ESSAY ON DESIGN AND INTELLIGENCE

Space *Unknown*

Designing Beyond the Human Mind

How artificial intelligence expands the frontier of human design and what it means for the progress of humanity.

BY **Bala Jeldi**

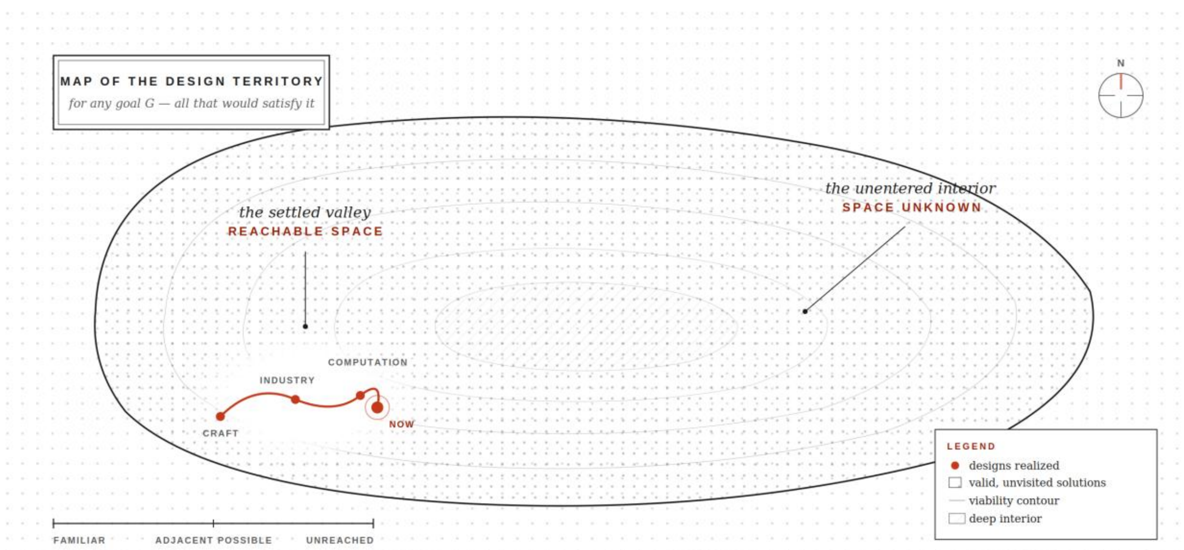

FIG. 00 *A map of the design territory. Every brief opens a country; we have settled one valley of it.*

EDITION June 2026 **SECTIONS** Eight **SUBJECT** Design, AI, Possibility

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IN BRIEF

Human design is bounded by cognition, not by possibility. For the first time, computational instruments can search beyond that boundary into the region this essay names the Space Unknown. What follows defines the territory, describes the instrument, surveys the domains it is opening, and argues that the designer's work shifts from generating answers to framing problems and judging them.

I Introduction

Every act of design begins with an intention, a goal, a problem, a brief, and ends with a chosen solution. Between intention and solution lies a vast territory of possibilities: every concept, configuration, and combination that could solve the problem. We rarely think about the size of this territory because we never see it. We see only the small clearing inside it that our minds were able to walk through before deciding.

I call the rest of that territory the part no human designer has ever reached — the Space Unknown.

This essay argues three things:

01. Human design is bounded not by the universe of possible solutions, but by the much smaller universe of solutions a human mind can reach.

02. Artificial intelligence, computational modeling, and large-scale compute are the first tools in history capable of systematically exploring beyond that boundary.

03. The opening of the Space Unknown is not merely a productivity gain. It is a civilizational shift comparable to the invention of the microscope or the telescope. A new instrument that lets us see what was always there but never visible.

II The Cognitive Boundaries of Human Design

Designers are taught to believe that creativity is unlimited. In practice, every working designer knows it is not. The bounds are real, and they are physical.

