Integrated Referee Report and Revision Response

Article 101

Executable Certification: Verification Code and Machine-Checked Proof as Accretive Layers in Orthogonal Review

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Record and scope. This integrated document preserves the supplied referee report in Part II and adds a publication-stage response and verification ledger in Part I. The supplied report recommends acceptance subject to minor targeted revisions. It is a historical review record, not a new external referee decision. The response distinguishes repairs already present in the submitted manuscript from changes made for this publication package.
The historical report's statements that all quantitative claims were independently verified and that chemistry was admissible without reservation are preserved as statements made in that report. They are *not* conclusions of a fresh chemical, experimental, or cross-corpus audit in this package. The companion executable supplements identify their own exact scope.

Part I. Publication-Stage Response and Verification Ledger

1 Disposition of the Supplied Referee Findings

The six findings below retain the identifiers of the supplied review. Responses are editorial revision dispositions prepared for the author; they do not imply an additional independent reviewer or a new study of the underlying historical dossiers.

ID	Disposition	Response and evidence in manuscript
M1	Already present; clarified	Definition 2 already restricted the verification layer's [A] clause to finite content. Publication revision clarifies that bounded evaluation and unbounded formal proof are declared editorial scopes, not a theorem that programs cannot check symbolic proofs. The nonnesting witnesses are read under that policy.
M2	Already present	Definition 3 explicitly lifts the statement predicates to manuscript-level conditions through universal quantification over eligible statements. Empty eligible sets satisfy those conditions vacuously.
M3	Already present; strengthened	Definition 1 already names the data tuple D and links it to mutation $\mu(D)$. The revision additionally requires explicit agreement tests; a nonconstant exit status alone does not constitute a certificate.
C1	Already present; clarified	Rollout already required finite [A] content for verification and enumerable or closed-over-$\mathbb{N}$ content for the formal layer. This wording is kept consistent with the revised domain policy.
C2	Addressed in this package	The period convention distinguishes a 43,200 s illuminated phase from an 86,400 s full cycle at duty one half. A downstream import must name which duration it uses. This editorial convention does not itself revise Article 64 or establish that other papers have been re-audited.
C3	Addressed in this package	Publication metadata uses Volume 1, Number 5, November 2026, starting at page 1955. The first-page citation uses the compiled page range, the first-page number is lower right, and the right-hand first-page ISSN header is removed.

2 Additional Targeted Precision Repairs

These items arose while preparing executable supplements and reconciling the manuscript with the supplied review. They supplement rather than silently replace the historical findings.

1. **Checking mechanism and trust boundary.** The distinction between judgment and executable checking is retained. Claims of guaranteed mechanical independence are qualified: a faithful encoding, relevant assertions, and a sound trusted computing base are prerequisites. A common modeling or encoding error may survive multiple checking methods. Using different generative systems alone does not establish statistical error decorrelation.

2. **Domain policy and real-valued arithmetic.** The two domains are declared certification scopes. A verification harness may check numerical approximations of real-valued expressions against tolerances. The present Core Lean dossier has a restricted scope; Lean with suitable libraries is not incapable of real analysis. The pool-ratio example is outside this formal dossier's declared policy, not beyond every possible formalization.

3. **Assertions and failed compilation.** An asserting program checks explicit claim-agreement conditions, rather than merely having a varying exit status. Lean's error recovery may retain a placeholder after a tactic error, but a failed batch compilation is not successful certification. Zero exit status and an acceptable axiom audit are both required.

4. **Sensitivity and falsification.** Mutation sensitivity is assessed against a passing baseline using perturbations expected to invalidate specified checks. Failure to catch a particular mutation is evidence of a sensitivity gap, not a proof that every result in the artifact is vacuous. A defect-free re-audit prompts scrutiny but is not by itself a logical refutation.

5. **Angles and metadata.** The angle $180^\circ - 133.9^\circ = 46.1^\circ$ is supplementary, not complementary. Bibliographic metadata and source manifests can be compared automatically, even though those checks are not arithmetic.

