

Chasing Shadows: A Projection Archaeology of Physics

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It Is All One — Notes. July 2026 (working draft)

Abstract. The papers of this series cite the great names of physics on every page, and until now the citations have run in one direction: the series' results audited against theirs, as if their table were the head of the room. This note turns the reading around — not to diminish anyone, but to complete the series' own first postulate. P1 says that what is observed is the three-dimensional projection of quaternionic motion. This note takes the postulate seriously about the observers themselves: the human brain is a Cartesian instrument, built for simultaneity, and it cannot picture the algebra — it can only feel it and trust it, or refuse it. Read that way, the history of physics is not a parade of authorities but a single long expedition conducted inside a shadow, and every famous near-miss is a data point about what the projection does to a mind working within it. The near-misses are catalogued here in four recurring shapes, each entry disciplined by a four-column rule so the catalogue cannot degenerate into flattery of the present. One claim of ownership is renounced at the door, permanently: the object this series describes is not the author's. It never belonged to Hamilton either, or to Poincaré, or to anyone who glimpsed a face of it. The series claims a reading, not a possession — a simplification of a perception that is common property. It is not mine. It is ours.

1. The Position, Stated First

Two commitments govern this note, and they are the reason it exists.

First: the projection is in the perceiver. The earlier papers located the projection in the mathematics — the adjoint shadow $q \cdot v \cdot \bar{q}$, the component-wise reading that turns one line into twenty. This note adds the missing half: the projection is also *neurological*. The instrument doing physics — the human visual cortex, the parietal geometry engine — is a machine for constructing a three-dimensional simultaneous *now*. Space parallel, time serial, one frame at a time. That is the shadow, running on wetware. A number system in which rotations refuse to commute, in which time is an angle, in which a state must turn 720° to come home — such a system cannot be *pictured* by that machine at all. It can be calculated. It can, in a limited bodily way, be felt (Section 3). It cannot be seen. Every physicist who ever worked has worked inside this constraint, and the history below is what the constraint did to them.

Second: no ownership. This note will re-read a century and a half of physics as approaches to one object. The reading invites a vulgar misunderstanding — that the giants were groping toward *this series* — and the misunderstanding is renounced here in terms that cannot be unsaid. The object is not the author's. The surprise of this series' author is not the pride of priority; it is the solitude of a particular vantage — the surprise that a reading

which simplifies so much is not already common. What is attempted in these papers is not an invention but a *simplification of our shared perception*: the same sky, the same spectra, the same bridge in Dublin, read with the projection named. If the reading is right, it was always everyone's. If it is wrong, the failure is the author's alone. That asymmetry — credit shared, blame private — is the only honest accounting available to a framework whose title is *It Is All One*, and the title includes the authorship.

2. The Instrument Problem: Why the Dismemberment Was Not a Crime

The pivotal episode of this history is usually told as a decision, and an earlier draft of this series' conversation told it that way: Gibbs and Heaviside *cut the quaternion product in half* — the dot product and the cross product are the two severed pieces of Hamilton's one multiplication — and physics adopted the dismembered arithmetic as its native language. Told as a decision, it sounds like a crime, or at best a lazy convenience.

That telling is wrong, and correcting it is this note's first duty. **The dismemberment was not deliberate institutionalization. It was the brain defending its native geometry.** Vector analysis won — instantly, totally, and against the passionate resistance of Hamilton's heirs — because it matches the shadow the cortex already computes. A dot product is a simultaneity question: how much do these two arrows, *now*, agree? A cross product is a snapshot question: what arrow, *now*, stands perpendicular to these two? Both are answerable inside a single frame of the brain's movie. The full quaternion product is not: it asks the perceiver to hold order-sensitivity — the fact that turn-then-tilt and tilt-then-turn end differently — as an *arithmetic* fact, not a story told across several mental frames. The instrument refuses. It is not a moral failure; it is a hardware constraint.

The historical record reads exactly as a hardware constraint would predict. The quaternion wars of the 1890s were not fought between the intelligent and the dull; they were fought between two temperaments facing an algebra neither could picture:

- **Those who trusted.** Hamilton, who needed thirteen years because his own brain kept demanding a three-component answer, and who described the final insight as arriving from outside — the closest a mathematician comes to saying *heaven-sent*. Tait, who kept the flame. Grassmann, whose parallel algebra of extension was so unpicturable it went essentially unread in his lifetime.
- **Those who cursed.** Kelvin, in a letter this note cites from memory at the series' standard: quaternions, "though beautifully ingenious, have been an unmixed evil to those who have touched them in any way." Heaviside, who called them a positive evil and rebuilt Maxwell without them. Their curse was sincere. They were reporting, accurately, the experience of a Cartesian instrument asked to run non-Cartesian arithmetic: it *hurts*.

