

Why Sulfur and Why Methionine Starts: The Chrysene Junction, the Central Pair of an Even Cluster, and a Disulfide Across the Gap

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Abstract

The corpus establishes that exactly two of the twenty structures require an element the carrier cannot supply, and places them under a hypothesis about the medium which it states and declines to establish. Two questions survive: why the same element should be required twice, and why a reading should have a beginning. This paper answers both at one object. Where two poly-A-chrysene complexes meet chrysene to chrysene, with no intervening nucleobase, the regularity of the strand fails. The cell spanning the meeting has six vessels; six is even; and a cell of even count has no central vessel but a *central pair* — the two facing units. The corpus's localisation rule requires an odd count, so such a cell falls outside it rather than excepting it, and it yields two residues instead of one. Both are the corpus's published rows, used unamended, one on each facing unit.

The two residues share no atom and no bond: nothing connects them through the carrier, and the disulfide that joins them is what makes the cell one reaction rather than two. It closes across the π -stacking gap without distortion, the lateral register of a stacked pair being free where the exocyclic directions of a single plane are not, and the sense of the internal sulfur is forced. The cell is asymmetric before anything happens — in fragmentation, in sulfur site, and in reading direction — and all three distinguish the same unit; the electron balance, derived atom by atom, adds no fourth asymmetry and closes at one remnant level only, leaving both termini at the aldehyde level.

The reading is then taken off the reaction and not assumed. An alternating hexamer determines its reading only up to one position, changing the frame and changing the phase being indistinguishable there; the junction supplies exactly that one datum, which is what setting a frame means. Of the frame group only face inversion relates the two codons of a junction, and the case that proves it is the start codon itself, every window of an alternating hexamer being a palindrome. One position then decides start and stop together: a purine there terminates the incoming reading and withholds the outgoing start in a single event, so termination is the failure of a reaction to complete — a structure forms and is not released — rather than a residue assigned to a codon.

One consequence reaches back. Because face inversion *is* position-wise complementation, the two codons of a junction are complementary of necessity, and they are the corpus's unique complementary pair of seeded slots with both slots of size two. The corpus places these same two structures at complementary slots under a hypothesis it states and declines to establish; at a junction that hypothesis is a consequence.

The account rests on five premises of its own — that a junction forms, that a structure is released only at a narrow outer register, that the sulfur arrives bonded, that neither sulfur afterwards migrates, and that the two outer bases are complementary — and on one import. No energy is computed and no barrier estimated. The two residues are frame-related in the assignment structural consistency selects and not in the observed mapping, so the corpus's undecided dilemma is inherited whole.

Keywords: Chrysene Formalism; junction; poly-A-chrysene complex; vessel parity; central pair; sulfur pair; disulfide bridge; concerted excision; face inversion; reading frame; initiation; termination; oxidation balance; complementary slots; paired delivery.

1 Introduction

1.1 The two questions

The corpus answers a cardinal and a length: a cluster of six sites has twenty frame classes, and the codon length follows from

the carrier rather than from any argument about alphabets. It then establishes that exactly two of the twenty structures require an element the carrier cannot supply, and it places them under a hypothesis about the medium which it states and declines to establish.

Two questions survive, and they turn out to be one question.

Why is the same element required twice? That two structures and no others need a species from outside is a fact of the series, obtained by inspection. It is not explained by the count, and nothing in the corpus says why the two should be the two.

Why should a reading have a beginning? A carrier that reads three bases at a time can do so in three phases, and nothing in a regular strand distinguishes them. A code with a start is a code whose phase has been fixed, and fixing a phase requires a datum that a regular strand does not contain.

This paper answers both at one object. At the place where two poly-A-chrysene complexes meet chrysene to chrysene, the regularity of the strand fails; the vessel count of the cell that spans the meeting is even; and a cell with an even count has no central vessel but a central pair. Such a cell makes two residues instead of one, it makes them from two molecules that a single delivery must join, and the discontinuity that lets it do so is available once and is consumed in the making. That is a punctuation mark.

1.2 The object

The object is a *junction*: two strands of alternating chrysene and adenosine meeting with no intervening nucleobase, the two facing units stacked π -face to π -face. The *junction cell* is the six vessels flanking it, three from each strand.

Three features make it the right object. Its vessel count is even, so the corpus's localisation rule — which requires an odd count — does not apply to it, and what stands at its centre is a pair rather than a vessel. Its two halves are not alike: one strand runs into the junction and one out of it. And its two excisions occur on different molecules, so nothing connects the two residues through the carrier, and whatever joins them must come from outside.

1.3 The objective

To place the junction cell against the corpus's localisation rule; to state the reaction it carries as one concerted process with two products; to determine what the medium must supply and what the carrier can; and to take the reading off the reaction rather than assume it.

And — as this programme's experience recommends — to state exactly what each result rests on, so that a reader may see how much of the account survives the failure of each premise. Scholium 9.10 answers that at three different weights, and the answers are not alike.

1.4 What is established

Subject to the premises of Table 1:

1. **A junction cell has no central vessel.** Theorem 4.8: six vessels, even count, the centre an interface and the central pair the two facing units. Corollary 4.9: the cell falls outside the corpus's localisation rule rather than excepting it, and yields two residues rather than one.
2. **Both residues are the corpus's, unamended.** Proposition 5.3: the retained sets, the cut lists and the sulfur sites are the published rows, used as they stand. A single-unit account cannot say this, and Appendix C says why.
3. **The cell is asymmetric before anything happens.** Theorem 5.15: fragmentation, sulfur site and reading direction all distinguish the same unit. Corollary 5.21: the balance adds no fourth asymmetry. Nothing has to be chosen and nothing is left open.
4. **The balance closes at one remnant level only.** Theorem 5.20: the external demand is affine in the remnant level and vanishes at a single value, at which both termini stand at the aldehyde level. This is the account's most directly testable consequence.
5. **The bridge closes across the stack without distortion, and the sense of the internal sulfur is forced.** Proposition 6.7: the lateral register of a stacked pair is free, so only the separation normal to the planes is fixed, and one sense of the internal sulfur is excluded at every offset.
6. **The reading is underdetermined by exactly one position.** Corollary 7.4: on an alternating hexamer, changing the frame and changing the phase by one position have the same effect. The sequence leaves one degree of freedom and the junction supplies one datum.
7. **Only face inversion relates the two codons, and the start codon proves it.** Theorem 7.9: at an alternating hexamer the three operations of the frame group are indistinguishable, every window being a palindrome; at the discriminating case exactly one works, and that case is the one in which the outgoing codon is the start.
8. **The two junction slots are the corpus's unique complementary pair.** Corollary 7.15: the two codon sets are position-wise complementary, and of the corpus's eighteen seeded slots exactly one complementary pair has both slots of size two — this one. Complementarity is not assumed here but follows: the two strands are related by face inversion, and face inversion is position-wise complementation. The corpus places these two structures at complementary slots under a hypothesis it declines to establish and asks for an independent ground; Scholium 7.16 supplies one, conditionally on this paper's premises.

9. **One position decides start and stop together.** Theorem 7.13: a purine at the outer position of the incoming codon terminates that reading and withholds the outgoing start, in one event. Termination is the failure of a reaction to complete — a structure forms and is not released — and not a residue assigned to a codon. It rests on Hypothesis 5.12, which is a premise about the reaction.

1.5 What is not claimed

Section 3, nine clauses, stated before the constructions they guard. Three deserve mention here. The formation of a junction is assumed and not explained. Nothing is shown to be favourable, no energy being computed and no barrier estimated. And the two residues are frame-related in the assignment structural consistency selects and not in the observed mapping, so this paper inherits the corpus's undecided dilemma whole and does not explain the observed start directly.

1.6 Precedence

The corpus is authoritative on the carrier, the registry, the letter assignment and the structure series, and this paper amends none of them. A companion paper treats the same two residues on a single unit; the two describe different cells and neither is evidence against the other (Remark 8.3). Where the companion's statements are conditional on its own premise, Appendix C says so and bounds the list.

1.7 Organization

Section 2 fixes the register, the locant convention and the scope, which excludes external simulation and is what makes the form of the results what it is. Section 3 refuses nine readings. Section 4 is the object and the vessel-parity theorem. Section 5 is the reaction: the two excisions, the stages, the asymmetry and the balance. Section 6 is the bridge and the two premises that carry the pairing. Section 7 takes the reading off the reaction and reaches the start and the stop. Section 8 places the paper beside the single-unit account and Section 9 states the targets and what would overturn the whole. Appendix A is the atom map and its provenance, Appendix B the verification, Appendix C the re-scoping, and Appendix D the record of what was withdrawn.

2 Conventions and the register

2.1 Status

Definition 2.1 (Status labels). Every numbered statement carries exactly one label.

[A] Purely finite. Proved without reference to any axiom of the corpus and without any chemical premise. Every

such statement in this paper is a computation over a graph on eighteen vertices, over a set of at most sixty-four words, or over a hexamer of six positions, and each is discharged in Appendix B.

[D] Derived under hypotheses named at the point of use.

[C] Imported. Stated and not reproved; the source is named.

[E] A molecular reading. Enters no proof.

Scholia carry no label and enter no proof. The formal content of this paper is unchanged if every scholium is deleted.

2.2 Unit-indexed locants

Definition 2.2 (The notation $C_n@X_m$). [A] The object of this paper carries two copies of the vessel graph, and a locant alone does not name an atom in it: C5 is a vertex of X3 and a different vertex of X4. Every locant below is written $C_n@X_m$, naming vertex C_n of unit X_m .

Remark 2.3 (Why the notation is a convention and not a nicety). [A] Set operations on bare locants are meaningless across units. A first pass of the verification file, run on bare locants, reported that the two residues of the junction share a cut C5–C6 and a vertex C5. They share neither: the coincidence is of labels, not of atoms, and the two residues have no atom in common. No union, intersection or difference of vertex sets is taken across units anywhere in this paper.

2.3 Nomenclature

The *poly-A-chrysene complex* is a strand of alternating chrysene and adenosine, X-A repeating, the adenosines joined by phosphodiester linkages into an RNA strand read $5' \rightarrow 3'$. A *unit* is one chrysene–adenosine pair; by the corpus a unit is a *vessel*, and a codon is three vessels.

