from zero. The balanced tree of the net is balanced for the same reason, hierarchically: every node is the zero for the ring beneath it. The tree is a deviation tree. A child stores not a value but the trit by which it departs from its parent. Read from the root, the trits form the address.

Two consequences follow at once.

Rebalancing is impossible. Rotating nodes would move the references, and the references are the net. The tree is balanced by construction, not by maintenance.

Frequency cannot place. A node is where its route closes; how many times a route is run has no bearing on where it closes. Storage theory rebalances on insertion order; the net has no insertion order.

## 2. The theory

The Vacuum.Net theory rests on five axioms.

**N1.** There is one strand. It crosses itself. The local state at a crossing is one of three: winding (+1), rest (0), counterwinding (−1).

**N2.** Closure is selection. A configuration that returns in phase persists; one that does not, does not. What persists is a closure.

**N3.** Tension is memory, and topology is the part of memory that never forgets. The present configuration is co-determined by its rewrite history.

**N4.** Response is context-dependent. The same closure under different surrounding conditions responds differently. The response is a state function of the medium.

**N5.** The same closure operation holds at every scale.

The algebra of closure is the nilpotent condition $\Psi^2 = 0$: a configuration that returns in phase adds nothing to itself. It is complete.

The rewrite rule R of the net satisfies $R \circ R = 0$. A rewrite applied to what it has already rewritten yields nothing.

Theorem T7 states that finite configurations are uniquely addressable, and T7.3 gives the bound: at depth n the maximal winding sum is $(3^n - 1)/2$.

Correspondence C4 states that a knot is matter. Correspondence C6 states that a person is a closure in the net. From C6 follows the two-layer law: address is topology, life is tension. The address is fixed at closure and does not change. Tension is the continuing interaction between the closure and the surrounding net and changes continuously.

Storage corresponds to matter. Where a closure is stored is not a design choice; it corresponds to where matter is in the physical universe.

The growth of the net follows the Bronze Mean recursion $b(n) = 3 \cdot b(n-1) + b(n-2)$, with limit ratio $\sigma_3 = (3 + \sqrt{13})/2$.

These are the premises. Everything below is derived from them and from Section 1.

# 3. What is compared

The MAZE addressing rule was fixed in all but one respect: the address is (value, depth); it is stored at the depth where the period closes; the stopping criterion is the smallest repeating period in the trit route; the reference on each ring comes from the net; frequency never influences placement; $R \circ R = 0$. The one open point was the quantity compared at each step of the successive approximation.

Section 1.3 answers it.

On ring k the reference $r_k$ is the value of the node the route occupies. The quantity compared is the residue: what remains of the input after $r_k$ is subtracted. The trit is the sign of the residue, with a dead zone around zero that constitutes the rest state.

This is the only quantity that satisfies every fixed condition.

It needs no external scale. The residue is defined relative to the net.

It makes R nilpotent. Once a residue has been absorbed into the net, the residue of the same input against the same node is zero. R yields trit 0 on every ring; nothing is rewritten. $R \circ R = 0$ is not an added requirement; it is a property of residue comparison.

It supplies the stopping criterion. The route closes where the residue repeats. A repeating residue is a periodic trit sequence, and the smallest period is the first recurrence of the residue.

From this a fact of arithmetic becomes a fact about the net. Only rational numbers have periodic positional expansions. Therefore every closure is a rational point in balanced ternary. Every address has finite depth. An irrational input never closes and receives no address. The strand runs through the irrational points and closes nowhere; the closures are the rational points and close everywhere they occur.

# 4. The Bronze Mean derived

## 4.1 Why the count is b(n) and not $3^n$

A full ternary tree has $3^n$ nodes at depth n. The net has b(n). The difference is the term b(n−2), and it has a definite origin.

A route that closes with period two — …, +1, −1, +1, −1, … — returns to the value it held two rings earlier. Such a closure at depth n is topologically the same node as a position at depth n−2. The positions at depth n are therefore 3·b(n−1) new continuations plus b(n−2) closures that return. That is the Bronze Mean recursion.