And Maxwell himself stood at the seam: he wrote quaternion ideas into the *Treatise* while distrusting quaternion methods — valuing, in his own words (from memory, flagged), the doctrine of vectors as a way of *thinking* more than a way of calculating. He felt the object

and could not hold it; Heaviside then re-cut the *Treatise* into the four component equations every student now learns — the projection, typeset.

The corollary matters for everything that follows: **since the algebra cannot be seen, allegiance to it has always been an act of trust, and trust is a temperament, not a proof.** Some found the algebra heaven-sent; some found it a curse; both were describing the same encounter between an unpicturable object and a picturing machine. The catalogue below must therefore never sneer. Every entry in it was compiled by minds working at the limit of an instrument they did not choose.

3. Feel and Trust: The Body's One Door

There is exactly one place where the human body touches the double cover directly, and it deserves its paragraph, because it grounds the phrase *we can feel and trust them* in anatomy rather than mysticism.

Hold a plate flat on your palm and rotate it 360° by twisting your arm: the plate returns; your arm is wound. Continue another 360° — the same direction — and the arm *unwinds*. The shoulder-elbow-wrist system is a physical realization of the fact that in the space of rotations, one full turn is not home and two full turns are. Vision cannot verify this; proprioception can. Dirac used the equivalent belt trick to teach the spinor; the neutron interferometers of 1975 measured the same fact in the laboratory record (the 4π experiments, cited throughout this series). The epistemic situation is exact: **the double cover can be measured and felt, but not pictured.** Physics done by sight alone will always re-derive the shadow; physics done by trust in the algebra — checked against measurement, since sight is unavailable — is the only road to the object. That is not a slogan; it is the operating condition of this entire series, and of everyone in the catalogue.

4. The Discipline: Four Columns or Quarantine

A historiography of near-misses has a failure mode of its own — the Eddington failure applied to history: resemblance-hunting, in which every past thinker is conscripted as a forerunner. The defense is the same as the series' defense everywhere: a stated rule, applied in public. **No figure enters the catalogue unless all four columns can be filled:**

1. **Found** — what they actually established, with its measured successes.
2. **Told** — what the projection told them it was (their own ontology, in their own terms).
3. **Deleted** — which specific algebraic feature the projection removed from their view (non-commutativity, the imaginary time axis, the winding integer, the fiber, non-associativity).
4. **Stopped** — why that specific deletion made them stop exactly where they stopped.

An entry that cannot fill column 4 is not evidence; it is flattery, and it goes to quarantine. The fourth column is the whole content of the method: a real projection does not merely hide the object — it *predicts the precise shape of the confusion* of anyone working inside it.

5. The Catalogue: Four Shapes of Failure

Shape I — Right numbers, wrong substance

Lorentz (1895–1904). *Found:* the exact transformations of space and time, the contraction, local time. *Told:* that these were dynamical effects of an ether pressing on moving matter. *Deleted:* that the medium is the metric — that no substance moves because the geometry itself carries the physics. *Stopped:* at the ether, defending it to the end of his life, because the shadow gives a simultaneity-brain no way to say "the stage bends" except "something on the stage pushes." He felt the medium — and this series, which carries a tension medium of its own, says his feeling was not wrong, only mislocated: the medium he sought was the mollusk, and the mollusk is the geometry. Right numbers, wrong substance: the shadow's signature con.

Shape II — Right object, wrong century

Kelvin (1867). *Found:* matter as stable topological windings of a medium — the vortex atom, the boldest ontology of the nineteenth century, and, in this series' terms, the correct one. *Told:* that the medium was a classical fluid ether and stability was hydrodynamic. *Deleted:* the quantum of winding — no $\hbar$, no closure condition, no reason windings come in integers. *Stopped:* when the classical vortex proved unstable and spectroscopy demanded integers the fluid could not supply. The idea died so publicly that "matter as knots" was radioactive for a century; his mathematics survived him as knot theory, a subject waiting for its physics. The same Kelvin later cursed quaternions — the man who glimpsed the object farthest ahead was among those the algebra hurt most, which is the instrument problem in one biography.