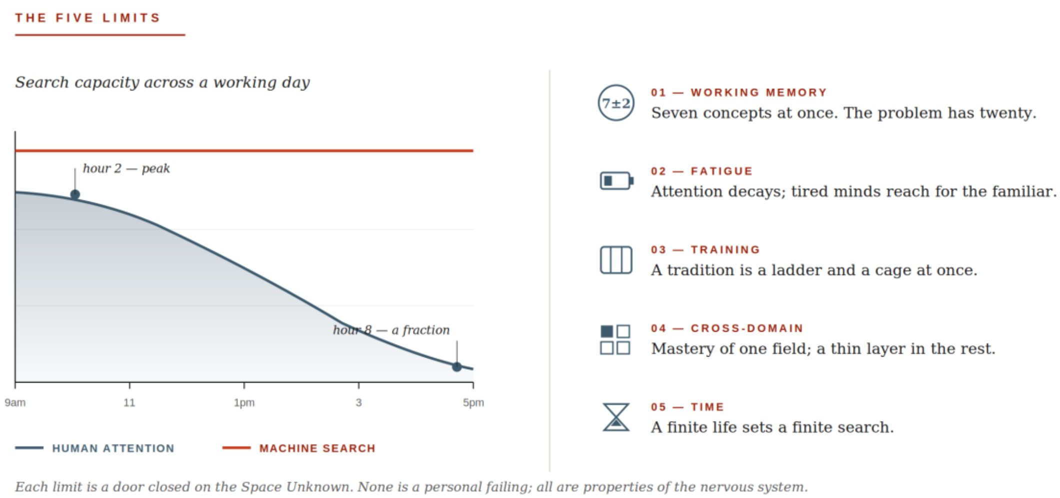

FIG. 01 *Five limits, one cage. Machine search does not tire; human attention must.*

Working memory is small. Most humans can hold roughly four to seven distinct concepts in active consideration. A design problem with twenty interacting variables which are material, cost, manufacturability, thermal behavior, supply chain, regulatory regime, aesthetics, ergonomics, lifecycle impact, and so on that exceed this capacity by an order of magnitude. To cope, designers prune. They fix some variables, ignore others, and explore the rest. Pruning is necessary, but every prune is a door closed on the Space Unknown.

Fatigue compresses search. A designer at hour two of a session generates more candidates than the same designer at hour eight. Energy, attention, and mood shape what gets considered. Decisions made under fatigue tend toward the familiar. Familiarity is the path of least cognitive resistance, and it is also the path that leads us back to what already exists.

Training is a cage as much as a ladder. A designer educated in a tradition, Bauhaus, Scandinavian minimalism, parametric architecture, Detroit automotive, internalizes its forms so deeply that those forms feel like *the* shape of the answer rather than *a* shape. Domain mastery accelerates work inside the known region. It rarely produces movement beyond it.

Cross-domain integration is shallow. A great mechanical engineer is not also a great economist, materials chemist, behavioral psychologist, and supply-chain analyst. Yet excellent design often lives at the intersection of all of them. Every designer is forced to operate as a generalist with a thin layer in every adjacent field, and this thinness limits the integrative leaps possible from a single mind.

Caliber expands but does not escape. A more skilled designer covers more of the territory, but the territory she covers is still bounded by human cognition. Even legendary designers such as Dieter Rams, Charles Eames, Zaha Hadid, explored a tiny fraction of what was possible in their problem domains. Their genius was not in seeing everything; it was in choosing well from what they could see.

These limits are not personal failings. They are properties of the human nervous system. Every human designer who has ever lived, no matter how brilliant, has worked inside the same cage.

III Defining Space Unknown

Let us be precise.

For any design goal *G*, define the Solution Space as the set of all configurations of matter, information, or process that satisfy *G* to some acceptable degree. This is an enormous, often astronomically large set.