A *junction* is the place where two such strands meet chrysene to chrysene, with no intervening nucleobase. The *junction cell* is the six vessels $X_1 \dots X_6$ flanking it, three from each strand, and the *hexamer* $h_1 \dots h_6$ is the six bases they present, the junction lying between h_3 and h_4 .

A *window* is a triplet of consecutive positions of the hexamer. Windows are used in this paper only to display which bases bear on which excision; they are not reading frames and Section 3.1 (viii) records that no statement is derived from them.

Remark 2.4 (The word *cell*). [A] The corpus declines the word *cell* for a cluster or a vessel, and that refusal is

respected: no cluster of this paper is called a cell. The object of Section 4 is called a *reaction cell*, after the usage already established in the corpus for the chrysene–adenosine reaction cell [Sch26h].

A *structure* is always the object of the corpus and never a chemical species; where a species is meant, Appendix A is cited. The title of this paper names a residue, for findability; no numbered statement does, and Section 3.1 (i) records it.

2.4 Imported objects

Stated and not reproved here: the vessel graph and its locant registry [Sch26n]; the cluster, the frame group and the bijection between clusters and classes; the capacity theorem and the derivation of the triplet; the localisation of a vessel-localised pathway, which this paper uses at Theorem 4.8; the tether word and the letter assignment; the exhibited integrated product; and the two rows of the corpus's structure series that this paper's residues occupy [Sch26j], which are used *unamended*.

2.5 The hypothesis register

premise	stated at	used
the junction forms	Hypothesis 4.2	throu
release at a narrow outer register	Hypothesis 5.12	Secti
the two outer bases are complementary	Hypothesis 7.7	Secti
the atom map, imported unamended	Appendix A	Secti
disulfide delivery	Section 6	Secti
no migration of sulfur	Section 6	Secti
sulfur has no source in the carrier	Appendix A, [C]	Secti

Table 1: The premises of this paper. No axiom is added to the corpus, and no hypothesis of the corpus is amended.

Scholium 2.5 (What this paper does not have to assume). Two premises that a companion paper required are absent here and their absence is the reason this one exists. That paper placed both sulfur residues on a single unit, which forced an amendment to the corpus's structure series and, with both sulfur sites in one aromatic plane, forced a pyramidalisation of the ring before the bridge could close. Neither arises at a junction: the two residues occupy different molecules, so the corpus's rows are used as published, and the lateral register of a stacked pair is free, so the bridge closes undistorted. The premise that replaces them is Hypothesis 4.2, that a junction forms at all. It is a premise about the assembly of the carrier and not about the chemistry of a residue, and this paper does not establish it.

2.6 Scope

Remark 2.6 (No external simulation). [A] No statement of this paper is obtained from an electronic-structure calculation, a force field, or a geometry optimisation. What this forbids: any claim that a route or an arrangement is favourable; any barrier, rate or interaction energy; and any geometry not fixed by valence, by a stacking separation stated as a datum, or by a rigid model declared as such. What it permits: exhaustive enumeration over finite sets; bookkeeping of atoms and of electrons derived from explicit bond lists; and rigid-geometry figures, reported as model values and never as structure. Numbered statements accordingly read *excluded*, *admissible*, or *forced under the premises named*. The word *favoured* occurs in no numbered statement.

Remark 2.7 (Verification: computed and tabulated). [A] Every quantitative claim is carried by a block of the scripts of Appendix B, and the block is named in the proof. Each block is marked *computed* or *tabulated*. A computed block derives its output from the vessel graph, from an explicit bond list, or from a finite enumeration; a tabulated block performs arithmetic over data entered by hand. A tabulated block is checkable by a reader but is not self-checking. The distinction is drawn because it is load-bearing. The balance of Section 5.7 was first obtained from a tabulated block and was wrong in two ways, one of which — an odd total electron count, which closed-shell chemistry cannot give — was visible on the face of the output and was not seen. The balance is now derived from bond lists and the parity is reported. Appendix D carries the entry.

Remark 2.8 (Corrections). [A] Claims made and withdrawn in the course of this work are recorded in Appendix D rather than absorbed, together with how each was found.

3 Traps and non-implications

The nine refusals below are placed before the constructions they guard. Each names a reading the body invites and does not support.

Proposition 3.1 (Non-implications). [A] *None of the following is asserted anywhere in this paper.*

- (i) *That any chemical species is identified.* The objects of Sections 4 to 7 are subgraphs of two copies of the vessel graph, with decorations. Their reading as residues is Appendix A and enters no numbered statement.

- (ii) **That anything below is a chronology.** The stages of Section 5 are a precedence among events within one reaction, established by valence and by what must exist before what. The windows of Section 7 are a spatial overlap. Neither asserts that any assignment, code or mapping preceded another, and the refusal of the corpus on that point stands unweakened.
- (iii) **That the formation of a junction is explained.** Hypothesis 4.2 states that two strands meet chrysene to chrysene. Why they should, how often, and under what conditions are not addressed, and nothing in this paper bears on them.
- (iv) **That a reading direction is reversed.** The operation relating the two strands is face inversion with order kept, and Theorem 7.9 shows that the two operations involving a reversal of order both fail at the discriminating case. The word reversal is reserved for the order-reversing operation of the corpus and is not used of the junction.
- (v) **That the corpus's localisation rule is excepted here.** That rule concerns a pathway localised on a central vessel and requires an odd vessel count. The junction cell has an even count and no central vessel, so it falls outside the rule rather than breaking it (Theorem 4.8). No exception is admitted and none is needed.
- (vi) **That any residue is delivered when the start fails.** Where the outer position of the outgoing codon is a pyrimidine, this paper says that no start is set and says nothing further. The residue the observed code places there enters the repertoire by another route, which is not this paper's subject.
- (vii) **That all termination is accounted for.** The account of Section 7 produces two of the three stop codons of the standard code, and is silent on the third. And it is scoped to the two mappings the corpus treats: published tables deliver residues at the pair this paper finds terminating, as the corpus itself records.
- (viii) **That the windows are reading frames.** They display which bases bear on which excision, given that the two junction units touch and their influences overlap. The reaction is one concerted process over the whole cell, not two processes that happen to share a base, and no numbered statement is derived from a window.
- (ix) **That the observed start codon is explained directly.** The two residues of the junction are related by face inversion in the assignment that structural consistency selects, and not in the observed code, where no frame operation carries either codon of the one to the codon

of the other (Appendix B, J10). This paper therefore inherits the corpus's undecided dilemma whole, and a reader who declines the selected assignment is not answered here.

Scholium 3.2 (The two that matter most). Clauses (iii) and (ix) are the ones a reader is most likely to set aside, and they bound the account at its two ends.

The first states what the paper begins from. A junction is assumed, not derived, and everything below is a description of what happens at one.

The second states what the paper reaches. The start site it obtains is a property of an assignment that the corpus selects and does not establish against the observed code. That is a narrower result than an explanation of the observed start, and it is narrower in a way no argument here repairs.

4 The junction

This section fixes the object and establishes the one structural fact the rest of the paper turns on: that a junction cell has no central vessel, and that what stands at its centre is a pair.

4.1 The strand and the junction

Definition 4.1 (Poly-A-chrysene complex). [C] A *poly-A-chrysene complex* is a strand of alternating chrysene and adenosine, the chrysene disubstituted at the 6- and 12-positions [Sch25a], the adenosine ether-linked through a phosphodiester to the 6-position, the 12-position carrying the second substituent, and the adenosines joined into an RNA strand read 5' → 3'. One chrysene-adenosine pair is a *unit*, and by the corpus a unit is a vessel.

Hypothesis 4.2 (The junction). [D] Two poly-A-chrysene complexes meet chrysene to chrysene, with no intervening nucleobase, the two facing units stacked π -face to π -face [Sch26a] and stabilised by that stacking together with the base stacking of the two strands.

Remark 4.3 (Status of the hypothesis). [A] Hypothesis 4.2 is not established here and is the premise on which the whole paper rests. It is a statement about how carriers assemble, not about how a residue forms, and Section 3.1 (iii) records that nothing below bears on it. Its falsifier is a demonstration that two such strands cannot terminate against one another in this way.

Definition 4.4 (The junction cell). [D] The *junction cell* is the six vessels $X_1, \dots, X_6$ flanking a junction, three drawn from each strand, with the junction between X_3 and X_4 . The hexamer $h_1 \dots h_6$ is the six bases these vessels present, h_3 and h_4 being those of the two facing units.

Proposition 4.5 (The two strands run oppositely through the cell). [D] *Of the two strands, one runs $5' \rightarrow 3'$ into the junction and the other $5' \rightarrow 3'$ out of it. The reading is therefore continuous in the $5' \rightarrow 3'$ sense across the boundary, and the cell is not symmetric under exchange of its two halves: one half is incoming and one outgoing.*

Scholium 4.6. Proposition 4.5 is the first of three asymmetries of the junction cell, and it is the only one available before any chemistry is done. The other two — which unit fragments, and which sulfur site is terminal — are established in Section 5, and Theorem 5.15 records that all three distinguish the same unit.

It is worth stating here what that will spare the paper. A companion paper, working on a single unit, had to force an asymmetric outcome onto a σ -symmetric object, and was left with two independent breaks whose relation it could not settle. The junction cell is asymmetric before anything happens.

4.2 Vessel parity, and the centre of a cell

The corpus fixes the site of a reaction within a cell: a vessel-localised pathway transforms the central vessel, and the existence of a central vessel requires the count to be odd. A codon is three vessels, the count is odd, the centre is the second vessel, and one residue is excised there. This is the rule the junction cell must be placed against.

Definition 4.7 (Centre of a stack of vessels). [A] For a run of N vessels indexed $1, \dots, N$, the *centre* is the vessel $\frac{N+1}{2}$ when N is odd, and the interface between vessels $\frac{N}{2}$ and $\frac{N}{2} + 1$ when N is even. In the even case the two vessels flanking that interface are the *central pair*.

Theorem 4.8 (A junction cell has no central vessel). [A] *The junction cell has $N = 6$ vessels. Six is even, so the cell has no central vessel: its centre is the interface between X_3 and X_4 , which is the junction itself, and its central pair is $\{X_3, X_4\}$ — the two facing units.*

Proof. The parity of N and the resulting centre, tabulated at $N = 1, 3, 5, 6, 7$; Appendix B, J8, computed. $\square$

Corollary 4.9 (The cell falls outside the localisation rule).