Clifford (1870). *Found:* the thesis this series adopts by name — matter is curved space; "small portions of space are of a nature analogous to little hills." *Told:* that the curvature lived in the metric scale of ordinary dimensions. *Deleted:* the winding — that the curvature is affordable only when carried by rolled-up directions (the 10^{43} price ratio of the Metrics note). *Stopped:* by arithmetic he could not yet do, and by death at 33. The corpus is, among other things, the settling of Clifford's estate.

Shape III — Right move, wrong axis

Maupertuis (1744) — the oldest entry in the catalogue. *Found:* the principle of least action — the true organizing law of mechanics, a century before Hamilton's reformulation and two before its explanation. *Told:* that it proved the economy of God — he read nature's parsimony explicitly as theology, the wisdom of a Creator who spends no more action than necessary. *Deleted:* the interference of windings — that "least" marks the path where the phases of neighboring histories agree (stationary phase), not where Providence economizes; the deletion was total, since the winding itself ($S/\hbar$ as accumulated phase) required a constant not measured until 1900 and a sum over histories not written until 1948. *Stopped:* at theology, defending the principle with metaphysics so vulnerable that Voltaire's ridicule nearly took the principle down with the man; it survived only because Euler and Lagrange re-clothed it as mathematics and agreed not to ask what it meant. Shape

III at its most naked: the right law, held for two centuries by a community that had collectively agreed to use it without believing anything about it — the Poincaré maneuver, institutionalized before Poincaré was born. When the meaning finally arrived (Dirac 1933, Feynman 1948), it was the winding: every path is taken, each carries its tick-count as phase, and the classical trajectory is where the windings constructively interfere. Maupertuis was chasing the shadow of the winding and called it God's thrift.

Poincaré (1905). *Found:* $l = i\tau$ — time as an imaginary coordinate, the Lorentz group as rotations. He held the key of Postulate 1 in his hand. *Told:* that it was a computational convenience — a trick. *Deleted:* that the identification is ontology, not notation; the shadow permits you to use a truth indefinitely so long as you agree not to believe it. *Stopped:* at the trick; and the textbooks later abandoned l "because it fails in curved spacetime" — a failure of the complex-number costume, not of the identification, since the complex quaternion carries $W = i\tau$ through curvature intact (Paper 1, §2.8).

Weyl (1918 – 1929). *Found, first attempt:* electromagnetism as geometry — the right move. *Told:* that the geometric freedom was scale. *Deleted:* the distinction between the metric's scale (which spectral lines nail down — Einstein's objection) and the state's phase (which nothing nails down). *Stopped:* he didn't. Weyl is the catalogue's one full recovery: eleven years later he rotated the same idea a quarter-turn in the complex plane — from scale to phase — and founded gauge theory. He is the existence proof that the seam of the projection can be found from inside, and the series inherits his repair explicitly (the compression lives in the quaternion phase, not the metric scale).

Ashtekar (1986). *Found:* general relativity rewritten on an $SU(2)$ connection — the unit quaternions — in which the equations simplify dramatically and handedness is native. *Told:* by the field's consensus, that the formulation carries a defect: the variables are complex, and awkward "reality conditions" must be bolted on. *Deleted:* that the "defect" is the physics — the formulation wants time imaginary, which is Postulate 1. *Stopped:* not by his own hand; the community routed around the reality conditions into loop variables, filing the complexness as embarrassment. The frame-quaternion note of this series claims that embarrassment as the point.

Shape IV — Right number, no geometry

Eddington (1930s). *Found:* the right question — are the dimensionless constants of nature counting problems in disguise? — which is precisely the gearbox conjecture of the foundations paper (α as pixel arithmetic). *Told:* that the counting could be done by pure-number manipulation on the integers at hand. *Deleted:* the geometry that does the counting — the seals, the pixels, the stabilizers. *Stopped:* in public failure so complete that his ghost now patrols every corridor where pure numbers meet measured masses — including this series' own $3/2$ curiosity and the $4h$ note, which post his name as a bond. The field drew the wrong lesson from him: it quarantined the *question* instead of the instrument.