6. **Historical evidence and chemical interpretation.** Counts and provenance from Articles 41, 62 and 64 and the unpublished dossier remain attributed reports. Rechecking $11.4 - 3.8 = 7.6$ establishes the scalar difference, not a thermodynamic free-energy result or experimental leaflet accommodation. No synthetic pathway, molecular realizability, or empirical outcome is newly certified here.

3 Targeted Verification and Limits

The present verification-code and Lean supplements must be read with their declared coverage and verbatim execution records. They provide reproducible checks of the editorial's selected arithmetic and formal structure. They are not a reproduction of the historical Article 62 or 64 dossiers and do not confirm the reported numbers of failed historical checks.

The current review ledger confirms the presence and logical purpose of the revisions above by inspection of the final source. Executable proof of a simplified status-domain model establishes its stated model, not that a natural-language statement was assigned the correct status label. Numerical testing of finitely many capacity identities is not a proof for all natural numbers; the companion formal theorem supplies the universal result within its precise encoding.

Publication-stage disposition. The supplied recommendation is retained as part of the review history. The original formal and production findings are addressed by the submitted repairs and the current package's targeted changes. This is a documented revision response and bounded verification record, not a replacement for external adversarial review or for the empirical evidence required by molecular claims.

Part II. Supplied Referee Report: Historical Record

The supplied report follows with its wording preserved, including its original target issue, recommendation, quantitative claims, and chemistry verdict. Its old Volume 1, Number 3 / October 2026 references identify the report's historical context; they are not the publication metadata of Article 101. Section and finding references within this part refer to the manuscript version reviewed at that time. Literal-code markup has been corrected so that examples such as the page-counter command print instead of executing. Part I records the present disposition and limits of endorsement.

REFEREE'S REPORT: ORTHOGONAL REVIEW ($\mathsf{M} \cap \mathsf{C} \cap \mathsf{H}$)

Manuscript: "Executable Certification: Verification Code and Machine-Checked Proof as Accretive Layers in Orthogonal Review"

Author: Charles D. Schaper, Ph.D. | **Target Issue:** *Annals of the Chrysene Formalism*, Vol. 1, No. 3 (Oct 2026)

Overall Assessment and Recommendation: Accept subject to minor targeted revisions.

This editorial companion to Article 41 formalizes a major methodological advance for the *Annals of the Chrysene Formalism*: extending the judgment-based admissibility condition $\mathcal{F}_{\text{adm}} = \mathsf{M} \cap \mathsf{C} \cap \mathsf{H}$ with two executable certification layers—an asserting verification-code harness (V) and a Lean 4 kernel proof dossier (L)—acting on status-indexed domains. The paper's epistemological framing is exemplary in its candor: it distinguishes mechanical independence of failure modes from statistical independence (Remark 1), documents a pre-production `sorryAx` transcription failure (Section 5.3), grades its own catch record rather than treating conservative defects as headline invalidations (Section 5.1), and records a judgment false positive (Section 9.1).

Across the three orthogonal review axes, one genuine set-theoretic contradiction requires correction in M (Definition 2 vs. Proposition 1), two minor formal clarifications are recommended in M, two cross-corpus alignment items are flagged in C, and the chemical and biophysical witnesses audited in H pass without defect.

1 Mathematical Review (M)

The mathematical review audits all formal definitions, propositions, proofs, and quantitative witnesses stated in the manuscript.

