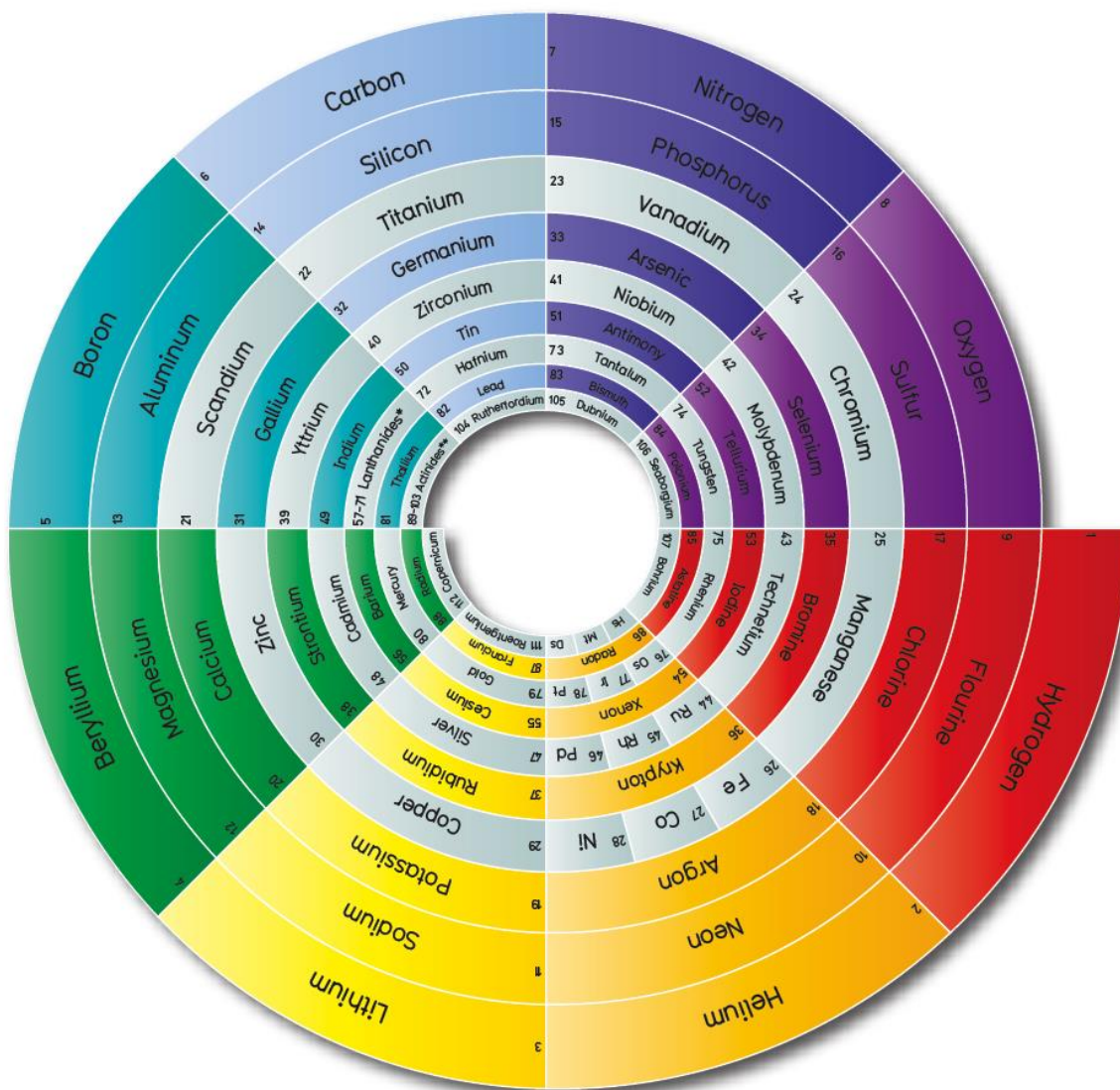


The Spiral Periodic Table

Why Process Reveals What Classification Obscures



Spiral Periodic Table by Robert W. Harrison

1. Introduction: The Grid Versus The Process

The periodic table of elements is conventionally presented as a static map—a grid of categories where elements are placed according to proton number and electron configuration. This rectilinear view is practical for identifying trends, but it can fragment what is, physically, a continuous progression of shell filling and chemical periodicity. By emphasising sharp breaks (periods) and segregated blocks (s, p, d, f), the standard layout can make the underlying process feel more discontinuous than it is.