Milgrom (1983). *Found:* that one acceleration, $a_0 \approx 1.2 \times 10^{-10} \text{ m/s}^2$, organizes the dynamics of every galaxy measured — and he noted himself, immediately, that $a_0 \approx cH/2\pi$.

Told: that Newton's second law must be modified below it, by an interpolation function with no origin. *Deleted:* the fiber — the propagating mode whose winding carries the screw; the shadow let him measure the edge of the mollusk and withheld the mollusk. *Stopped:* forty years at the number, unable to say why it falls from the sky. The screw paper's answer — it falls from the algebra — is dedicated, in effect, to the durability of his measurement.

Wylar (1971). *Found:* $1/137.036$ from the volumes of symmetric domains — quaternionic domains, as the Metrics note records. *Told:* nothing; that was the failure — a number arrived without a physics to carry it. *Deleted:* the connection between his geometry and any dynamical object. *Stopped:* under the derision that unanchored coefficients earn. Filed here, as in the Metrics note, as precedent to be properly re-derived or refuted, someday that is not today.

The trusters — a fifth column, of the faithful

Some entries are not failures but *unheard successes* — those who worked in trust of the algebra and were filed as curiosities: **Grassmann** (unread in his lifetime), **Tait** (lost the war), **Silberstein** (1912, the biquaternion relativity this series' Paper 1 credits), **Lanczos** (1929 — the quaternionic Dirac equation, one year after Dirac, ignored for ninety years; the designated field equation of this series' matter sector), **Conway** (1937), **Günaydin and Gürsey** (1973, octonionic quarks), **Dixon, Furey**. Their common fate — marginality — is itself a datum: it is the immune response of a Cartesian instrument-culture to arithmetic it cannot picture. The series stands in this column and expects the same response; the expectation is stated now so that receiving it will carry no information.

6. The Clustering Retrodiction

If physics has been done inside the shadow of this algebra, the historiography makes a testable claim about the *present*: **the unexplained residues of standard physics should cluster exactly at the projection's blind spots**. Audit the textbooks' list of postulates-without-derivation:

- Where the projection deletes **non-commutativity** (order-sensitivity): spin, imposed as intrinsic; parity violation, imposed by hand on $SU(2)_L$; the measurement postulate, imposed as metaphysics. All three are theorems or projections in the algebra (the double cover; $ij = k$; real-axis projection).
- Where it deletes **the imaginary time axis**: the Lorentzian signature, imposed as convention; the KMS relation between temperature and time, imposed as formalism. Both are the W-circle.
- Where it deletes **the winding integer**: quantization itself, imposed as commutation relations. It is closure.
- Where it deletes **non-associativity** — the deepest layer, invisible even to quaternion-trusting eyes: confinement, carried for fifty years as a brute fact supported by lattice numerics.

The residues sit where the deletions sit. That clustering was not arranged by this series; it was found by it, and it is the single strongest piece of evidence that the shadow-reading of

history is a diagnosis and not a decoration. The retrodiction also points forward: the monstrosities still standing — renormalization's subtraction rituals, the three generations, the hierarchy of scales — should mark algebra not yet unwound, and the series' own open problems list (the stiffness, the gearbox, the logarithm) sits at exactly those addresses.

7. What This Note Does Not Claim

It does not claim the giants were fools; the instrument problem acquits them all, curse-hurlers included. It does not claim they approached *this series*; they approached the object, which belongs to no one, this author least of all. It does not claim the shadow-reading is unfalsifiable armor; the four-column rule is its exposure, and any entry whose fourth column is empty must be withdrawn in public. And it does not claim that trusting the algebra suffices — Eddington trusted numbers and fell; trust is admitted here only when chained to measurement, which is the discipline every paper of this series answers to: numbers first, meaning when earned.

8. The Sentence

Physics has been one expedition, conducted for three centuries inside a shadow cast by an object no participant could see — some cursing the algebra that hurt their sight, some trusting it past the point of sight, all of them reading the same one thing. This series adds no new object. It proposes only to name the shadow, so that the expedition can stop mistaking the projection's seams for laws of nature. The reading is offered as what it is: not mine — ours.

References

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Acknowledgment: drafting assistance by machine (Claude, Anthropic). The positions renounced and claimed in Sections 1 and 7 are the author's own, dictated in conversation; the machine's earlier framing of the Gibbs–Heaviside episode as deliberate institutionalization is corrected in Section 2 at the author's instruction.