Inside the Solution Space sits a much smaller region: the Reachable Space which is the subset of solutions that human designers, given finite time, attention, knowledge, and tools, can actually conceive and evaluate.

> DEFINITION
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> **Space Unknown** *(n.)* The set of solutions to a design problem that are entirely valid — physically lawful, manufacturable, often elegant — but that no human mind has ever reached. Formally: Solution Space minus Reachable Space.

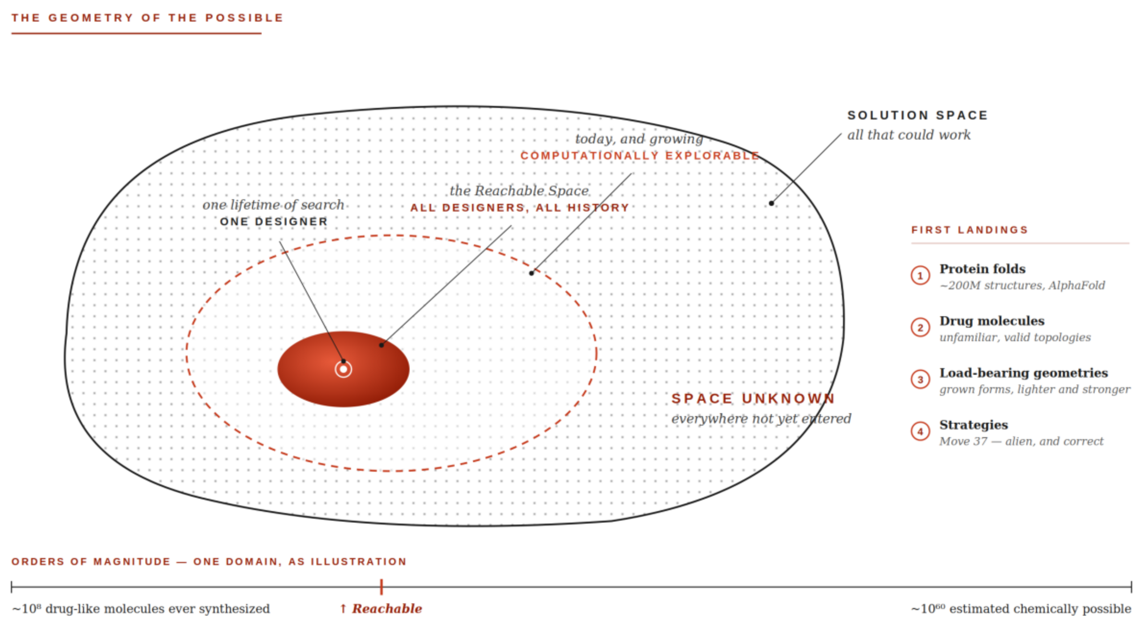

FIG. 02 *Nested reach: one designer, all designers in history, and the computationally explorable — inside the space of all that could work.*

The Space Unknown is not mystical. It is not a place where the laws of physics differ. It contains entirely lawful, manufacturable, sometimes elegant solutions. It is unknown only in the sense that no human mind has stood in it. A protein fold that no one has imagined. A circuit topology that no engineer has drawn. A drug molecule that no chemist has synthesized. A building geometry that no architect has sketched. A market structure that no economist has modeled. They all exist, in principle, the way America existed in 1490 which is fully real, fully unvisited.

> *The Space Unknown is not small. It dwarfs the Reachable Space in nearly every domain where it has been measured.*

IV The Computational Unlocking

Three capabilities, brought together for the first time in this decade, allow systematic exploration of the Space Unknown.