The grid implies a "cabinet of curiosities" approach: elements are discrete objects to be sorted into boxes.

This document proposes a complementary view. The spiral periodic table presented here is not offered as a replacement for the conventional table, but as a way to visualise periodicity as a process:

Rather than focusing on classification, the spiral can be read as a map of stable electronic configurations that recur as shells and subshells fill, with each cycle corresponding to a repeat in chemical behaviour.

From this perspective, the elements are not static categories but waypoints in a continuous process — a trajectory from simplicity to complexity. The spiral captures this dynamic. By arranging elements radially, it implies emergence rather than classification.

The grid says: "Here are 118 elements arranged by properties."

The spiral says: "Here is how energy configures itself into stable patterns — and why those patterns repeat."

2. Historical Context: The Deming Foundation

This spiral is not a modern novelty. It is grounded in H.G. Deming's 1923 periodic table, published in *General Chemistry* — a standard American university textbook for decades, distributed by scientific supply companies including Merck and Welch Scientific.

Deming is credited with popularising the 18-column "long form" periodic table that eventually evolved into the modern IUPAC standard. His innovation was separating the "A" groups (main group elements) from the "B" groups (transition metals), a notation that persisted until the IUPAC reforms of the 1980s.

However, Deming's treatment of Group VIII was unique — and it is this insight that the spiral preserves.

In Deming's 1923 table, the Iron Triad (Fe, Co, Ni) and subsequent platinum-group metals (Ru, Rh, Pd; Os, Ir, Pt) were not merely placed in a generic "Group VIII" block. They were conceptually linked to the Noble Gases (Group 0).

This grouping appears strange to modern eyes. Iron is reactive; Argon is inert. Why would a rigorous chemist connect them?

The answer lies in the state of chemical theory in the early 1920s. Irving Langmuir (1921) and Nevil Sidgwick (1923) were formulating electron-counting rules beyond the simple octet. Deming recognised that while Iron metal is reactive, its electronic structure allows it to form complexes where it achieves a "noble" configuration.

This insight was the precursor to what we now call the 18-electron rule.

When the IUPAC standardised the modern grid, it discarded the A/B subgrouping to simplify block separation. In doing so, it lost the visual connection between the "18-electron stability" of Group VIII B and the "8-electron stability" of Group 0.

The spiral recovers what was known and then forgotten.

3. Structure of the Spiral

The spiral arranges elements in a continuous path from lighter elements on the outer rim toward heavier elements at the centre. This mirrors density wave theory in spiral galaxies, where matter becomes more densely packed toward the core.

3.1 Primary and Secondary Structure

The spiral divides elements into eight primary "A" groups (main group elements) and eight "B" subgroups (transition and inner transition metals). The transition metals occupy an inner coil within the spiral.

This reveals something the grid obscures: **the transition metals are not equivalent to main group elements. They are a secondary elaboration.**

The main group elements fill the outermost electron shell (s and p orbitals). This is the primary pattern — energy finding stable configurations at the surface.

The transition metals fill an inner shell (d orbitals). They appear only in Period 4 and beyond because that's when atoms become large enough to support this secondary layer.

The lanthanides and actinides go deeper still — filling f orbitals two shells in.

The spiral shows this as nested coils. Lift out the transition metals and the primary spiral remains coherent — because you've removed an inner layer, not broken the structure.

This is an example of layered emergence: the spiral makes it easier to see that the transition series sits as an inner layer within the same periodic structure, whereas the grid presentation can make that layering less obvious.