1.1 Primary Defect: Set-Theoretic Contradiction Between Definition 2 and Proposition 1

In Section 3, Definition 2 defines the status-indexed domains of the formal-proof layer L and the verification-code layer V via Equations (2) and (3):

$$\begin{aligned}\operatorname{dom}(\mathsf{L}) &= \{\sigma : \lambda(\sigma) = [\mathrm{A}],\ \sigma \text{ enumerable or closed over } \mathbb{N}\},\\ \operatorname{dom}(\mathsf{V}) &= \{\sigma : \lambda(\sigma) = [\mathrm{A}]\} \cup \{\sigma : \lambda(\sigma) = [\mathrm{D}],\ \sigma \text{ reduces to arithmetic over stated constants}\}.\end{aligned}$$

Immediately following Definition 3, Proposition 1 asserts that the two domains are not nested:

$$\operatorname{dom}(\mathsf{L}) \not\subseteq \operatorname{dom}(\mathsf{V}) \quad \text{and} \quad \operatorname{dom}(\mathsf{V}) \not\subseteq \operatorname{dom}(\mathsf{L}).$$

Finding [M1] (Required Revision — Formal Contradiction): Under the literal wording of Equations (2) and (3), Proposition 1 is false in its first half. Because the first term in the union defining $\operatorname{dom}(\mathsf{V})$ in Equation (3) is the *unqualified* set $\{\sigma : \lambda(\sigma) = [\mathrm{A}]\}$, elementary set inclusion yields

$$\operatorname{dom}(\mathsf{L}) = \{\sigma : \lambda(\sigma) = [\mathrm{A}],\ \sigma \text{ enumerable or closed over } \mathbb{N}\} \subseteq \{\sigma : \lambda(\sigma) = [\mathrm{A}]\} \subseteq \operatorname{dom}(\mathsf{V}).$$

Consequently, $\mathrm{dom}(\mathsf{L}) \subseteq \mathrm{dom}(\mathsf{V})$ as written, which contradicts Proposition 1 ($\mathrm{dom}(\mathsf{L}) \not\subseteq \mathrm{dom}(\mathsf{V})$), the proof of Proposition 1 (which exhibits the all-m capacity dichotomy $4^m = 2^m \cdot 2^m$, a statement with $\lambda(\sigma) = [\mathrm{A}]$, as lying in $\mathrm{dom}(\mathsf{L}) \setminus \mathrm{dom}(\mathsf{V})$), and Remark 3 (which states that the intersection $\mathrm{dom}(\mathsf{V}) \cap \mathrm{dom}(\mathsf{L})$ consists only of the *finite* [A] content).

Repair: Restrict the [A] clause of Equation (3) to finite (or finitely evaluable) statements:

$$\mathrm{dom}(\mathsf{V}) = \{\sigma : \lambda(\sigma) = [\mathrm{A}],\ \sigma \text{ finite}\} \ \cup\ \{\sigma : \lambda(\sigma) = [\mathrm{D}],\ \sigma \text{ reduces to arithmetic over stated constants}\}.$$

With this restriction in place, statements with $\lambda(\sigma) = [\mathrm{A}]$ that quantify over all $m \in \mathbb{N}$ lie in $\mathrm{dom}(\mathsf{L}) \setminus \mathrm{dom}(\mathsf{V})$, finite [A] statements form the exact intersection $\mathrm{dom}(\mathsf{V}) \cap \mathrm{dom}(\mathsf{L})$ described in Remark 3, and Proposition 1 holds rigorously.

1.2 Secondary Mathematical Clarifications

Finding [M2] (Recommended Clarification — Lifting Statement Predicates to Manuscript Level in Definition 3): In Equation (1), $\mathcal{F}_{\mathrm{adm}} = \mathsf{M} \cap \mathsf{C} \cap \mathsf{H}$ is an intersection of subsets of the manuscript space (total predicates on a manuscript Σ). In Definition 2, $\mathrm{dom}(\mathsf{V})$ and $\mathrm{dom}(\mathsf{L})$ are subsets of individual statements $\sigma \in \Sigma$. Equation (4) then writes

$$\mathcal{F}'_{\mathrm{adm}} = \mathsf{M} \cap \mathsf{C} \cap \mathsf{H} \cap \mathsf{V}|_{\mathrm{dom}(\mathsf{V})} \cap \mathsf{L}|_{\mathrm{dom}(\mathsf{L})}.$$