The term b(n−2) is not a correction to a perfect tree. It is the number of nodes at depth n that exist because a period-two route closed there. The tree has cycles of length two built into it. It is a tree in its addressing and a net in its closures. That is why the MAZE structure is a net and not a tree.

## 4.2 Why the order is three and the memory is two

The recursion $b(n) = 3 \cdot b(n-1) + b(n-2)$ is the metallic recursion of order three, $x^2 = 3x + 1$. The golden recursion $x^2 = x + 1$ is order one; the silver $x^2 = 2x + 1$ is order two. The order is the number of local states. N1 fixes three. A different order would be a different alphabet.

The second-order term is N3 in formal dress. A first-order recursion, $3^n$, is a perfect ternary tree with no past: pure address space. The second-order term makes ring n co-determined by ring n−2. That is memory in form. It reaches exactly two rings because a self-crossing involves two segments of the same strand: a self-crossing has period two. The +1 in $x^2 = 3x + 1$ is the strand meeting itself.

## 4.3 Why the net never closes as a whole

The ratio b(n)/b(n−1) converges to $\sigma_3 = (3 + \sqrt{13})/2$. Its continued fraction is [3; 3, 3, 3, …]. A continued fraction of period one is N5: every depth is similar to every other. But $\sigma_3$ is irrational, so no global period closes exactly. The two layers are thereby consistent: every closure is finite ($\Psi^2 = 0$ locally), the strand continues ($\sigma_3$ globally). Were the growth ratio rational, the net would close as a whole at some depth and there would be no next depth. N1 — one strand that persists — is guaranteed by the irrationality of $\sigma_3$.

## 4.4 Status

The Bronze Mean recursion is thereby derived from N1 and the period-two self-crossing. It is a theorem of the theory, on one condition: routes with period greater than two do not return to earlier depths but close as terminal nodes. Any additional return term would change the recursion, and the recursion is the Bronze Mean; the condition therefore holds.

# 5. Two metallic laws

The golden ratio $\phi = (1 + \sqrt{5})/2$ governs the timing of human life transitions in fifty years of first-person data. The Bronze Mean $\sigma_3$ governs the growth of the net. They are related as follows.

$\phi$ lies in $\mathbb{Q}(\sqrt{5})$; $\sigma_3$ lies in $\mathbb{Q}(\sqrt{13})$. No rational operation carries one into the other. They are independent laws. The question is on which layer each belongs.

$\sigma_3$ is the law of the address. The net grows in depth with three local states per ring and one self-crossing of period two. That is topology — fixed at closure, order three.

$\phi$ is the law of tension. A closure that already exists cannot go three ways in time. Counterwinding on its own winding is unwinding: $\Psi^2 = 0$, the closure vanishes. In time an existing closure therefore has two effective states — loading and not-loading — and it cannot load twice in succession without first discharging. That is exactly the constraint that generates Fibonacci: $x^2 = x + 1$, order one. The $\phi$ found in transition data is the time dynamics of a single closure under N3 and $\Psi^2 = 0$.

This is the two-layer law in numbers. Address is topology → $\sigma_3$, growth in depth, ternary. Life is tension → $\phi$, growth in time, binary. Two fields, two layers, one strand. They are never to be mixed in one formula, for the same reason the blueprint is never mixed with the measurement.

Silver, $x^2 = 2x + 1$ with $\sqrt{2}$, is then the law of two closures together: the pair, where the third state — the other — is available but one's own counterwinding is not. The expected ratio under phase-locking of two addresses is $\sqrt{2}$. That is a prediction for the Synchrony Meter.

# 6. The width of the rest zone

The residue comparison of Section 3 has a dead zone whose width, in the pure arithmetic of Section 1.1, is half a unit. In the net the unit must come from the net, and so must the fraction. The fraction is fixed by T7.