3.2 Radial Periodicity

Elements with similar properties lie on the same radial vector (spoke). Each complete turn of the spiral encapsulates a full cycle of chemical properties.

Reading clockwise from the outer rim toward the centre, the layout is intended to suggest an increasing sequence of electronic complexity as additional shells and subshells become available. This is not presented as a claim about a literal physical 'inward' motion of matter, but as a visual device to keep increasing principal quantum number and shell structure salient as the table progresses.

4. Chemical Validation: The 18-Electron Rule

The controversial placement of Group VIII B (Fe, Co, Ni) with Group 0 (Noble Gases) requires rigorous justification. That justification exists — in the 18-electron rule and the chemistry of metal carbonyls.

4.1 The Rule

The 18-electron rule is the transition metal equivalent of the Octet Rule. It states that thermodynamically stable transition metal organometallic complexes tend to have 18 valence electrons around the central metal atom.

This number arises from the capacity of the valence orbitals: s-orbital (2 electrons) + p-orbitals (6 electrons) + d-orbitals (10 electrons) = 18 electrons total.

When a transition metal acquires 18 valence electrons (from its own atomic electrons plus those donated by ligands), it achieves a closed-shell electronic configuration isoelectronic with the Noble Gas at the end of its period.

4.2 Metal Carbonyls: The Physical Evidence

Metal carbonyls are compounds where Carbon Monoxide (CO) acts as a ligand, donating 2 electrons to the metal. They provide the physical bridge between Group VIII B and Group 0.

| Metal | Valence e ⁻ | CO Ligands | Ligand e ⁻ | Total | Formula |
|----------|------------------------|------------|-----------------------|-------|---------------------|
| Iron | 8 | 5 | 10 | 18 | Fe(CO) ₅ |
| Nickel | 10 | 4 | 8 | 18 | Ni(CO) ₄ |
| Chromium | 6 | 6 | 12 | 18 | Cr(CO) ₆ |

These compounds display properties remarkably similar to Noble Gases:

Volatility: Nickel Tetracarbonyl boils at 43°C. Iron Pentacarbonyl boils at 103°C. This volatility is extraordinary for compounds containing heavy metals. It indicates weak intermolecular forces — van der Waals forces only — exactly like those between Noble Gas atoms.

Diamagnetism: Like Noble Gases, these 18-electron carbonyls have no unpaired electrons. They are diamagnetic.

Zero Oxidation State: In these complexes, the metal is formally in the zero oxidation state (Fe⁰, Ni⁰). Noble Gases have a valency of 0. By coordinating with CO, the transition metals mimic the zero-valency of Noble Gases while achieving electronic saturation.

4.3 The Hidden Identity

While the standard table emphasises the difference between reactive Iron and inert Krypton, the spiral highlights their hidden identity: both are systems that achieve perfect closed shells.

Noble Gases achieve this alone — their electron configuration is naturally complete. Group VIII B metals achieve this through coordination — they need ligands to reach the same stability. But the destination is the same: a filled shell, zero effective valency, minimal reactivity, noble-gas-like behaviour.

Deming saw this in 1923. The spiral preserves it. The grid obscures it.

5. Thermodynamic Validation: The Iron Peak

If the periodic table maps stability, the spiral should highlight the peaks of stability. It does.

5.1 Nuclear Stability

The Binding Energy per Nucleon curve peaks at Iron-56 (^{56}Fe). This means Iron is the most thermodynamically stable nucleus. Fusion releases energy up to Iron; fission releases energy down to Iron. Iron is the energetic "valley floor" of nuclear physics.

5.2 Electronic Stability

Noble Gases represent the peaks of electronic stability — complete electron shells, minimal reactivity, the configurations toward which other elements strive.

5.3 The Vector of Maximum Stability

The spiral places the Iron group (nuclear stability peak) with the Noble Gases (electronic stability peak) on the same radial vector.