[D] *The corpus's localisation requires an odd vessel count and yields a pathway transforming one vessel and, with it, one residue. The junction cell has an even count, so no pathway of that kind exists on it. A pathway localised at the junction is localised on an interface rather than on a vessel, and the cell yields two residues rather than one.*

Scholium 4.10. Corollary 4.9 is the section's point and it should not be read as a licence. The second-site rule of the corpus is not excepted at the junction: it is a consequence of a proposition whose hypothesis the junction cell does not satisfy, and a statement that does not apply is not a statement that has been broken. Nothing is admitted here beyond the arithmetic of Definition 4.7, and Section 3.1 (v) says so.

What the corollary buys is the location of the reaction. The excisions of Section 5 occur at X_3 and X_4 , and they do so not by an exception to the centre but because the central pair is the only thing *centre* can mean at even count. A reader who grants Definition 4.7 has granted the placement.

Proposition 4.11 (Why six vessels and not three). [D] *A cell of three vessels spanning the junction — two from one strand and one from the other — has an odd count and a central vessel, and would fall inside the corpus's localisation rule. It is not the cell of this paper, for two reasons. Its central vessel is not a unit of the central pair, so its excision would occur away from the junction and away from either sulfur site. And its codon draws two of its three bases from one strand and one from the other, so neither outer position of Section 7 lies within it and no position of it can carry a start or a stop.*

Corollary 4.12 (Two residues, not two cells). [D] *The junction cell is one cell producing two residues, and not two cells producing one each. A cell producing one residue is localised on a central vessel by the corpus's rule; neither half of the junction cell has one, each half being an even count of three vessels plus an interface, and neither half carries both sulfur sites.*

4.3 What the cell presents

Proposition 4.13 (The junction bases are the inner pair).

[D] *The two units of the central pair present the bases h_3 and h_4 . The outer positions h_1 and h_6 are borne by X_1 and X_6 , the units furthest from the junction on each strand.*

Remark 4.14 (Where the reading is treated). [A] Nothing in this section assigns a codon to anything. The chemistry of the cell is Section 5 and Section 6, and the reading is taken off the chemistry in Section 7. The order is deliberate: the primitive of this paper is a reaction over a cell, not a window over a sequence, and Section 3.1 (viii) guards the difference.

4.4 Falsification register for this section

statement	what would refute it
Hypothesis 4.2	a demonstration that two poly-A-chrysene complexes cannot terminate against one another chrysene to chrysene
Theorem 4.8	a recomputation disagreeing with J8
Corollary 4.9	a vessel-localised pathway on an even count, or a central vessel at $N = 6$
Proposition 4.5	a junction at which both strands run the same way through the cell

5 The concerted reaction

Section 4 placed the reaction at the central pair. This section says what it does there. The two excisions are taken from the corpus unamended, the ordering is fixed by valence and by what must exist before what, and the balance is derived atom by atom.

The section's principal result is not any one of these. It is Theorem 5.15: the cell is asymmetric in three ways at once, all three distinguish the same unit, and nothing has to be chosen.

5.1 Non-implications

Proposition 5.1 (Non-implications of this section). [A] *None of the following is asserted below.*

- (i) *That the stages are elementary steps. Each may comprise several, and whether the third is concerted is not settled here.*
- (ii) *That the balance establishes feasibility. It shows the transformation is not excluded on electron-counting grounds and says nothing about any barrier.*
- (iii) *That the balance is a mechanism. It is global over the cell, and says nothing about how electrons reach the sulfur-sulfur bond. At a junction that silence covers more than it would on one unit: the two electrons must come from carbons of two different molecules, joined only by the bond being reduced. The arithmetic is unaffected and the mechanical question is harder here*

than in the single-unit account, and is not addressed in either.

- (iv) *That the loss of aromaticity is accounted anywhere. Rings are opened on both units and the scope of Remark 2.6 excludes computing what that costs. It is named here and nowhere quantified.*
- (v) *That the asymmetry of Theorem 5.15 is explained. The theorem records that three asymmetries agree; it does not say why a junction should have any.*

5.2 The two excisions

Definition 5.2 (The two paths). [D] Under the atom map of Appendix A, the junction cell excises

	unit	retained	sulfur
first residue	X3	{C5@X3}	terminal at C5@X3
second residue	X4	{C5@X4, C4b@X4, C10b@X4}	internal, in C4b@X4

with boundary cuts C4b@X3–C5@X3 and C5@X3–C6@X3 on X3, and C4a@X4 – C4b@X4, C5@X4 – C6@X4, C10a@X4–C10b@X4 and C10b@X4–C11@X4 on X4.

Proposition 5.3 (Both paths are the corpus's rows as published). [D] *Both retained sets and both cut lists are those the corpus records for these two structures, unamended. The induced edges of the second are C4b@X4–C5@X4, retained as the C_β – C_γ bond, and C4b@X4–C10b@X4, consumed by the insertion — and the corpus severs that edge in the same row, so the insertion is already accounted for.*

Proof. Comparison of the two sets and their boundaries against the published rows; Appendix B, K1, computed. $\square$

Scholium 5.4. Proposition 5.3 is worth stating because a companion paper could not state it. Placing both residues on one unit makes the two retained sets meet at the base point, which forces the second onto the image of its published set and, with it, a series of amendments to the corpus. Here the sets lie on different molecules and the question does not arise. That both locants read C5 is a coincidence of labelling and nothing more; Remark 2.3 applies.

Proposition 5.5 (Nothing joins the two residues through the carrier). [D] *The two residues occupy different molecules. They share no atom, no bond, and no cut, and no path through either carrier connects them.*

Corollary 5.6 (The bridge is load-bearing). [D] *Until the disulfide of Section 6 is formed, and after it is cleaved, the two residues of the junction cell are unconnected objects. The bridge is the only thing that makes the cell one reaction rather than two.*

5.3 Valence, and the moves the cell admits

Lemma 5.7 (Valence at the two sulfur sites). [A] *C5@X3 has degree two in the vessel graph and carries a hydrogen, so it admits an exocyclic substituent without any prior removal. C4b@X4 and C10b@X4 have degree three and carry none, so the internal site requires the edge C4b@X4–C10b@X4 to be opened first.*

Proof. The degree sequence; Appendix B, K3, computed. □

Corollary 5.8 (No move is added). [D] *The removal Lemma 5.7 requires is a cut the corpus already records for the second residue's row (Proposition 5.3). The junction cell therefore admits no move beyond those the corpus already carries, and it does not require the pyramidalisation a single-unit cell requires (Section 6).*

5.4 The stages

Definition 5.9 (The stages). [D] *The transformation of the junction cell comprises the following.*

	event
0	the junction at rest: X3 and X4 stacked face to face; no exogenous atom present
I	C4b@X4–C10b@X4 opened, freeing the internal site; C5@X3 needs no opening
II	one disulfide delivered across the gap: one sulfur to C5@X3, one to C4b@X4, the two bonded to each other
III	the sulfur–sulfur bond reduced; the sulfur at X4 closes to C10b@X4 giving the thioether, the sulfur at X3 is protonated to the thiol; two electrons consumed
IV	amination at each C _α ; the transannular bonds; each C' esterified to its ribose 2'-oxygen; the boundary cuts on both units; both residues released

Theorem 5.10 (The first three stages are totally ordered). [D] *Stage I precedes stage II, stage II precedes stage III, and stage III precedes the release of stage IV. The grounds are respectively:*

- (a) *C4b@X4 has degree three and carries no exocyclic substituent until one of its edges is removed (Lemma 5.7);*
- (b) *a bond cannot be reduced before it exists;*
- (c) *while the sulfur–sulfur bond is intact the two residues are held together across the stack, and they are held by nothing else (Corollary 5.6), so releasing first would liberate one object and not two.*

Proof. Each clause is a finite statement about valence or about the existence of a bond; Appendix B, K5, tabulated, with the valence of clause (a) computed at K3. □

Scholium 5.11. Clause (c) is where the junction differs from a single-unit cell in kind and not in degree. There, the two residues were parts of one molecule until late and the bridge fixed only *when* they might come apart. Here they are never parts of one molecule, and the bridge is what makes a single concerted reaction out of two excisions that have no other connection. A reader who declines the bridge is not left with a weaker version of this cell; they are left with two cells.

5.5 Release, and when it fails

Hypothesis 5.12 (Release at the outer position). [D] *A structure formed at a unit of the central pair is released only when the register at the outer position of that unit's codon is narrow. Where it is wide, the structure engages the base point and is not liberated, and the carrier is consumed.*

Remark 5.13 (This is the corpus's second failure mode, not a new one). [D] *The corpus distinguishes two ways a codon may carry no structure: no structure is consistent with it and the carrier is not consumed; or a structure is consistent, is not released, and the carrier is.* Hypothesis 5.12 is a statement about the second mode and about nothing else. The distinction matters because the corpus assigns the gating of *consistency* to the register at the second position, and that register is the same at every codon this paper treats. Consistency therefore cannot distinguish them, and the corpus's own account of the pair this paper terminates at is likewise an account of release and not of consistency. Any restatement of Section 7 must preserve this: the outer position decides whether a structure formed *leaves*, not whether one forms.

Scholium 5.14. Hypothesis 5.12 is placed here, among the chemistry, and not in Section 7, because the paper's order of

reasoning requires it. The reading is taken off the reaction; a claim about whether a reaction completes is a claim about the reaction. An earlier form of this manuscript stated the consequence in the reading section and cited the selected assignment for it, which is reading off the code — exactly the inversion this paper’s method forbids. Appendix D carries the entry.

The hypothesis is not established. It is the fourth premise of the paper and it carries the termination result alone.

Δ_ω is taken over the atoms whose incidences change. A negative total means the cell must be reduced from outside; a positive total, oxidised.

Definition 5.18 (Sources). [D] Sulfur arrives as a disulfide, in which each sulfur has $\omega = -1$; nitrogen as ammonia; and both carboxyl oxygens are carrier-internal, one the phosphate oxygen at C_β and one the 2’-oxygen of the adenosine ribose.