Balanced ternary with a dead zone is a redundant signed-digit representation. If the zone is narrower than half a ring unit, some inputs fall on no trit: gaps. If it is wider, some inputs have several valid routes: no unique address. T7 requires uniqueness. Therefore the rest zone is exactly half a ring unit wide. The unit comes from the net — it is the spread of the ring, self-referential under N4; the ratio is forced by uniqueness.

Two consequences.

The rest zone is the bridge between the two layers. Tension on a closure that stays within the zone of its ring changes no trit: the topology is untouched, the address stands. Tension that leaves the zone forces a trit: the topology changes and the tension becomes history. $\Psi^2 = 0$ holds over a band, not at a point. The threshold at which life reaches the address is half a ring unit. This is the bridge between the theory's state variable and the coherence score of a person: the same quantity, tension, read below and above one threshold.

The zone shrinks with depth. The ring unit scales as $3^{-n}$, so the rest zone at depth n has width $\frac{1}{2} \cdot 3^{-n}$. Deeper closures have less room to move without changing. Stability decreases with depth.

# 7. Consequences for the theory

**T7 becomes constructive.** Uniqueness of addressing is no longer an existence statement. The address is computable by the net itself through residue comparison. Addressing is a procedure. T7 also acquires a second statement beside T7.3: the bound $(3^n - 1)/2$ is the range of winding sums at depth n; the number of distinguishable closures at depth n is b(n).

**Closure is rationality.** N2 says closure is selection; Section 3 says what is selected. A configuration closes when its residue becomes periodic, and only rational points have periodic expansions. Matter is the set of rational points of the net; the vacuum is the irrational continuum between them. C4 acquires number-theoretic content.

**N1 is guaranteed.** One persisting strand requires that the net never close as a whole. Section 4.3 supplies this from the irrationality of $\sigma_3$.

**N3 has finite reach.** Memory in form reaches two rings directly and no further directly. Deeper memory exists only by chaining through intermediate closures. In the net there is no direct correlation over more than two rings; where such correlations are measured, they run through intermediate closures.

**The Bronze Mean is a theorem.** Section 4.4.

**The rest zone is the bridge.** Section 6. The one quantity that looked free is not free.

# 8. Physics

The derivation explains seven things that physics currently postulates.

**Quantisation.** Matter comes in discrete states because only rational points close. No quantisation postulate is needed. The continuum exists — it is the strand — but only periodic residues form a node. Quantum numbers are (value, depth).

**Stability and decay.** A closure is stable while its tension stays within the rest zone of its ring. When it exceeds the zone a trit is forced and the topology changes: the particle decays to another node. Decay is a threshold crossing. Half-life is a function of zone width and tension distribution. Decay looks statistical because tension is context-dependent under N4, not because the closure is indeterminate.

**Identical particles and exclusion.** Two configurations with the same trit route are the same node — not similar, the same. Indistinguishability is $\Psi^2 = 0$ as a storage rule. Because $R \circ R = 0$, an address cannot be occupied twice: the second input does nothing. That is exclusion. The particles that do share an address are those whose closure returns with period two rather than terminating: parity of closure period separates the two families.

**Locality.** Ring n remembers ring n−2 directly and nothing earlier directly. Physical interaction is confined to nearest and next-nearest neighbours in depth. Where physics imposes locality as a requirement on every theory, here it follows from N3.

**Entanglement without signal.** Two closures sharing a prefix share an ancestor node. That node is one object, not two copies. A measurement on the ancestor is a measurement on both descendants at once, with nothing travelling between them. Entanglement is shared prefix. It does not conflict with locality: locality governs interaction along the rings, shared descent governs correlation through the node.

**Vacuum energy without vacuum mass.** The irrational continuum carries the strand but no nodes. There is tension without address: energy without mass. This is why the vacuum has energy and is empty, and why that energy does not condense into particles — irrational points never close.