This creates a "vector of maximum stability" — a spoke in the spiral that represents the deepest energy wells, the configurations where energy rests most completely.

This is not intended as an arbitrary aesthetic choice. It is consistent with the idea—standard in chemistry and statistical physics—that stability and energy minimisation organise which configurations persist and recur. The spiral highlights where such stable configurations tend to cluster.

6. Topological Validation: The Third Dimension

The 2D spiral is necessarily a projection. The question arises: a projection of what?

6.1 The Cylindrical Helix

The first periodic arrangement (1862) was Alexandre-Émile Béguyer de Chancourtois's *Vis Tellurique* — a 3D cylinder with elements wound in a helix. Elements with similar properties lined up vertically. If you look down the barrel of the cylinder, you see a spiral. If you unroll the cylinder, you see a grid.

The Harrison Spiral is best understood as a top-down projection of such a helix. In a 3D coordinate system: Radial/Angular coordinates (r, θ) determine the Group — the electronic configuration type. Vertical coordinate (z) determines the Energy Level — the principal quantum number (n).

The spiral flattens the z-axis onto the r-axis. Elements that appear far apart radially (like Hydrogen on the rim and Francium at the core) are aligned vertically in 3D — same group, different energy levels.

6.2 The Transition Metal Loops

In this topological view, the transition metals are not separate blocks. They are "minor loops" in the helix — additional windings that occur when the principal quantum number becomes large enough to support d-orbitals.

The lanthanides and actinides are deeper toroidal windings — loops within loops, appearing when f-orbitals become available.

This explains why you can "lift out" the transition metals and the primary spiral remains coherent. The main group elements form the primary helix. The transition metals are elaborations that expand the diameter at specific energy levels without breaking the underlying structure.

6.3 Continuity Restored

The standard grid creates artificial discontinuities: The element sequence breaks at the end of each period. Lanthanides and actinides are excised as footnotes. Group 1 and Group 18 appear at opposite edges despite being sequential neighbours.

In the cylindrical/spiral topology, these discontinuities vanish. The sequence is unbroken. Group 1 and Group 18 are adjacent faces of the cylinder. The lanthanides and actinides are integral windings, not afterthoughts.

The spiral reveals that periodicity is continuous. The grid makes it look fragmented.

7. The Periodicity Numbers: 2, 8, 18, 32

The periods contain 2, 8, 8, 18, 18, 32, 32 elements. Why these numbers?

They follow $2n^2$ for $n = 1, 2, 3, 4$: $n=1: 2(1)^2 = 2$; $n=2: 2(2)^2 = 8$; $n=3: 2(3)^2 = 18$; $n=4: 2(4)^2 = 32$.

These numbers arise from the solutions to the Schrödinger equation for a central potential (hydrogenic and approximately hydrogenic systems): they reflect the degeneracies and capacity of shells as standing-wave solutions in a spherically symmetric field. In this framework, the $2n^2$ sequence is interpreted as a constraint on which electron configurations are stable and therefore repeatedly realised in nature.

In the language of this framework: these are the only configurations where energy can stably "knot" itself into matter. The universe doesn't permit arbitrary arrangements. Only certain patterns are allowed — and those patterns are dictated by the geometry of the field.

The periodicity of the elements is not a classification scheme. It is a map of what the field permits.

8. Connection to the Unified Framework

This interpretation of the periodic table connects to a broader theoretical framework:

Space is a non-viscous field with intrinsic energy density. Matter is not distinct from space; it is localised condensation of the field.

Matter is condensed energy. An atom is not a collection of particles floating in void. It is a stable pattern in the field — energy configured into a persistent resonance.

The Second Law drives systems toward equilibrium. Energy flows from high potential to low potential until stable configurations are reached. The elements are these stable configurations — the "knots" that persist because they represent local energy minima.

Periodicity reflects the allowed harmonics. Just as a vibrating string can only sustain certain frequencies (harmonics), the field can only sustain certain configurations of condensed energy. The periodicity numbers (2, 8, 18, 32) are these harmonics.