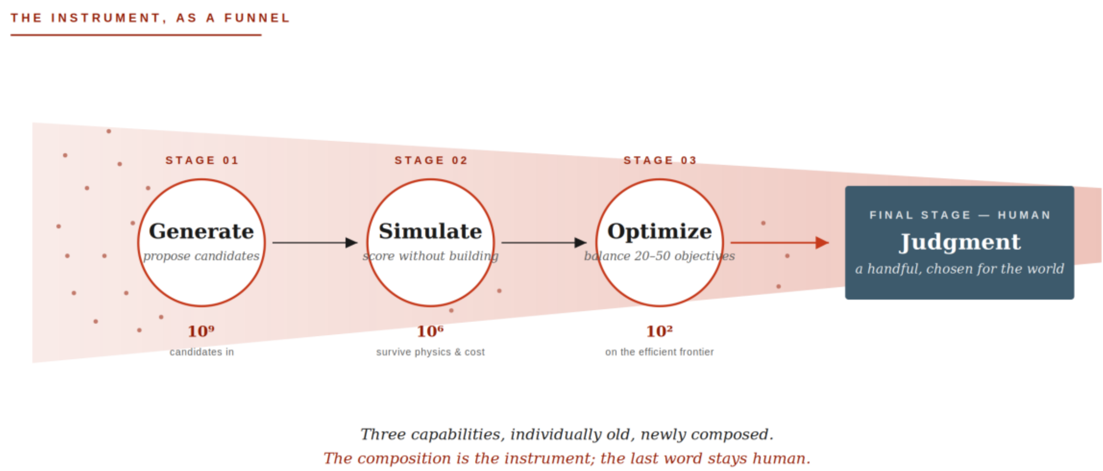

FIG. 03 *The funnel: a billion candidates in, a handful out — judgment last, and human.*

Generative models can propose candidate solutions in volumes no human team could match — millions of molecules, billions of geometries, trillions of code variants and they can do so non-trivially, producing candidates that are coherent rather than random.

Simulation and surrogate modeling can evaluate those candidates against physics, chemistry, biology, and economics without building each one. This collapses the cost of exploration. Where a human team might prototype five ideas, a computational pipeline can virtually prototype five million.

Optimization across many objectives at once lets the system honor twenty or fifty competing constraints simultaneously, rather than the four or five a human can balance. This is the capability that most directly attacks the working-memory bottleneck.

Together, these three capabilities form an instrument. Like a telescope, the instrument does not invent what it shows us. It lets us see what was already there.

We have early, persuasive evidence that this works. AlphaFold predicted the three-dimensional structures of nearly all known proteins, a task that had absorbed structural biology for half a century. Generative design tools have produced structural components — antennas for spacecraft, partitions for aircraft, brackets for engines — whose forms look biological, almost grown, and which outperform their human-designed predecessors on weight, strength, or both.

In game play, AlphaGo's "Move 37" against Lee Sedol was famously described by professionals as alien — a move no human master would have made, and yet correct. In drug discovery, generative chemistry has surfaced candidate molecules that medicinal chemists describe as unfamiliar in their topology and yet pharmacologically valid. In materials science, computational search has identified battery electrolytes and catalysts that escaped decades of human-led search.

In every one of these cases, the pattern is identical: a region of the Space Unknown was entered, and it contained something useful.

V Domains of Transformation

The implications fan out across nearly every field where humans design.