To avoid a type mismatch between manuscript-level sets and statement-level restricted predicates, add a brief clause in Definition 3 clarifying that $\mathsf{V}|_{\mathrm{dom}(\mathsf{V})}$ (and analogously $\mathsf{L}|_{\mathrm{dom}(\mathsf{L})}$) denotes the set of manuscripts Σ such that $\mathsf{V}(\sigma)$ holds for all $\sigma \in \Sigma \cap \mathrm{dom}(\mathsf{V})$. Noting this universal quantification over $\Sigma \cap \mathrm{dom}(\cdot)$ also provides the formal justification for the third rollout rule in Section 8: when $\Sigma \cap \mathrm{dom}(\mathsf{V}) = \emptyset$, the condition holds vacuously.

Finding [M3] (Optional Refinement — Connecting Definition 1 to Definition 4): Definition 1 defines a program P over a manuscript's quantitative claims as *reporting* if its exit status $\chi(P)$ is "constant over all inputs," and *asserting* otherwise. Because the verification harnesses published in the dossiers execute as self-contained scripts without runtime user inputs, a pedantic reader might ask what the input domain of P is. Explicitly identifying the "inputs" of P with the tuple of defining manuscript data and claimed quantities D (so that $\chi(P(D)) = 0$ and $\chi(P(\mu(D))) \neq 0$ under a mutation μ as formalized in Definition 4) links Definitions 1 and 4 into a single formal structure.

1.3 Verification of Quantitative Claims and Derivations in the Text

All quantitative figures and algebraic claims in the manuscript were independently recomputed and verified:

1. **Article 41 coverage rate (Section 1.1):** $48/63 = 76.19\%$ (explicit); $55/63 = 0.873015\cdots \approx 87.3\%$ (including indirect). Verified.
2. **Chrysene perimeter cut sets (Section 2.2 & Remark 3):** Single-edge cuts on an 18-cycle yield 18 Hamiltonian paths; two-edge cuts yield $\binom{18}{2} = \frac{18\times17}{2} = 153$ pairs. Verified.
3. **Capacity dichotomy (Proposition 1):** $4^m = (2^2)^m = 2^{2m} = 2^m \cdot 2^m$ for all $m \in \mathbb{N}$. Verified.
4. **Unwinding dissipation scaling (Section 5.1):** For $E = N\zeta(\omega r)^2(L/v)$ with helical coupling $\omega \propto v$, $(\omega r)^2 \propto v^2$ and $L/v \propto v^{-1}$, so $E \propto v^2 \cdot v^{-1} = v^1$ (linear in fork speed v, advancing one decade per decade of speed rather than two). Verified.
5. **Diurnal period vs. active phase (Section 5.1):** 12 h = $12 \times 3{,}600$ s = 43,200 s $\approx 4.3 \times 10^4$ s. At a duty cycle of 0.5, the full forcing period is $T = 24$ h = 86,400 s. Verified.
6. **Orientation bearing vs. line angle (Section 5.2):** Taking absolute values of vector components folds the obtuse bearing 133.9° into its supplementary acute line angle $180° - 133.9° = 46.1° \approx 46°$, placing the window boundary near the zero-separation orientation $133.9° - 90° = 43.9°$ (window span $90° - 46° = 44°$). Verified.
7. **Tether folding contraction (Section 9.1):** An arm of extended contour length 11.4 Å with a freely jointed extension of 3.8 Å contracts unforced by $11.4 - 3.8 = 7.6$ Å. Verified.

2 Concordance Review (C)

The concordance review evaluates whether the manuscript preserves the invariants, terminology, status taxonomy, and cross-article dependencies of the *Annals of the Chrysene Formalism*.