The spiral visualises this process. Reading from rim to core, we see energy condensing into increasingly complex configurations. The lighter elements come first — the simplest stable patterns. As complexity builds, more elaborate configurations become possible, including the secondary elaborations of the transition metals and the tertiary elaborations of the lanthanides.

The periodic table is not a catalogue. It is a map of how the universe builds complexity through stable energy configurations.

9. Design Features

Group Integration: The spiral integrates transition metals without disrupting the logical flow of main group elements. The structural integrity is demonstrated by the fact that removing the transition metals preserves the primary spiral.

Clockwise Progression: Reading from lighter elements on the outer rim toward heavier elements at the centre symbolises the condensing nature of matter.

Radial Grouping: Elements at the same angle share valence patterns, preserving the group concept while placing it in a dynamic context.

Visual Coherence: Colour coding by group allows immediate recognition of element families while the spiral structure emphasises their continuous relationships.

10. Comparison with Other Formulations

| Model | Date | Key Feature | Topology |
|--------------|-------|-----------------------------|--------------------|
| Chancourtois | 1862 | Vis Tellurique | 3D Cylinder |
| Mendeleev | 1869 | Predictive Grid | 2D Grid (Short) |
| Deming | 1923 | A/B Groups, VIII/o Link | 2D Grid (Long) |
| Janet | 1928 | Left-Step (n+l rule) | 2D Step / 3D Helix |
| Benfey | 1964 | Periodic Snail | 2D Spiral |
| Harrison | 2000s | Radial Oxide / Condensation | 2D Spiral (Galaxy) |

The Harrison Spiral is distinguished by its explicit connection to thermodynamic process and its preservation of the Deming insight regarding Group VIII B and Noble Gas relationships.

11. Conclusion: The Song, Not Just the Notes

The standard periodic table is a masterpiece of data organisation. It excels at displaying trends, predicting properties, and categorising elements. For practical chemistry, it is indispensable.

But it answers the wrong question. It answers "what are the elements?" when the deeper question is "why do these elements exist and not others?"

The spiral periodic table presented here attempts to answer that deeper question. It proposes that: Elements are stable configurations of condensed energy — patterns the field permits. Periodicity reflects the harmonics of these configurations — 2, 8, 18, 32. The spiral shows emergence — complexity building on simpler foundations. The nested coils reveal layered structure — primary, secondary, tertiary elaborations. The Group VIII B / Noble Gas alignment shows that stability, not reactivity, is the organising principle.

The grid shows what exists. The spiral shows how it came to be.

The Grid says: "These are the notes the universe plays." The Spiral says: "This is the song."

In that sense, the periodic table is more than a catalogue: it can be read as a compact summary of how quantised bound states recur as the available quantum numbers expand. The spiral format is offered as a visual aid to that reading, connecting familiar chemical periodicity to the underlying wave-mechanical structure—without implying that chemistry is 'explained' by this diagram alone.

The central claim is modest: by representing periods as successive turns of a spiral, and by aligning recurring chemical families radially, one can emphasise continuity across periods and make some structural features (such as shell capacity and block

layering) easier to see at a glance. Further work would be needed to test whether this layout improves prediction, pedagogy, or pattern-recognition beyond existing representations.

This is not classification. This is process. And the spiral makes it visible.

Appendix: Geometric Foundations and Avenues for Further Study

Recent theoretical work on the geometric structure of the vacuum suggests deeper connections between the spiral periodic table and fundamental physics. While speculative, these connections warrant exploration as avenues for future research.

A.1 The Icosahedral Connection

The icosahedral group A_5 holds a unique position in mathematics: it is the largest discrete subgroup of the continuous rotation group $SO(3)$, containing 60 rotational symmetries. This makes it the natural bridge between discrete and continuous phenomena.