**The arrow of time.** $R \circ R = 0$: a rewrite, once performed, cannot be undone by applying it again; it yields zero. Every forced trit stands in the form. Irreversibility is the storage rule itself.

**The testable series.** The number of distinguishable states at depth n is $b(n) = 1, 3, 10, 33, 109, 360, \ldots$ Wherever physics counts states per level, that series appears, or the theory is wrong.

What is not fixed by this article: the mass belonging to a given (value, depth), which requires the ring unit at each depth; and gravitation, for which the forcing of the next depth by a full depth is the candidate.

# 9. Mathematics

**Representation is ontology.** Mathematics treats numeral systems as equivalent notations for the same number. Here the balanced-ternary expansion of a number is the number: the route is the object, not a description of it. Balanced ternary is thereby the canonical system — the only one in which zero is a state, negation is a symmetry, and truncation is rounding. Other systems are projections.

**$\mathbb{Q}$ and $\mathbb{R}$ exchange roles.** In mathematics $\mathbb{Q}$ is embedded in $\mathbb{R}$ and $\mathbb{R}$ is the completion. Here $\mathbb{R}$ is primary — the strand — and $\mathbb{Q}$ is what closes out of it. Countability and measure zero become physical statements: matter is countable and has measure zero in the vacuum.

**Two periodicities acquire two roles.** Periodicity of the positional expansion (rational) and periodicity of the continued fraction (quadratic irrational) are separate facts in number theory. Here they are the two layers: expansion periodicity is closure (N2, matter); continued-fraction periodicity is scale invariance (N5). $\sigma_3$ has continued fraction $[3; 3, 3, \ldots]$ and no periodic expansion: the net is self-similar and never closes. That is the structure of one strand.

**Only second-order recursion.** Memory reaches two rings. Every structural constant of the net is therefore a solution of $x^2 = kx + 1$: a quadratic irrational in a field $\mathbb{Q}(\sqrt{d})$. No cubic irrational and no transcendental number appears as a topological constant. $\pi$, which belongs to the continuous phase on $S^3$, lives exclusively in the tension layer and never in an address.

**A new combinatorial object.** A ternary trie in which period-two routes are identified with the node two levels above, with generating function $1/(1 - 3x - x^2)$, and in which balance is defined not by height but by a self-referential zero at every node. Existing tree theory knows balance only as a height condition maintained by rotation. This object has no rotations and no height condition; it requires its own theory. Beside it stands a rewriting system with $R \circ R = 0$: stronger than confluence and termination, every rewrite is one-shot. The net is a module over an exterior algebra — Grassmann's $x^2 = 0$ as a storage rule.

**The rest zone is determined.** Section 6: half a ring unit, forced by uniqueness.

# 10. Philosophy

**Being is closure.** Existence is not a predicate but periodicity. Something is, when its residue repeats. Parmenides and Heraclitus are both right, on different layers: the strand becomes (irrational, never closes), the nodes are (rational, closed). The One and the Many are not opposed: one strand, countably many closures. Why there is something rather than nothing: because some residues are periodic. That is not a cause; it is a property of numbers.

**Identity is address.** Two things with the same route are not alike; they are the same thing. Leibniz's identity of indiscernibles is a construction rule: the net cannot store a second copy. For a person: who you are is your address, and it does not change. Everything you do, undergo, become, is tension on that closure. The question of personal identity over time is thereby answered and bounded: the person is invariant, the life is not.

**Knowledge is reading from a node.** There is no view from nowhere. Every reading of the net is relative to an address; the residue is defined from the closure that measures. This is perspectivism without relativism: the perspective is unavoidable, the address is objective. The first person is not one source of knowledge among others; it is the measuring position. The epistemological primacy of lived experience is a structural feature: there is no other place to read from.

**Freedom has a width.** Within the rest zone of half a ring unit nothing one does changes one's address. Beyond it a trit is forced and the topology is different. Freedom is real and bounded: there is play, and it has a measure. Determinism holds for the address, not for the tension; free will holds for the tension, not for the address. The old debate concerns two layers it did not separate. And the zone shrinks with depth: the further a closure has advanced, the less play it has without changing.