2.1 Concordance with Article 41 and Corpus Taxonomy

1. **Preservation of $\mathcal{F}_{\text{adm}}$:** Equation (1) and Definition 3 preserve the five-stage workflow and the non-substitutability of $\mathsf{M} \cap \mathsf{C} \cap \mathsf{H}$ established in Article 41.
2. **Discharge of Prospective Protocol:** Section 10 cleanly discharges Article 41's closing proposal by inserting dossier construction and cross-system verification between Stage 4 (post-revision verification) and Stage 5 (meta-review).
3. **Status Label Taxonomy:** The status labels {[A], [D], [C], [E]} in Section 3 and Table 2 match the provenance conventions of Articles 62–65.
4. **Fail-Loud Drafting Markers:** The preamble implements the fail-loud counter `uncleared` for `PLACE` and `CHECK` with `finaltrue`. A full scan of the manuscript source confirms zero surviving drafting markers either in body text or inside verbatim environments, concordant with the lesson drawn from Article 62 in Section 5.1.

2.2 Concordance Items for Attention

Finding [C1] (Concordance Alignment — Terminology Between Definition 2, Section 8, and Table 2): In Definition 2 (Equation 2), dom(L) is defined by the predicate "σ enumerable or closed over $\mathbb{N}$" (matching Table 2's two rows for [A]: "finite, axiom-free" and "closed over $\mathbb{N}$"). In Section 8 (Rollout, second bullet), the criterion for receiving a formal-proof dossier is phrased as "if its [A] content is enumerable or *structural*," and the first bullet triggers a verification-code dossier on "any statement labelled [A]." Aligning the wording in Section 8 with the exact predicates of Definition 2 (as repaired under **[M1]**) will prevent ambiguity when deciding whether a paper with purely inductive [A] claims requires a numerical harness.

Finding [C2] (Downstream Corpus Concordance — The 43,200 s Period Convention of Article 64): Sections 5.1 and 7.1 highlight that Article 64 fixed a twelve-hour illuminated phase (43,200 s $\approx 4.3 \times 10^4$ s) and used that figure in two appendix blocks for the forcing period T itself, whereas at a duty cycle of $1/2$ a twelve-hour light phase corresponds to a twenty-four-hour diurnal cycle (86,400 s). Because subsequent articles in Volume 1, Issue 3 (such as the lineage and loop dynamics papers) import Article 64's cycle definitions and reference both $T = 43{,}200$ s and the twelve-hour light phase of a diurnal cycle, Remark 4's retroactive re-audit rule applies directly here. The editorial (or the withdrawals/corrections register of Article 64) should explicitly state whether downstream imports standardize on $T = 43{,}200$ s as the active forcing phase duration or re-index the full cycle to 86,400 s so that the cross-paper ledger remains invariant.

Finding [C3] (Production Metadata — Provisional Pagination): As noted in the source comments, `setcounter{page}{1}` is currently set to provisional page 1, while the bibliography cites Articles 62 and 64 in the same issue (`Vol. 1, No. 3`) at pages `1279–1320` and `1348–1370`, respectively, and the first-page footer citation omits page numbers (`1(3).`). At issue composition, update `setcounter{page}{...}` and append the final page range to the first-page footer citation block.

3 Chemistry and Physical Admissibility Review (H)

Because this manuscript is a methodological editorial, it advances no new synthetic pathway or molecular structure of its own. Instead, H evaluates two questions: (1) whether the boundary drawn around chemical claims is epistemically sound, and (2) whether the chemical and biophysical witnesses imported from Articles 62 and 64 are accurately and admissibly represented.

1. **Epistemic Demarcation of H (Sections 1, 3, 7.2, and 9):** The manuscript explicitly states that V and L do not intersect H: regiospecificity of bond cleavage by a named reagent, direction of elimination, partition thermodynamics, and experimental

realizability lie outside $\mathrm{dom}(\mathsf{V}) \cup \mathrm{dom}(\mathsf{L})$. Section 7.2 properly distinguishes internal consistency of a reaction-transport architecture from prebiotic realization in nature. This demarcation is chemically and philosophically sound.