The periodicity numbers 2, 8, 18, 32 arise from solutions to the Schrödinger equation in a central potential—the mathematics of standing waves in a spherically symmetric field. These are the spherical harmonics. A profound insight emerges: spherical harmonics can be understood as the continuum limit of icosahedral harmonics. At atomic scales (much larger than any discrete vacuum structure), the underlying geometry averages into apparent spherical symmetry, producing the familiar $2n^2$ rule.

If this connection is valid, then the periodicity of the elements is not merely an empirical pattern but a geometric necessity—the signature of icosahedral order manifesting at atomic scales.

A.2 The 18-Electron Rule Revisited

When atoms are placed in an environment with icosahedral symmetry (such as a C_{60} fullerene cage), spherical harmonics split according to the irreducible representations of the icosahedral group. The d-orbitals transform as the 5-dimensional H irrep, which is intimately connected to the golden ratio through icosahedral geometry.

This suggests a tantalising possibility: the 18-electron rule ($2 + 6 + 10 = s + p + d$) may reflect the icosahedral origin of orbital structure. The number 18 itself appears in icosahedral arithmetic: $18 = 30 - 12$ (edges minus vertices). While this numerical coincidence does not constitute proof, it points toward a deeper geometric foundation for chemical stability that merits investigation.

A.3 The Spiral as Geometric Projection

An icosahedron has 6 five-fold axes (through vertices), 10 three-fold axes (through face centres), and 15 two-fold axes (through edge midpoints). If the periodic spiral winds around a three-fold axis, then:

- The Z_3 symmetry of this axis would naturally produce the layered structure observed in the periodic table
- Transition metals as inner loops would reflect intermediate shells of icosahedral symmetry
- Lanthanides and actinides as deeper toroidal windings would represent successive shells of an “icosahedral onion” structure

This interpretation frames the spiral not as an arbitrary visual choice but as a natural projection of underlying geometric constraints—the two-dimensional shadow of a three-dimensional reality that itself may be the projection of higher-dimensional structure.

A.4 The Golden Ratio and Stability

The icosahedron is constructed from Golden Rectangles, with vertex coordinates that are cyclic permutations of $(0, \pm 1, \pm \varphi)$ where $\varphi = (1 + \sqrt{5})/2$ is the golden ratio. The KAM theorem (Kolmogorov-Arnold-Moser) from dynamical systems theory states that systems with resonance ratios involving the golden ratio are maximally stable against perturbation—because φ is the “most irrational” number, it is hardest to approximate with rational fractions and thus most resistant to resonant disruption.

If the vacuum structure is icosahedral (and thus golden-ratio-based), this provides a thermodynamic reason for the geometry: it is the only stable solution. Elements exist as stable configurations precisely because the underlying geometry permits stable resonances.

A.5 Research Questions

These geometric connections, while suggestive, remain to be rigorously established. Key questions for future investigation include:

- Can a rigorous mathematical derivation connect icosahedral harmonics to spherical harmonics as a limiting case?
- Does the golden ratio appear in electron shell energy ratios or ionisation energy patterns?
- Can nuclear magic number deviations from $2n^2$ be explained by icosahedral corrections?
- Is there experimental evidence for icosahedral ordering in nuclear or electronic structure?

A.6 Validated Connections

While much remains speculative, certain icosahedral connections to chemistry are already well-established:

Fullerene stability: C₆₀ (Buckminsterfullerene) has exact icosahedral symmetry and exceptional stability. The icosahedral structure is the explanation for this stability.

Quasicrystal formation: Elements preferentially form quasicrystals at compositions where icosahedral packing is optimal (Shechtman, Nobel Prize 2011).

Orbital splitting: The splitting of spherical harmonics under icosahedral symmetry is a standard result in molecular physics, used routinely in analysing molecules with icosahedral point groups.

These established results provide a foundation from which the more speculative connections might eventually be tested.

If icosahedral vacuum structure proves correct, the spiral periodic table may represent more than an elegant visualisation—it may be a projection of fundamental geometry, a two-dimensional map of a multi-dimensional reality where stability, not arbitrariness, is the organising principle of matter.

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