5.6 The cell is asymmetric from the start

Theorem 5.15 (Three asymmetries, one unit). [D] *The two units of the central pair differ in three respects:*

	X3	X4
fragmentation	one remnant, seventeen carbons	two remnants, seven
sulfur site	terminal, in the plane	internal, out of the plane
reading	strand runs into the junction	strand runs out of it

All three distinguish the same unit, and the unit they mark — fragmented, internal, outgoing — is X4.

Proof. The fragmentation is the component count after removal of each retained set; Appendix B, K6, computed. The sites are Definition 5.2. The reading is Proposition 4.5. $\square$

Scholium 5.16 (What this spares the account). A single-unit cell is built on an object with exactly one non-trivial symmetry and no datum breaking it, so an asymmetric outcome must be forced onto it. The companion paper locates that forcing on one orbit of edges and finds a second break in the oxidation level of the remnant, and it cannot settle whether the two are the same choice; the question is left open there.

No such question arises here. The junction cell is asymmetric before anything happens, the three asymmetries of Theorem 5.15 agree, and Theorem 5.20 below shows that the balance adds no fourth. The account has one asymmetry, it is not a choice, and there is nothing to settle.

What the theorem does not do is explain the asymmetry. A junction is asymmetric because one strand arrives and one departs, and why a junction should exist is Hypothesis 4.2.

Proposition 5.19 (The sinks). [D] *Nitrogen passes from ammonia to an amine without change of index. Each of the two sulfurs passes from -1 to -2 , in a thiol and in a thioether respectively, so the sulfur sink is two electrons for the cell — one disulfide — and not two for each unit.*

Theorem 5.20 (The cell is self-sufficient at one remnant level only). [D] *The fracture leaves several carbons of each remnant with a new hydrogen; two of them, one on each unit, carry the ether oxygen of their tether and may terminate at the alcohol or the aldehyde level. The remaining remnant carbons are taken at the hydrocarbon level, which is an assumption and not a result. Let k be the number of the two oxygen-bearing termini that stand at the aldehyde level. Then the total index change of the cell is $2k - 4$, so*

$$v(k) = 2k - 4, \quad v(k) = 0 \iff k = 2.$$

A redox-self-sufficient junction cell leaves both oxygen-bearing remnant termini at the aldehyde level.

Proof. The index change is derived from explicit bond lists, atom by atom, over the five carbons of X3 and the nine of X4 whose incidences change, with the two termini parameterised; Appendix B, K10–K12, computed. $\square$

Corollary 5.21 (The balance imposes no asymmetry). [D] *The two units make the same demand at $k = 2$. The balance therefore adds nothing to Theorem 5.15 and subtracts nothing from it.*

Scholium 5.22 (Two errors, and how they were found). The balance was first obtained from a block that entered the oxidation states by hand rather than deriving them, and it was wrong twice. The C_β of the first residue was given two carbon neighbours where it has one, the C_α , together with the sulfur and two hydrogens. And the resulting total was *odd*, which closed-shell chemistry cannot give and which was visible on the face of the output.

5.7 The balance

Definition 5.17 (Oxidation index). [A] For an atom, ω is the sum of bond orders to more electronegative partners less the sum to less electronegative ones, bonds between atoms of one element contributing nothing. For a transformation,

Both are of one kind: a tabulated block formats an assertion, and no computation stands behind it that could disagree. The balance is now derived from bond lists, the parity is reported, and Remark 2.7 marks every block as computed or tabulated so that a reader can see which statements are self-checking. Appendix D carries the entry, and the superseded block is struck from the verification file rather than left to be cited.

an existence claim about the lateral register, not a prediction of one.

- (iv) *That sulfur is shown to have no source in the carrier. That is imported; this section shows only why the junction demands two atoms of it and why one event supplies them.*

5.8 Falsification register for this section

statement	what would refute it
Proposition 5.3, Lemma 5.7, Theorem 5.15	a recomputation disagreeing with K1, K3, K6
Theorem 5.10	a route reaching the bridged cell without prior removal at C10b@X4, or releasing two residues with the sulfur–sulfur bond intact
Theorem 5.20	an index computation giving a total not affine in k , or not $2k-4$; or a self-sufficient cell exhibiting a remnant terminus below the aldehyde level
Definition 5.18	a sulfur source other than a disulfide, or a carrier-external carboxyl oxygen

6.2 The demand, and the delivery

Proposition 6.2 (The cell demands two sulfur atoms). [D] *The junction cell requires one sulfur terminal at C5@X3 and one internal between C4b@X4 and C10b@X4: two atoms, one to each of two different molecules.*

Proof. Definition 5.2; Appendix B, K8, computed. □

Hypothesis 6.3 (Disulfide delivery). [D] The cell receives its sulfur as a disulfide, in a single event, and the two sulfurs of that disulfide become the two sulfurs of the pair.

6 The disulfide across the gap

The bridge is what makes the junction cell one reaction (Corollary 5.6). This section states what it requires, what it delivers, and on what premises it carries the pairing.

Two of those premises are the paper's principal exposure and are named as such. A third requirement, which a single-unit cell cannot meet, is met here without any distortion, and the reason is stated exactly.

6.1 Non-implications

Proposition 6.1 (Non-implications of this section). [A] *None of the following is asserted below.*

- (i) *That the pairing of a thiol with a thioether is selected by an argument of the carrier alone. It rests on Hypothesis 6.3 and Hypothesis 6.11, and neither is established here.*
- (ii) *That the bridged species is observed. It is an intermediate required by the construction and no claim is made that it has been isolated.*
- (iii) *That the geometry of Proposition 6.7 is a computation of structure. It is a rigid model with a stated stacking separation, and the conclusion drawn from it is*

Corollary 6.4 (One event, two molecules). [D] *A disulfide supplies two atoms. Under Hypothesis 6.3 one delivery event therefore serves both residues exactly, with no atom left over and none required from a second event.*

Scholium 6.5 (Why sulfur, and why it is common to both). The corpus records that sulfur is the one element the carrier cannot supply and that exactly two structures require it. At a junction that fact acquires a reading it does not have elsewhere.

A disulfide is a linkage between two sulfur atoms, and it is therefore the one species in the account that can be delivered to *two separate molecules at once* and hold them together while both fragment. Everything else the medium supplies is delivered to a single carrier. So at the one place in the architecture where a reaction must span two carriers, the reagent that spans them is a disulfide, and the two residues formed there are the two that carry sulfur.

The reading is offered and not pressed. It says why the two sulfur-bearing residues are the junction's residues, given that the junction exists and that sulfur is exogenous. It does not establish either, and Proposition 6.1 (iv) records the second.

6.3 The bridge closes without distortion

Definition 6.6 (The bridge). [D] The *bridge* is the configuration in which one sulfur is bonded to C5@X3, the other to C4b@X4, and the two to each other.

Proposition 6.7 (The bridge closes, and the sense of the internal sulfur is forced). [D] *Let the two units be stacked with their planes separated by 3.40 Å [Sch25b], let the thiol sulfur lie in the plane of X3, and let the internal sulfur stand 1.68 Å from the plane of X4. Then*

- *if the internal sulfur is displaced toward X3, the gap normal to the planes is 1.72 Å and the bond closes at a lateral offset of 1.12 Å, a sulfur–sulfur bond being 2.05 Å [NEE] between the two sulfurs;*
- *if it is displaced away, the normal gap is 5.08 Å and the bond cannot close at any lateral offset.*

The sense of the internal sulfur is therefore not free: it must point toward the partner unit.

Proof. The normal separation and the lateral offset required to reach a sulfur–sulfur bond length [NEE]; Appendix B, J6 and K4, computed. □

Remark 6.8 (The separation is a resting value). [A] The figure of 3.40 Å is the separation of two units stacked and unbonded. Once the bridge is formed the two are covalently joined and the separation is an output of the bonded geometry rather than a stacking datum. The proposition therefore uses the resting value to conclude that the bonded state is reachable, which is an approximation and is declared as one. Computing the bonded geometry is excluded by Remark 2.6 and is Target 9.6.

Remark 6.9 (Why no distortion is invoked). [D] Between two sites on one aromatic plane the exocyclic directions are fixed by the ring and admit no rotation, so the separation of two substituents is determined and cannot be adjusted; a single-unit cell fails there and must pyramidalise a ring carbon before its bridge can close. Between two sites on *different* molecules only the separation normal to the planes is fixed. The lateral register of a stacked pair is free, and Proposition 6.7 is an existence claim about it. The pyramidalisation a single-unit cell requires is therefore an intramolecular obstruction and not a general one. It does not arise here, and Corollary 5.8 records that the junction cell adds no move on its account.

Scholium 6.10. Proposition 6.7 is the second thing the junction gives back that a single unit cannot. The first is the corpus's rows unamended (Scholium 5.4); this is the bridge undistorted. Both have the same cause — two molecules rather than one — and both are stated so that a reader can see what the premise of the junction is buying.

What it costs is Hypothesis 4.2, and that is not a small price. A single-unit cell needs no assumption about how carriers assemble.

6.4 What carries the pairing

Hypothesis 6.11 (No migration). [D] A sulfur does not move from the site at which it is first attached to another. The sites at which the bridge closes are the sites the two residues retain.

Remark 6.12 (Where the weight rests). [A] Nothing in this section forbids a disulfide from closing at some other pair of sites, nor a sulfur from moving afterwards. That the bridge closes where the residues need it is Hypothesis 6.11; that it closes at all as one event is Hypothesis 6.3. Together these two carry the pairing, and neither is established here. A reader who declines them is not left with a different pairing. They are left with a junction at which two residues form independently, the bridge does nothing, and the cell is two cells — which is Corollary 5.6 read in the other direction.

Scholium 6.13 (The premises, counted). The paper rests on five premises of its own and one import. The junction forms (Hypothesis 4.2); a structure is released only at a narrow outer register (Hypothesis 5.12); the sulfur arrives bonded (Hypothesis 6.3); neither sulfur afterwards moves (Hypothesis 6.11); the two outer bases are complementary (Hypothesis 7.7); and sulfur has no source in the carrier, which is imported. Table 1 lists them and this scholium is the place a reader should check it against the body. They are of three kinds: one about how carriers assemble, two about what the medium delivers and where it stays, and two about the cell's own reading and release. None is about the code, and none is amended from the corpus. That is the whole of what this paper assumes — and it is more than the companion assumes, which is the exchange Section 8 states.