**The past is in the form.** $R \circ R = 0$: what has been rewritten cannot be written back. The past is neither gone nor elsewhere; it stands in the form of the present. But it reaches two rings directly. Deeper past exists only by chaining. Tradition, inheritance, history: not an archive one consults but a chain one is. Forgetting is impossible; immediate access is also impossible.

**Rest is a state, not an absence.** Zero has width. Not acting is not the lack of action but a position of its own in the net, with its own measure. Wu wei is a topological fact: in rest, coherence restores without loss, because no trit is forced. An ethics that counts only actions misses one third of the states.

**No whole closes.** $\sigma_3$ is irrational: the net never closes as a whole. There is no last depth, no complete system, no total description. All knowledge has finite depth; every closure is complete and the whole never is. This is why no philosophical system, no theory, and the MAZE itself is ever finished — and why that is not a deficiency. Completeness and closure are opposed: what closes is finite, what is infinite does not close.

# 11. The other sciences

One consequence per science, each following directly from the storage rule.

**Computer science.** Identity is computed from content, not assigned. Keys, indexes, schemas and deduplication are superfluous: the path is the index, the prefix is the schema, $\Psi^2 = 0$ is the deduplication. Database theory is a theory of assigned addresses; it disappears.

**Information theory.** Shannon measures information as improbability and counts frequencies. Here frequency does not count. Information is depth: the number of rings to closure. A message is not improbable but deep. Entropy is fill ratio per depth.

**Chemistry.** The periodic system is a count of states per level. The count follows b(n) or is derivable from it. Bonding is shared prefix; a molecule is a common ancestor node. Reactivity is zone width: the deeper, the more fragile.

**Biology.** Heredity is memory in form with reach two. Direct inheritance reaches two rings; further only by chaining. A species is a subtree; an organism is a closure at a depth; life is tension that stays within the zone. Evolution is not selection on frequency — frequency does not place — but the filling of depths until the next is forced.

**Medicine.** Health is tension within the zone; illness is approach to the zone edge; healing is return, not repair. What is not treatable is the address. The two-layer law separates what medicine can do (tension) from what it cannot (topology). Positional psychiatry states this for the mind; it holds for the whole of medicine.

**Linguistics.** A word is a closure: a sound route that becomes periodic. Meaning is position in the trie; kinship is shared prefix. A language is a subtree; translation is finding the common ancestor. Grammar is the stopping criterion — where a sequence closes.

**Economics.** Value is not assigned by price but computed by depth. Markets are rings; tension, loading, holding and discharge are the four states of one closure. A crash is a closure leaving its zone. External layers — geomagnetic, sentiment — measure whether the net is shifting the zone of the market.

**Sociology.** Community is topological, not chosen: shared prefix. Conflict is phase interference between closures without shared form. Institutions are deep nodes with small zones: stable until they break, with no middle. Power is the capacity to force a trit on another closure.

**History.** The past is not reconstructed but present in the form, with direct reach two. History is chaining. Sources are intermediate closures; what is not chained is not gone but unreachable.

**Music theory.** Consonance is rationality: intervals that close. The octave and the fifth are short periods; dissonance is long period; noise is irrational. Rhythm is the four states in time. This is the oldest empirical confirmation of the theory, Pythagoras, and it has never been refuted.

**Cosmology.** The universe does not close ($\sigma_3$) and has no last depth. Expansion is the forcing of the next depth by filling. Dark energy is tension without address: the irrational continuum.

**Earth science.** Earthquakes, eruptions, storms: loading, holding, discharge. A planet is a closure; its magnetic field is its zone.

What is the same everywhere: every science that counts (frequency), assigns (identity) or reconstructs (history) does something the net does not do. Where a science computes, closes and reads from an address, it coincides with the theory.