2. **Topological and Chemical Graph Witnesses for Chrysene (Sections 2.2, 3, and 6):** Chrysene ($C_{18}H_{12}$, benzo[*a*]phenanthrene) possesses an 18-carbon tetracyclic ortho-fused skeleton with $V = 18$ carbon vertices and $E = 21$ C–C bonds, comprising an 18-edge perimeter cycle and 3 interior ring-junction chords (cyclomatic number $\mu = E - V + 1 = 4$).

   - Deleting any single perimeter edge leaves a connected 18-vertex Hamiltonian path (18 single-edge cuts).
   - Deleting any pair of perimeter edges yields $\binom{18}{2} = 153$ two-edge cut sets that partition the perimeter into two chains.
   - In the mutation sensitivity tests (Section 6), deleting one of the three interior chords reduces the cyclomatic count from 4 to 3 without altering the perimeter cut sets, breaking exactly the cyclomatic check (1 theorem).
   - Shifting a substituted perimeter locant from C12 to C11 alters the inter-substituent path lengths along the perimeter and across the rings, propagating into the single-edge counts, two-edge partition, named cut sets, and chain numbering (7 of 23 theorems).

   All chemical graph invariants and mutation behaviours reported in Section 6 are exact.

3. **Bilayer Leaflet Orientation and Polarity (Section 5.2):** In a lipid bilayer leaflet, the membrane normal $\hat{\mathbf{n}}$ is a directed polar axis pointing from the apolar hydrocarbon midplane toward the aqueous interface. Treating the vector joining the two substituted chrysene positions via the magnitudes of its components folds the obtuse bearing (133.9°) into an acute line inclination (46°), erasing the sign of the projection along $\hat{\mathbf{n}}$. At 43.9°, the vertical depth separation between the two anchor positions vanishes (0.18 Å vs. 3.64 Å), which would place both polar groups at virtually the same leaflet depth and violate amphiphilic anchoring. The physical chemistry of the cross-layer catch in Section 5.2 is lucid and accurate.

4. **Tether Conformational Entropy and Hydrophobic Mismatch (Section 9.1):** The resolution of the false positive in Section 9.1 rests on polymer chain statistics: a tether of contour length $L_c = 11.4$ Å whose freely jointed end-to-end extension is 3.8 Å undergoes an unforced entropic retraction of 7.6 Å. Because the required geometric slack across the admissible tilt window is less than 7.6 Å, the capped arm accommodates the leaflet core thickness without incurring an enthalpic folding penalty. The physical argument is sound.

Verdict on H: Admissible without reservation. No chemical or biophysical revisions are required.

4 Graded Revision Register

In accordance with the review standards of the *Annals of the Chrysene Formalism*, the findings of this report are graded below by layer and disposition.

ID	Layer	Grade	Action Required
[M1]	M	**Required**	Restrict the [A] clause in Definition 2, Eq. (3) to $\{\sigma : \lambda(\sigma) = [\mathrm{A}],\ \sigma \text{ finite}\}$ so that $\mathrm{dom}(\mathsf{L}) \not\subseteq \mathrm{dom}(\mathsf{V})$ holds in Proposition 1 and matches Remark 3.
[M2]	M	Recommended	Clarify in Definition 3, Eq. (4) that $\mathsf{V}\vert_{\mathrm{dom}(\mathsf{V})}$ and $\mathsf{L}\vert_{\mathrm{dom}(\mathsf{L})}$ lift to manuscript-level sets via universal quantification over $\sigma \in \Sigma \cap \mathrm{dom}(\cdot)$.
[M3]	M	Optional	Connect "over all inputs" in Definition 1 to perturbations $\mu(D)$ of the defining data D in Definition 4.
[C1]	C	Recommended	Align the domain wording in Section 8 (Rollout bullets 1–2) with the exact predicates of Definition 2 and Table 2.
[C2]	C	Recommended	Note in Section 5.1 or Remark 4 how Article 64's $T = 43{,}200$ s light-phase vs. 86,400 s diurnal period convention is standardized for downstream papers importing T.
[C3]	C	Production	Replace provisional page counter `\setcounter {page}{1}` and populate the page range in the first-page footer citation upon issue composition.