6.5 Falsification register for this section

statement	what would refute it
Proposition 6.2	a junction cell demanding other than two sulfur atoms
Proposition 6.7	a recomputation disagreeing with J6, K4; or a stacking separation at which the normal gap exceeds a sulfur–sulfur bond in both senses
Hypothesis 6.3	a sulfur source that is not a disulfide, or delivery of the two sulfurs in separate events
Hypothesis 6.11	migration of a sulfur between sites after attachment

7 The reading

The reaction is fixed. This section takes the reading off it.

The order matters and is the paper’s method. The primitive is a reaction over a cell (Remark 4.14), and a codon is what the bases of a strand are called once that reaction has run. Nothing below is assumed about frames before the chemistry; what is assumed about the chemistry is Table 1 and nothing further.

Three results follow. The frame relating the two strands is face inversion, and the case that proves it is the start codon itself. The hexamer that carries the junction is underdetermined by exactly one position, so a phase must be fixed from outside — which is what setting a frame means. And that phase is fixed at one base, which decides start and stop together.

7.1 Non-implications

Proposition 7.1 (Non-implications of this section). [A] *None of the following is asserted below.*

- (i) *That a reading direction is reversed. The relation is face inversion with order kept, and Theorem 7.9 excludes both order-reversing alternatives.*
- (ii) *That the combinatorics selects the hexamer of Section 7.5. It does not; the pairing does, and Proposition 7.19 states how many hexamers share the combinatorial property.*
- (iii) *That any residue is delivered where the start fails. Where the outgoing outer position is a pyrimidine, this paper says no start is set and says nothing further.*
- (iv) *That termination is derived. It follows from Hypothesis 5.12, which is a premise about the reaction and is not established. And it is partial: two of the three stop codons of the standard code are produced, the third is not, and the account is scoped to the two mappings the corpus treats.*

- (v) *That the observed start codon is explained. The two residues are frame-related in the assignment structural consistency selects and not in the observed code (Theorem 7.22).*

7.2 The phase is underdetermined by one position

Definition 7.2 (Face inversion). [C] *Face inversion* is the operation exchanging the orientation value at every site of a stack, with the order of sites kept. On words it is the position-wise complement. The corpus’s order-reversing operation is written separately and is never called an inversion here.

Proposition 7.3 (Alternating hexamers are inversion-invariant up to a shift). [A] *For an alternating hexamer h over two complementary letters, the face inversion of h equals h shifted by one position.*

Proof. A finite check over the four alternating hexamers; Appendix B, J1, computed. $\square$

Corollary 7.4 (Frame and phase are indistinguishable). [A] *On such a hexamer, changing the frame and changing the phase by one position have the same effect on every window. The sequence therefore determines the reading only up to one position.*

Scholium 7.5 (This is why a junction can set a frame). Corollary 7.4 is the section’s central observation and it is worth reading as a positive statement rather than as a deficiency.

A sequence that fixed its own phase would need nothing to set a frame, and a frame would not be a thing that could be set. An alternating hexamer fixes its phase to within one position and no further, so something outside the sequence must supply the last position — and a physical discontinuity in the carrier is exactly such a thing, available once, at one place, and not re-readable.

The junction and the sequence are matched in this respect: the sequence leaves precisely one degree of freedom, and the junction supplies precisely one datum. Section 7.4 shows that the datum it supplies decides start and stop together.

7.3 The frame relation is face inversion

Definition 7.6 (The two codons of a junction). [D] The incoming strand contributes $h_1 h_2 h_3$ and the outgoing strand $h_4 h_5 h_6$, each read $5' \rightarrow 3'$, and by Proposition 4.5 the reading is continuous across the boundary. Write c_{in} and

c_{out} for the two.

Hypothesis 7.7 (Complementary outer bases). **[D]** At a junction the outer position of the outgoing codon is the complement of the outer position of the incoming one.

Remark 7.8 (Why this is a premise and not a fact). **[A]** The two outer bases lie at opposite ends of the cell, on different strands, with six units between them and nothing pairing them. Their complementarity is therefore not supplied by the architecture and is assumed.

It is assumed because two results need it. Theorem 7.9 relates the two codons, which requires that a relation hold; and Corollary 7.15 identifies the two slots, which holds for the complementary cases. Where the hypothesis fails the two codons are unrelated and this paper says nothing about the junction.

Theorem 7.9 (Only face inversion relates the two codons). **[D]** Let the junction bases be fixed, let the outer positions be h_1 and h_6 , and assume Hypothesis 7.7. Of the three operations of the frame group — face inversion, order reversal, and their composite — only face inversion carries c_{in} to c_{out} at every value of the outer positions. At an alternating hexamer the three cannot be told apart, every window being a palindrome. At the discriminating case, where the outer positions are the pyrimidine C and the purine G, face inversion carries UAC to AUG, order reversal gives CAU, and the composite gives GUA.

Proof. The three operations applied to c_{in} at each value of the outer position; Appendix B, J9, computed. $\square$

Scholium 7.10 (The start codon is what proves the frame). The order of Theorem 7.9 should be preserved in any restatement. The paper does not assume face inversion and then find a start codon. It finds that the start codon is the only case at which the two junction codons are frame-related at all, and that at that case exactly one operation works. The alternating hexamer, which is the composition the complex assembles (Section 7.5), cannot decide the question: every one of its windows is a palindrome. The deciding case is the one with a pyrimidine outside the incoming codon and a purine outside the outgoing one, and that is the case in which the outgoing codon is the start. The theorem also settles the vocabulary. Order reversal fails at the deciding case, so no reading direction is reversed at a junction, and the word *reversal* is reserved accordingly.

7.4 Start and stop at one position

Proposition 7.11 (The outer positions are wobble positions). **[D]** h_1 is the third position of c_{in} and h_6 the third position of c_{out} . By the corpus the third position carries no information of its own and acts only through the relation of its width to the second, which is a distinction between pyrimidine and purine. It does not gate whether a structure is consistent with the codon; the corpus assigns that to the register at the second position, which is the same at every codon this section treats.

Scholium 7.12. Proposition 7.11 is where the weakness of the outer positions is *derived* rather than asserted. They are not weak because they lie outside the reaction — they are borne by the units furthest from the junction, but they are inside their own codons. They are weak because they are wobble positions, and the junction's switch is the ordinary wobble distinction applied at a boundary. What that distinction decides here is release and not consistency, and Remark 5.13 says why it can decide nothing else.

Theorem 7.13 (One position decides start and stop together). **[D]** Assume Hypothesis 5.12 and Hypothesis 7.7. The two codons are $c_{\text{in}} = \text{UA}h_1$ and $c_{\text{out}} = \text{AU}h_6$, and

h_1	c_{in}	h_6	c_{out}
pyrimidine	the first residue is released	purine	the s
purine	formed, not released; the reading terminates	pyrimidine	not r

A purine at h_1 therefore terminates the incoming reading and, by Hypothesis 7.7, withholds the outgoing start: one event at one position. In both failing cases a structure forms and is not liberated, which is the corpus's second failure mode and not its first (Remark 5.13).

Proof. The failure of release at a wide outer register is Hypothesis 5.12; which codons the four values of h_1 give, and which of them the selected assignment leaves unfilled, is a finite check at Appendix B, J7 and J9, computed. The theorem is the first statement; the check confirms that its consequence agrees with the assignment and does not establish it. $\square$

Corollary 7.14 (The two start codons arise together). **[D]** The purine cases at h_6 are two, and both give the second sulfur residue. The account therefore does not choose between the two codons at which that residue is observed to initiate; both are starts, and the pyrimidine cases are not.

Corollary 7.15 (The two slots are the corpus's unique complementary pair). **[D]** *The codon sets of the two junction slots are position-wise complementary. Among the eighteen slots the corpus seeds there are exactly three complementary pairs, and exactly one has both slots of size two: it is this one.*

Proof. The complement of the incoming slot against the outgoing one, and the complementarity count over the seeded slots; Appendix B, J11, computed. $\square$

Scholium 7.16 (An independent ground for the corpus's hypothesis). Corollary 7.15 is the strongest claim this paper has on the corpus's open targets, and it should be read carefully.

The corpus establishes that exactly two structures require an element the carrier cannot supply, and places them at complementary slots *under a hypothesis* — that one delivery serving two structures is preferred to two that must coincide. It states that this hypothesis is the only unsupported premise carrying a headline result there, and asks for an independent ground for it.

At a junction the complementarity is not assumed. The two strands are related by face inversion (Theorem 7.9); face inversion *is* position-wise complementation (Definition 7.2); so the two codons of a junction are complementary of necessity. And one delivery serves both because the two sites are one bond apart across the stack (Corollary 6.4), not because one event is preferred to two. The corpus's hypothesis is a consequence here rather than a premise, and its target is discharged — conditionally on this paper's own premises, which are not fewer.

Two bounds, and they are the same two that bound everything in this section. The identity holds in the assignment structural consistency selects, which is where the corpus's theorem also lives, so the ground reaches no further than that theorem does (Theorem 7.22). And it requires Hypothesis 7.7, without which the two codons are not complementary at all.

Corollary 7.17 (No residue is asserted where the start fails). **[D]** *Where h_6 is a pyrimidine the account delivers no start and nothing further. What the observed code places at those codons enters the repertoire by another route and is outside this paper.*

Remark 7.18 (Termination, and what it does not cover). **[D]** Theorem 7.13 produces termination as the failure of a reaction and not as a residue assigned to a codon; in particular the code this paper works in does not require

the first sulfur residue to terminate. The two terminating codons it produces are exactly the pair the corpus finds fixed in both observed mappings, and which it shows needs no exchange to place — so the junction is a second route to a result already in the corpus.

Two bounds. The standard code has a third stop codon which nothing here produces. And the corpus itself records published tables [Nat24] delivering residues at the pair this paper finds terminating, so the claim is scoped to the two mappings the corpus treats, as the corpus scopes its own.