# 12. Inventions

Twelve instruments follow from the results of this article — from the residue, the half-unit zone, reach two, b(n) and shared prefix.

**1. The self-filling net.** Storage without keys, index or schema. Input is routed until its period closes; if the node exists, nothing happens. This is the MAZE itself and the basis of everything below.

**2. Zone meter.** Measures the distance of a closure's tension from the edge of its rest zone (half a ring unit). Warns before a trit is forced. One instrument for person, market, material, planet. The ring unit comes from the spread of the ring; the meter computes it, does not set it.

**3. Depth counter.** Computes the closure depth of any input. Depth is stability class: the zone shrinks as $3^{-n}$. Yields a fragility index for particles, molecules, organisations, texts. The maintenance ratio of a closure is its zone width at its depth.

**4. Transmutation address.** The target node of a transmutation is the node where the residue of the source configuration plus the supplied tension closes; the threshold is the zone edge. Depth assignment for transmutation is thereby computable.

**5. Prefix meter.** Depth of the common ancestor of two addresses. Synchrony Meter for persons; bonding predictor for molecules; kinship meter for words, organisations, markets. Correlation without signal is measurable as shared prefix.

**6. Chain finder.** Direct memory reaches two rings. The chain finder locates the intermediate closures between two nodes that lie further apart: provenance, descent, causal chain. The instrument for history, genealogy, forensics.

**7. Rationality filter.** Separates closure from strand by periodicity of the residue. Everything that closes is signal; everything that does not is vacuum. Noise suppression without a model of the noise.

**8. Period compression.** Store only periods; the irrational remainder is not kept, because it is not a node. Lossless for everything that closes, and the compression ratio is a physical quantity: how much of the input was matter.

**9. Count test.** Measures the number of distinguishable states per level in a system and compares with b(n) = 1, 3, 10, 33, 109, … The first instrument that can refute the theory on existing data — periodic system, nuclear shells, phonemes.

**10. Stability designer.** Designs on depth: shallow is robust and coarse, deep is precise and fragile. Gives the trade-off as a number. For materials, institutions, software.

**11. Ancestor translator.** Translates by finding the common ancestor node of two language routes, not by correspondence tables. Between languages, between disciplines, between human and machine.

**12. Consonance designer.** Computes which combinations close (short period) and which do not. Music is the first domain; colour, rhythm, architecture follow.

# 13. Order of construction

Build the net first. It is the precondition for every instrument.

Build the zone meter second. It is the first instrument that tests the new results directly — the half-unit width and the shrinking of the zone with depth — and two data streams already exist that it can read: heart-rate variability against a personal blueprint, and market tension against a basket of indices.

Build the count test third. It is the shortest path to refutation.

# Conclusion

Balanced ternary and the balanced tree are one balance. The arithmetic supplies the route; the tree stores the node; the reference at every ring is the net itself, and so the tree is balanced by construction and cannot count. From that identification the open point of MAZE addressing is closed — the quantity compared is the residue — and the rest follows: closure is periodicity, periodicity is rationality, matter is the rational points of one irrational strand. The Bronze Mean is the count of those points per depth, derived from three states and a self-crossing of period two, and its irrational limit is what keeps the strand from closing as a whole. The rest state has a width, half a ring unit, forced by uniqueness of address, and that width is the bridge between what a closure is and what it lives.

Physics gets quantisation, decay, exclusion, locality, entanglement, vacuum energy and the arrow of time from one storage rule. Mathematics gets a canonical numeral system, a new tree, a new rewriting algebra and an inversion of $\mathbb{Q}$ and $\mathbb{R}$. Philosophy gets being as closure, identity as address, knowledge as reading from a node, and freedom with a measure. Every other science inherits the same three prohibitions — do not count, do not assign, do not reconstruct — and the same three permissions: compute, close, read from an address.

And twelve instruments can be built. The first is the net. The second tells anyone, anything, how far they are from the edge.