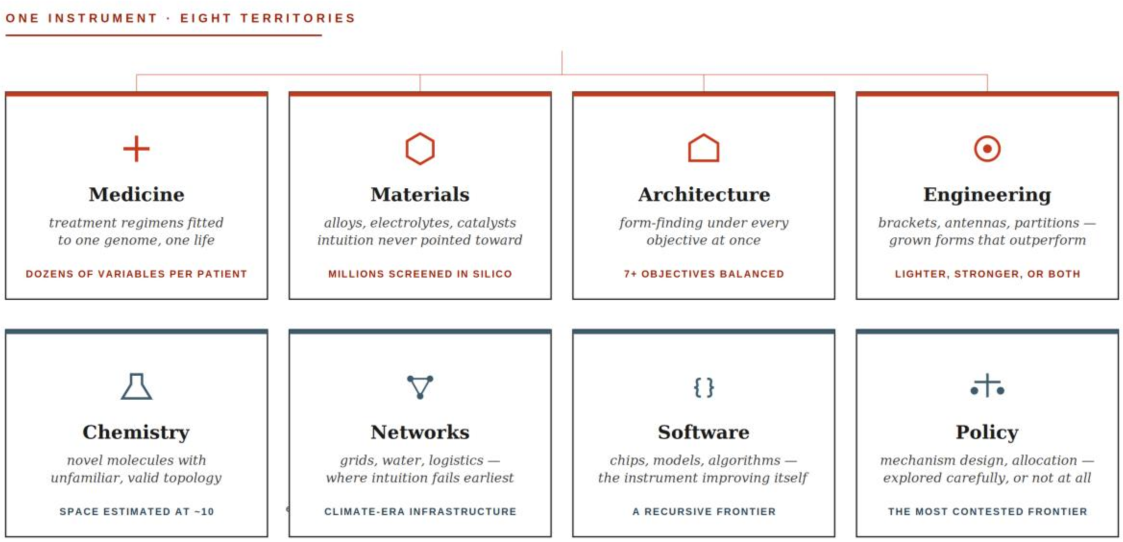

FIG. 04 *One instrument, eight territories. Each card is a frontier already being entered.*

Medicine. Personalized treatment regimens involve dozens of patient-specific variables — genome, microbiome, history, comorbidities, lifestyle, drug interactions. No physician can hold them all. Computational design can. The result is not a replacement of the doctor but a far larger menu of treatment configurations to choose from, including configurations no human protocol would have proposed.

Materials. The known periodic table allows for combinations vastly exceeding what has been synthesized. Compute-driven materials discovery has already produced superconductors, photovoltaics, and structural alloys that human intuition did not point toward. The Space Unknown of matter itself is being charted.

Architecture and the built environment. Buildings have to satisfy structural, thermal, acoustic, social, regulatory, aesthetic, and economic objectives simultaneously. A computational designer can explore form-finding under all of them at once, producing buildings that use less material, perform better, and look unlike anything in the architectural canon.

Engineering systems. Power grids, transportation networks, water systems, and supply chains are exactly the kind of high-dimensional optimization problems where human intuition fails earliest. Computational design here is not a luxury but, increasingly, a necessity for climate-era infrastructure.

Software and computation itself. AI systems are now being used to design better AI systems, better chips, better algorithms — a recursive movement into the Space Unknown of computation.

Policy and economics. This is the most contested frontier, and the most important. Mechanism design, taxation, urban planning, and resource allocation are design problems with enormous Solution Spaces and tiny Reachable Spaces. Whether we choose to explore the Space Unknown here, and how carefully, is one of the defining questions of the next century.

VI The New Role of the Human Designer

A common fear is that opening the Space Unknown ends the human designer. The opposite is closer to the truth — but the role transforms.