7.5 Which hexamer, and why

Proposition 7.19 (The combinatorial property is not rare). **[A]** *Of the four thousand and ninety-six hexamers, five hundred and twelve place both junction windows in a single registry class, and four of those are alternating. The alternating hexamer over the complementary pair $\{C, G\}$ has the same inversion-invariance as that over $\{A, U\}$ and lies in a single class likewise.*

Proof. Exhaustive over hexamers; Appendix B, J1, J3 and J4, computed. $\square$

Proposition 7.20 (The complex selects the composition). **[D]** *The poly-A-chrysene complex is the pre-existing object and the presented strand is what arrives at it. A presented uracil pairs canonically with a tethered adenine and is thereby attracted to the complex; a presented cytosine or guanine is not. An alternating region over $\{A, U\}$ is therefore the composition the complex draws from what is available, and the alternative alternating region is not.*

Scholium 7.21 (What selects, and what does not). Proposition 7.19 is stated before Proposition 7.20 so that the reader is not left to infer that the symmetry does the work. It does not. The inversion-invariance of Corollary 7.4 and the single-class property are shared by both alternating hexamers and, in the second case, by five hundred and twelve hexamers in all.

What distinguishes the one the junction is built on is the pairing, and the pairing rests on the one feature of the architecture that is not a choice: the complex is made of adenine. Stated that way the claim is stronger than a combinatorial one, and it is the only form in which it is available.

7.6 What the reading reaches, and what it does not

Theorem 7.22 (The pair is frame-related in the selected assignment only). [A] *In the observed standard mapping, no operation of the frame group carries either codon of the first sulfur residue to the codon of the second: face inversion gives codons of a third residue, and the two order-reversing operations give codons of others again.*

Proof. The three operations applied to each codon of the first residue in the standard mapping; Appendix B, J10, computed. $\square$

Scholium 7.23 (The result, bounded). Theorem 7.22 is the section's least comfortable statement and it belongs here rather than in a discussion.

Everything above holds of the assignment that structural consistency selects. The observed mapping stands two exchanges from that assignment, and the corpus states the resulting dilemma and declines to decide it. This paper inherits the dilemma whole. It shows that a junction in the selected assignment sets a frame at a start codon and terminates at a stop; it does not show that the observed start arises this way, and a reader who declines the selected assignment is not answered here.

What would settle it is what the corpus says would settle it, and nothing in this paper is a step toward it.

7.7 Falsification register for this section

statement	what would refute it
Proposition 7.3, Proposition 7.19, Theorem 7.22	a recomputation disagreeing with J1, J3, J4, J10
Theorem 7.9	an operation of the frame group other than face inversion carrying c_{in} to c_{out} at the discriminating case
Proposition 7.11	an outer position acting otherwise than through its width relation to the second
Theorem 7.13	a junction terminating at a pyrimidine outer position, or setting a start at a pyrimidine outgoing one
Proposition 7.20	a presented base pairing canonically with the tether other than the one stated

8 Relation to the single-unit account

A companion paper [Sch26k] places both sulfur residues on one chrysene unit. This section states what that paper supplies to this one, what this one returns to it, and where the two disagree. It is

a concordance section: it establishes nothing and no statement of Sections 4 to 7 depends on it.

8.1 What is inherited

The companion establishes four things this paper uses and does not reprove: that a disulfide is the form in which two sulfur atoms are delivered in one event; that the bridged intermediate is the object through which two sulfur-bearing residues are formed together; the staging of such a formation — open a site, bridge, reduce, release — and the argument that the release cannot precede the reduction; and the balance of a cell carried out atom by atom, with sulfur a two-electron sink and nitrogen neutral.

Each is used here on a different object and none is used unaltered in its consequences.

8.2 What this paper returns

Remark 8.1 (Three of the companion's difficulties do not arise). [A] Three statements of the companion are conditional on its own premise — that both residues form on a single unit — and this paper shows what they become without it.

The corpus's rows. On one unit the two retained sets meet at the base point, which forces the second residue onto the image of its published set and, with it, a series of amendments to the corpus's structure series. On two units no disjointness arises and both rows are used as published (Proposition 5.3). The companion's amendments are therefore a description of what a single-unit cell would require and not errata against the corpus.

The distortion. On one aromatic plane the exocyclic directions are fixed and the bridge cannot close without pyramidalising a ring carbon, which the companion admits as a move. Across two molecules the lateral register is free and the bridge closes undistorted (Remark 6.9). The companion's move is an intramolecular obstruction and not a general one.

The two asymmetries. The companion must force an asymmetric outcome onto a symmetric object, obtains one break in an orbit of edges and a second in the oxidation level of the remnant, and cannot settle whether they are one choice. Here the cell is asymmetric before anything happens, the three asymmetries agree (Theorem 5.15), and the balance adds no fourth (Corollary 5.21). The question does not arise.

8.3 What this paper costs by comparison

Scholium 8.2 (The exchange, stated plainly). It would be convenient to present the junction as the better account on every measure, and it is not.

The companion assumes nothing about how carriers assemble. Its cell is one unit of a strand, and a reader who grants the corpus has granted the object. This paper assumes that two strands terminate against one another chrysene to chrysene (Hypothesis 4.2), which is a premise about assembly that neither paper establishes and that the corpus does not supply.

What is bought with it is the list of Remark 8.1; the only thing either account offers on initiation — a cell with two products, an even vessel count, and a discontinuity that can carry a frame; and one thing more, which neither account anticipated. At a junction the two structures are placed at complementary slots of necessity rather than by hypothesis (Corollary 7.15), so the corpus's paired-delivery premise becomes a consequence. That is the one place where this paper returns something to the corpus rather than to its companion.

The exchange is therefore one premise about assembly against three difficulties and a result. A reader is entitled to judge it either way, and the registers of both papers state what would settle it.

8.4 Where the two disagree

Remark 8.3 (The two accounts are not alternatives at the same object). [A] The two papers do not offer competing descriptions of one cell. They describe two cells, one of which occurs where a strand is regular and one where two strands meet, and nothing forbids both. If the junction of Hypothesis 4.2 does not form, the companion's account is what remains and this paper falls entire; if it does form, the companion's account is what happens away from junctions and this paper what happens at them.

No statement of either paper decides between them, and neither should be read as evidence against the other.

8.5 The junction is consumed

Scholium 8.4 (Against persistence, and why the tension is the result). The corpus holds that the stack, the registry and the product persist together, and argues from that coexistence that nothing can precede anything. The junction cell does not persist: it opens rings on both its units and is destroyed in the reaction it carries.

Read one way this is a difficulty. Read the other it is what the paper is for. A frame boundary is the place

where the regularity of the strand fails, and a punctuation mark that could be read twice would punctuate nothing. A discontinuity is available once, at one place, and is consumed in being used — which is exactly the character a frame-setting event must have, and exactly what a persisting template cannot supply.

The corpus's persistence is a statement about the carrier, the registry and the product along a regular strand, and nothing here contradicts it: a junction is where the strand is not regular. What the tension does bound is the scope of the result. This paper accounts for the *setting* of a frame and not for its maintenance, and Target 9.7 says so.

9 Targets and conclusion

9.1 Non-implications restated

Proposition 9.1 (The three most at risk). [A] *None of the following is asserted anywhere in this paper.*

- (i) *That the formation of a junction is explained. Hypothesis 4.2 is a premise about how carriers assemble; it is not derived, and everything below it is a description of what happens at a junction granted that one exists.*
- (ii) *That the observed start codon is explained. The two residues are frame-related in the assignment structural consistency selects and not in the observed mapping (Theorem 7.22), so this paper inherits the corpus's undecided dilemma whole.*
- (iii) *That anything is favourable. No energy is computed and no barrier estimated, the scope of Remark 2.6 forbidding both, and the word occurs in no numbered statement.*

9.2 Open problems

stated at	problem
Section 4	What conditions bring two poly-A-chrysene complexes to terminate against one another chrysene to chrysene, and how often.
Section 5	Whether the third stage is concerted, and what the opening of rings on both units costs. Both lie outside the declared scope.
Section 6	Whether the bridge closes at the sites the residues retain, or elsewhere with a subsequent migration. This is Hypothesis 6.11 and it is assumed.
Section 7	The third stop codon of the standard mapping, which the junction does not produce; and whether a frame once set is maintained, a discontinuity being available once and not re-readable.

9.3 Targets

Target 9.2 (The junction). Establish the conditions under which a junction forms, or show that it cannot. This is the premise on which the whole paper rests and the one on which it would fall entire.

Target 9.3 (The delivered species and its fixity). Independent grounds for Hypothesis 6.3 and Hypothesis 6.11. Together they carry the pairing; without them the junction has two residues forming independently and the cell is two cells.

Target 9.4 (Release, and the outer bases). Independent grounds for Hypothesis 5.12, which carries termination alone, and for Hypothesis 7.7, on which the frame relation and the slot identity both depend. Both were added in review, an earlier form of this paper having asserted their consequences without them.

Target 9.5 (The remnant prediction). Theorem 5.20 predicts that a redox-self-sufficient junction leaves both remnant termini at the aldehyde level. A single product analysis decides it, and it is the most directly testable consequence of the account.

Target 9.6 (The lateral register). Proposition 6.7 establishes that a register exists at which the bridge closes, using the resting stacking separation (Remark 6.8). Determining which register a stacked pair adopts, and what the separation becomes once the two units are covalently joined, requires a relaxed geometry and lies outside the declared scope.

Target 9.7 (Maintenance of a frame). A junction is consumed in the reaction it carries. Determine what, if anything, maintains a reading frame downstream of the discontinuity that set it.

Target 9.8 (The dilemma). The corpus states what would decide between the selected assignment and the observed mappings. Nothing in this paper is a step toward it, and the start result stands or falls with that decision.

9.4 Conclusion

Proposition 9.9 (What is established). [A] *Subject to the premises of Table 1, this paper establishes the following.*

- (i) *A junction cell has six vessels, hence no central vessel: its centre is an interface and its central pair is the two facing units (Theorem 4.8). The cell therefore falls outside the corpus's localisation rule rather than excepting it (Corollary 4.9), and it yields two residues rather than one (Corollary 4.12).*
- (ii) *The two residues are those of the corpus's structure series, used unamended, one on each facing unit (Proposition 5.3); they share no atom and no bond, and the bridge is the only thing that makes the cell one reaction (Corollary 5.6).*
- (iii) *The cell is asymmetric in three ways at once, all three distinguishing the same unit (Theorem 5.15), and the balance adds no fourth (Corollary 5.21). Nothing has to be chosen.*
- (iv) *The external electron demand is affine in the remnant level and vanishes at one value only: a self-sufficient junction leaves both oxygen-bearing termini at the aldehyde level (Theorem 5.20).*
- (v) *The two junction slots are position-wise complementary of necessity, and they are the corpus's unique complementary pair of size-two seeded slots (Corollary 7.15), so the corpus's paired-delivery hypothesis is a consequence here and not a premise.*
- (vi) *The bridge closes across the stack without distortion, and the sense of the internal sulfur is forced (Proposition 6.7).*
- (vii) *An alternating hexamer determines its reading only up to one position (Corollary 7.4), and a junction supplies exactly that one datum.*
- (viii) *Of the frame group, only face inversion relates the two codons of a junction, and the case that proves it is the start codon (Theorem 7.9).*
- (ix) *One position decides start and stop together: a purine there terminates the incoming reading and withholds the outgoing start in one event (Theorem 7.13).*

Scholium 9.10 (What would overturn the paper). Three findings would do it, and they are of quite different weights. A demonstration that no junction forms would remove the object and with it every statement above. Nothing would survive.

Sulfur delivered otherwise than as a bridged pair, or free to migrate between sites, would leave the object standing and remove the reaction. What remained would be a pair of independent excisions on adjacent units, a vessel-parity observation, and no account of initiation.

A decision against the selected assignment would leave the cell, the reaction and the balance intact and remove the reading. Sections 4 to 6 would stand entire and Section efp3s7:sec:reading would become a statement about an assignment nobody holds.

The three are entered in the registers of their sections, and none is addressed by this paper.

A The atom map and its provenance

A.1 Status of this appendix

This appendix is the source of the atom map on which Sections 4 to 7 are stated and is not evidence for it. It is also the only place in the paper where a chemical species is named; Proposition 3.1 (i) records that a reader who deletes it loses the interpretation and no result.

Its burden is lighter than that of the companion appendix it corresponds to. There, the two residues share a unit, their retained sets cannot both contain the base point, and the second must be displaced onto the image of its published set — so the map used is not the corpus's, and the appendix must argue that the displacement is forced rather than fitted. Here the two residues occupy different molecules, no disjointness arises, and *both rows are the corpus's as published*. The appendix has correspondingly little to defend.

A.2 What is imported

imported, unamended	from
that the residues arise as derivatives of a fused four-ring aromatic, and the substituted family as encoding material	[Sch20b, Sch20d, Sch20a, Sch20c, Sch25a]
the vessel graph, its locant registry and the ring decomposition	[Sch26j]
the retained set and cut list of the first sulfur residue	[Sch26j]
the retained set and cut list of the second sulfur residue	[Sch26j]
that a unit is a vessel and a codon three vessels; the localisation of a vessel-localised pathway	[Sch26j]
the tether, the letter assignment and the exhibited integrated product	the corpus and the specification
that sulfur has no source within the carrier	[Sch26j]

A.3 What is new

- (1) **The junction** (Hypothesis 4.2): that two poly-A-chrysene complexes meet chrysene to chrysene with no intervening nucleobase.
- (2) **That the two sulfur residues form there, one on each facing unit**, as one concerted reaction rather than two.
- (3) **The delivered species and the fixity of the sites** (Hypothesis 6.3, Hypothesis 6.11).
- (4) **The centre of an even cell** (Definition 4.7): that a run of an even number of vessels has an interface at its centre and a central pair, which is arithmetic and not chemistry.

Nothing in the retained sets, the cut lists or the sulfur sites is new. Item (2) is the premise from which the paper's content follows; items (1), (3) and (4) are respectively an assumption about assembly, two about the medium, and a definition.

Scholium A.1 (The map is not fitted, because it is not chosen). The objection this appendix must answer in the companion — that the retained sets may have been chosen so as to make the argument work — has no purchase here. Both sets are the corpus's, published before this paper and used without alteration. The sites follow: a residue retaining one vertex can carry only a terminal sulfur there, and a residue retaining three of which two are adjacent across an edge the corpus severs in the same row carries its sulfur internally at that edge if it carries one at all.

What a referee should press is item (2), the premise of co-excision at a junction. It is not derived from anything. Every consequence in the body is a consequence of it, and Target 9.2 states what would settle it.

A.4 The map

	first residue, on X3	second residue, on X4
C'	C6 β @X3	C6 β @X4
C $_{\alpha}$	C6 α @X3	C6 α @X4
C $_{\beta}$	C5@X3	C5@X4
C $_{\gamma}$	—	C4 b @X4
sulfur	terminal at C5@X3	internal, in C4 b @X4–C10 b @X4
C $_{\varepsilon}$	—	C10 b @X4

The retained sets and cut lists are Definition 5.2. Each residue draws its C $_{\alpha}$ and C' from the tether of its own unit, so the two are supplied independently: this is a difference from a single-unit cell, where one unit must supply both.

A.5 Sources of the heteroatoms

atom	first residue	second residue	source
sulfur	terminal	internal	medium, as a disulfide
α -nitrogen	at C6 α @X3	at C6 α @X4	medium
carboxyl O (1)	phosphate O at C $_{\beta}$	phosphate O at C $_{\beta}$	carrier
carboxyl O (2)	ribose 2'-O, as ester	ribose 2'-O, as ester	adenosine
remnant O	ether O at C6	ether O at C6	carrier

Remark A.2 (Reading). [E] Under the map the first residue is cysteine and the second methionine. This reading enters no numbered statement of the body.

Scholium A.3. That the vertex counts agree with the two side chains is recorded and is not offered as evidence. The map was constructed to describe those residues, so agreement is a condition of its being the map at all and not a test it has passed. What can be tested is in the falsification registers of the body, and none of it is an atom count.

B Verification

B.1 The files

All computations are emitted by three scripts, each requiring the verification file of the corpus in the same directory. `junction-checks.py` carries the hexamer arithmetic, the registry classes, the frame operations and the cross-stack geometry, in blocks J1–J10. `junction-stages.py` carries the two paths, the valences, the stages and the fragmentation, in blocks K1–K9. `junction-balance.py` carries the balance, derived atom by atom from explicit bond lists, in blocks K10–K12.

Remark B.1 (Computed and tabulated). [A] Each block is marked *computed* or *tabulated*, in the sense of Remark 2.7. A computed block derives its output from the vessel graph, from a finite enumeration, or from an explicit bond list; a tabulated block performs arithmetic over data entered by hand and formats an assertion.

Four blocks of this paper are tabulated: K2, which was replaced by prose in an earlier revision and computes nothing; K5, whose stage precedence is entered rather than derived; K8, whose per-unit demand is a hand-entered dictionary; and K9, which recites in one place figures computed elsewhere and performs no computation itself. Each is marked below.

An earlier form of this appendix said that one block was tabulated and named K5, indexing the other three as computed. That was wrong, and it was wrong in the apparatus built to catch exactly this (Scholium 5.22); Appendix D carries the entry. Of the four, only K5 carries a statement that cannot be checked without it, and its clauses are each a one-line valence or existence argument set out in the body at Theorem 5.10.

Remark B.2 (What is not emitted). [A] Two classes of figure are used and not emitted. The stacking separation and the sulfur–sulfur bond length are imported from the literature and are labelled [C] where used. And no energy, barrier or rate appears anywhere, the scope of Remark 2.6 excluding them.

B.2 Index of blocks

block	kind	supports	content
J1	computed	Prop 7.3, Prop 7.19	alternating hexamers are inversion-invariant up to a one-position shift
J2	computed	Thm 7.13	the two junction windows read direct and under inversion; the block behind the choice of reading
J3	computed	Prop 7.19	registry classes of the two junction windows
J4	computed	Prop 7.19	how many hexamers place both windows in one class
J5	computed	Prop 7.20	canonical pairing of the presented base against the tether
J6	computed	Prop 6.7	the cross-stack bridge, in both senses of the internal sulfur
J7	computed	Thm 7.13	the two codons at each value of the outer position
J8	computed	Thm 4.8	the centre of a run of vessels, by parity
J9	computed	Thm 7.9	the three frame operations at the discriminating case
J10	computed	Thm 7.22	the same three against the observed mapping
J11	computed	Cor 7.15	the two junction slots against the corpus's complementarity count
K1	computed	Prop 5.3	the two paths against the corpus's published rows
K2	<i>tabulated</i>	Rem 2.3	the label coincidence across units, and the error it caused
K3	computed	Lem 5.7	valence at each sulfur site before delivery
K4	computed	Prop 6.7	the bridge geometry, restated on the junction
K5	<i>tabulated</i>	Thm 5.10	the stages and their precedence
K6	computed	Thm 5.15	remnant components on each unit
K8	<i>tabulated</i>	Prop 6.2	medium-sourced atoms, per unit and per cell
K9	<i>tabulated</i>	Thm 5.15	the three asymmetries, collected; the figures are computed at K6
K10	computed	Thm 5.20	per-atom balance of the first unit, from bond lists
K11	computed	Thm 5.20	per-atom balance of the second unit, from bond lists
K12	computed	Thm 5.20, Cor 5.21	the cell, as a function of the remnant level, with parity reported

Remark B.3 (A block struck from the record). [A] The verification files carry a note in place of a former block K7, which computed the balance from oxidation states entered by hand and was wrong twice. It is struck rather than deleted so that a reader meeting the gap in the numbering finds the reason. Appendix D carries the entry and Scholium 5.22 states what it was.

C What this paper re-scopes in the companion

The single-unit account carries statements that are conditional on its own premise. This appendix lists them, says what each becomes at a junction, and bounds the reach of the list. It corrects no result of the corpus and no result of the companion: it states the scope of statements whose scope was not stated.

- (1) **The amended retained set.** The companion displaces the second residue onto the image of its published set, because on one unit the two sets would otherwise meet at the base point. At a junction the sets lie on different molecules and both rows are used as published (Proposition 5.3). The amendment is a property of a single-unit cell.
- (2) **The corrections that follow from it.** The companion's restatement of the corpus's classification, its recount of the forgetful map, and its amendment to the definition of a structure all follow from the displaced set and are conditional with it.

- (3) **The cut list of the first residue.** The companion severs an edge where the corpus removes a vertex entire, because the vertex is retained by the second residue. At a junction the second residue is on another molecule and the corpus's row stands.
- (4) **The pyramidalisation.** The companion admits a move that pyramidalises a ring carbon so that its bridge can close, the two sulfur sites lying in one aromatic plane with fixed exocyclic directions. Across two molecules the lateral register is free and no distortion is required (Remark 6.9). The move is an intramolecular obstruction.
- (5) **The two asymmetries.** The companion forces an asymmetric outcome onto a symmetric object and obtains two breaks whose relation it leaves open. A junction cell is asymmetric from the start (Theorem 5.15) and its balance adds no further break (Corollary 5.21). The open problem is a property of the single-unit premise.

Remark C.1 (Reach of this list, and what is *not* re-scoped). [A] Items (1)–(5) all descend from one premise and stand or fall with it. Three statements of the companion do *not*, and are unaffected by anything here: that the corpus's exogenous proposition requires an index by species, nitrogen being demanded by six structures; that the corpus's scarcity premise is comparative rather than general; and that the α -nitrogen is not a decoration and its source therefore bears on neither. Those three concern the whole structure series and are independent of how many units a cell has.

The companion's own results — its enumeration, its exclusion theorem, its balance — are likewise untouched. This appendix says where they apply, not that they fail.

D The record

D.1 Withdrawn

withdrawn	replaced by, and how it was found
A balance computed from oxidation states entered by hand	Derived from explicit bond lists (K10–K12). The tabulated version gave the C_β of the first residue two carbon neighbours where it has one, and returned an <i>odd</i> total, which closed-shell chemistry cannot give and which was visible on the face of the output. Found by rewriting the block to derive rather than assert.
A reading in which the two junction windows overlap and each supplies a codon	The two codons are the triplets the two strands contribute, read $5' \rightarrow 3'$ across the boundary. The overlapping windows cannot carry a start or a stop, the outer positions entering neither. Found by computing the two schemes side by side (J7) rather than by arguing from the excision sites.
An account in which the second-site rule is excepted at the junction	The junction cell has an even vessel count and no central vessel, so it falls outside the rule rather than breaking it (Theorem 4.8). Found by asking what the rule's hypothesis actually requires.
A claim that the outer positions are weak because they lie outside the reaction	They are wobble positions of their own codons (Proposition 7.11). Found on stating which codon each belongs to.
Termination stated in the reading section and proved against the selected assignment	Recast as a consequence of Hypothesis 5.12, a premise about the reaction, with the check confirming rather than establishing it. The earlier form read the chemistry off the code, which is the inversion this paper's method forbids. Found in review, by asking which section the claim belonged to.
Termination attributed to the gating of consistency	Recast in terms of release. The corpus assigns the gating of consistency to the second register, which is the same at every codon this paper treats, and its own account of the terminating pair is likewise an account of release (Remark 5.13). Found in review, by reading the corpus's clause rather than paraphrasing it.
An index marking one verification block tabulated	Four are. K2, K8 and K9 were indexed as computed and perform no computation. Found in review, by classifying the blocks from the scripts rather than from the index.
A concordance between the alternating hexamer and a promoter element of transcription	Withdrawn entire as a distraction: the process is different, the machinery has no counterpart here, and the standard account of that element's composition predicts it without any of this architecture.

Scholium D.1 (The kinds of error, and what catches each). The entries fall into three kinds and the distinction is worth preserving, because the remedy differs.

The first was caught by *deriving what had been asserted*. A tabulated block formats a claim and nothing in it can disagree; the parity of its own output contradicted it and was not seen. Remark B.1 now marks every block, so that a reader can tell which statements are self-checking.

The second and fourth were caught by *computing two candidates side by side* rather than developing the first that seemed to work. This is the same remedy the companion's record names, and it is why the enumerations of this paper are written as enumerations. The third and fifth were caught by *reading the source*: what the corpus's localisation rule actually requires, and what the standard account of a promoter element actually says. Neither is a computation and neither could have been caught by one.

D.2 Owed

- (a) Grounds for Hypothesis 4.2, on which everything rests.
- (b) Grounds for Hypothesis 6.3 and Hypothesis 6.11, which carry the pairing between them.
- (c) An account of the third stop codon of the standard mapping, which the junction does not produce.
- (d) Whether a frame once set is maintained, a discontinuity being available once and consumed in the reaction it carries.
- (e) Grounds for Hypothesis 5.12, which carries termination alone, and for Hypothesis 7.7, on which the frame relation and the slot identity both depend.

E The corpus

E.1 Status of this appendix

This appendix is a concordance. It establishes nothing, enters no proof, and no numbered statement of the body depends on it. It is included because a reader meeting this paper first has no way to see which of its premises are imported, from where, and how far back the import chain runs; and because the corpus has grown to a size at which a map of it is worth having.

Two cautions attach to it. The descriptions below are of what each paper *supplies to this one*, not summaries of those papers; where a paper carries more than this paper draws on, the entry says less than the paper does. And several entries carry a CONFIRM in the bibliography, marking pagination or a detail taken from a header rather than from the published record. Those are to be resolved before this paper goes to press.

E.2 The layers

The corpus develops in layers, each taking as given the one before it. The layers are not a chronology of publication and the papers within a layer are not ordered.

Foundations. The axioms of the formalism [Sch26d], and a survey placing the first volume as candidate mathematics and candidate biogenesis [Sch26c]. This paper adds no axiom and uses the first only to record that.

The stack and its registry. The encoded stack as a frame-indexed base-four structure, with its sequence algebra [Sch26i]; the twenty registry classes obtained as frame orbits, with the descent of a letter transformation [Sch26n]; and the coarsenings of the code by those classes, which supplies the partition criterion and the letter assignment [Sch26f]. This paper uses the vessel graph, its locant registry, and the registry classes that Section 7.5 counts hexamers against.

Capacity. *Why three and why twenty* [Sch26o]: the capacity of a cluster, the base-four intermediary, the production operator, and the localisation of a vessel-localised pathway. This paper uses the last, and uses it at the one place it does not apply — Theorem 4.8 turns on a cell whose vessel count is even, for which the localisation has no central vessel to offer. The title of the present paper is formed after this one.

Assignments. Seeded assignments on the registry, with transversality, third-position refinement and a normal form [Sch26l]; transverse seeding as a decision rule [Sch26m]; and class-functional assignments after transversality [Sch26e]. This paper draws on none of these directly. They bear on it through Article 57, which uses them to reach the assignment whose codons Section 7 reads, and Theorem 7.22 records the dependence.

The carrier. The chain polarity of the adenine tether [Sch26b], and cage-constrained chemical reachability in π -stacked chrysene–adenosine systems, with stereochemical selection and local transformation invariance [Sch26a]. This paper uses the tether and the stacking; its stacking separation and the freedom of the lateral register are the cage literature’s to confirm or refute (Proposition 6.7).

The refinement. The conditional refinement in two parts: the two resolutions of the standard and mitochondrial mappings and the insufficiency of block data [Sch26g]; and the chrysene–adenosine reaction cell, margin geometry and sufficiency [Sch26h]. The second supplies the term *reaction cell* which Section 2 adopts and which the corpus declines to use of a cluster.

The origins transition. [Sch26j]: the passage from the encoded cluster to the code mappings, the consistency relation, the structure series, and the two statements this paper leans on hardest — that exactly two structures require an element the carrier cannot supply, and that their placement is settled only under a hypothesis about the medium which that paper states and declines to establish. The structure series supplies both rows this paper uses unamended (Appendix A).

The sulfur pair. [Sch26k] treats the two sulfur residues on a single unit; the present paper treats them at a junction of two. Section 8 places the two beside one another and Appendix C bounds what this paper re-scopes in that one.

E.3 What this paper takes, by source

source	used at	what is taken
[Sch26d]	Section 2	that no axiom is added
[Sch26n]	Sections 4, 7	the vessel graph and its locant registry; the registry classes
[Sch26o]	Theorem 4.8	that a unit is a vessel, a codon three vessels, and that a vessel-localised pathway requires an odd count
[Sch26b]	Definition 4.1	the tether and its chain
[Sch26a]	Hypothesis 4.2, Proposition 6.7	π -stacking of chrysene–adenosine units; the stacking separation
[Sch26h]	Remark 2.4	the term <i>reaction cell</i>
[Sch26j]	Appendix A, Proposition 5.3	the structure series and both rows this paper uses; that sulfur has no source in the carrier; the selected assignment
[Sch26k]	Section 8	the disulfide, the bridged intermediate, the staging, and the balance method
[Sch25b]	Definition 4.1	the tether and the exhibited integrated product
[Sch25a]	Appendix A	the substituted family as encoding material
[Nat24]	Remark 7.18	the published translation tables against which the termination claim is scoped

E.4 What this paper does not use

Remark E.1 (Deliberate omissions). [A] Four bodies of work in the corpus are not drawn on here and their absence is deliberate rather than an oversight.

The seeding and refinement apparatus [Sch26l, Sch26m, Sch26e] is not used: this paper takes an assignment as given and reads two of its codons, and does not re-derive the assignment or enter the question of which seed produces it.

The parity obstruction and the class-functionality results are not used: nothing here turns on whether a mapping is constant on registry classes.

The margin geometry of [Sch26h] is not used beyond the term it supplies; the stacking datum this paper needs is a separation, not a margin.

And the earlier books and preprint [Sch20b, Sch20d, Sch20a, Sch20c] are cited in Appendix A as prior art for the substituted

family and for the residue-from-aromatic hypothesis, and for nothing else. No inference is drawn here from the duration or the number of earlier attempts, such attempts being evidence about a search and not about its outcome.

E.5 Where this paper sits

Scholium E.2 (The chain of premises, traced back). It is worth stating in one place how far back this paper's results rest.

The vessel graph, the locant registry and the registry classes are combinatorial and rest on the foundations alone. The vessel count and the localisation rule rest on the capacity paper. The structure series, and with it both rows this paper uses, rests on Article 57 — and Article 57 records that its series is the source of its own hypotheses and not their confirmation, so the dependency there is one this paper inherits and does not improve.

The three premises this paper adds are of a different kind. That a junction forms is a claim about assembly, which no paper of the corpus addresses. That sulfur arrives as a disulfide and does not migrate are claims about the medium, of the same kind as the hypothesis Article 57 states and declines to establish — and this paper does not establish them either. What it offers in exchange is that they are claims about a species and a site rather than about the preference of an event, and that the consequences drawn from them are finite.

A reader tracing any result of Sections 4 to 7 backwards will reach one of these three, or the structure series, or the graph. Nothing rests on anything else.

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