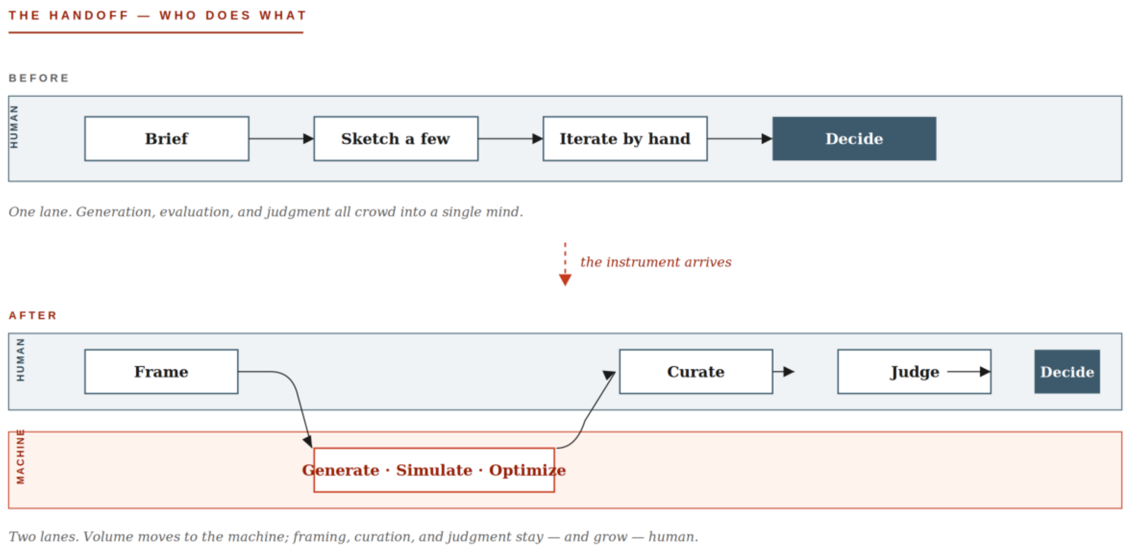

FIG. 05 *The handoff: volume moves to the machine; framing, curation, and judgment stay human.*

The human designer's center of gravity moves from generation to judgment. When candidates are infinite, taste matters more than productivity. When the machine can propose ten thousand viable answers, the question becomes: *which of these is the right one for these humans, in this place, at this moment?* That question is irreducibly human. It draws on values, ethics, culture, aesthetics, and lived experience. No optimizer can answer it on its own, because it requires knowing what we are optimizing for — and that is a question about us, not about the design.

The designer also becomes a framer of problems. The Space Unknown is only useful if we point the instrument at the right problem. Computational systems are extraordinary at solving problems and almost incompetent at choosing which problem to solve. Defining the goal, the constraints, and the success criteria — the design brief itself — becomes the highest-leverage human activity in the workflow.

And the designer becomes a translator between machine and world. The optimizer does not know that a building has to feel welcoming, that a medical device has to fit a frightened patient's hand, that a chair has to survive a toddler. Embedding these tacit constraints into the formal model — and noticing when the model has missed something important — is human work, and likely will remain human work for a long time.

The designer of the next generation will be measured less by what she draws and more by what she *chooses* — and by the quality of the questions she puts to the instrument.

VII Risks and Considerations

Honesty requires acknowledging that exploring the Space Unknown is not unambiguously good.

A solution can be optimal on its stated objectives and harmful on objectives we forgot to state. A drug can be effective and addictive. A logistics network can be efficient and brittle. An algorithm can be accurate and unjust. The history of optimization is also a history of unintended consequences, and the Space Unknown contains many such traps.

There is a **verification problem**: when a candidate looks alien, how do we trust it? Human intuition served, among other things, as a sanity check. A bridge that looks wrong probably is. When the optimizer hands us a bridge that looks unlike any bridge ever built, we lose that check and must replace it with rigorous simulation, testing, and oversight.

There is a **concentration problem**. The compute and data required to explore the Space Unknown at scale are not evenly distributed. Whoever controls the instrument controls the discoveries. Ensuring broad access — through open models, public infrastructure, and shared scientific norms — is a political question, not just a technical one.

There is a **meaning problem**. Human designers derive identity from creating. If creation increasingly happens through the machine, we must rebuild a sense of authorship that honors curation, judgment, and intention as creative acts in their own right. This is a cultural shift, and cultural shifts take time.

None of these risks argues against exploring the Space Unknown. They argue for exploring it carefully, with humility, with oversight, and with the understanding that the instrument shows us what is *possible*, not what is *wise*.

VIII Conclusion

For most of human history, the boundary of design was the boundary of the human mind. The greatest designers were those who pushed that boundary outward by a few precious meters — Edison, Eames, Mies, Jobs, Curie, Turing — and a civilization grew in the space they opened.

We are now building instruments that move the boundary by kilometers at a time.

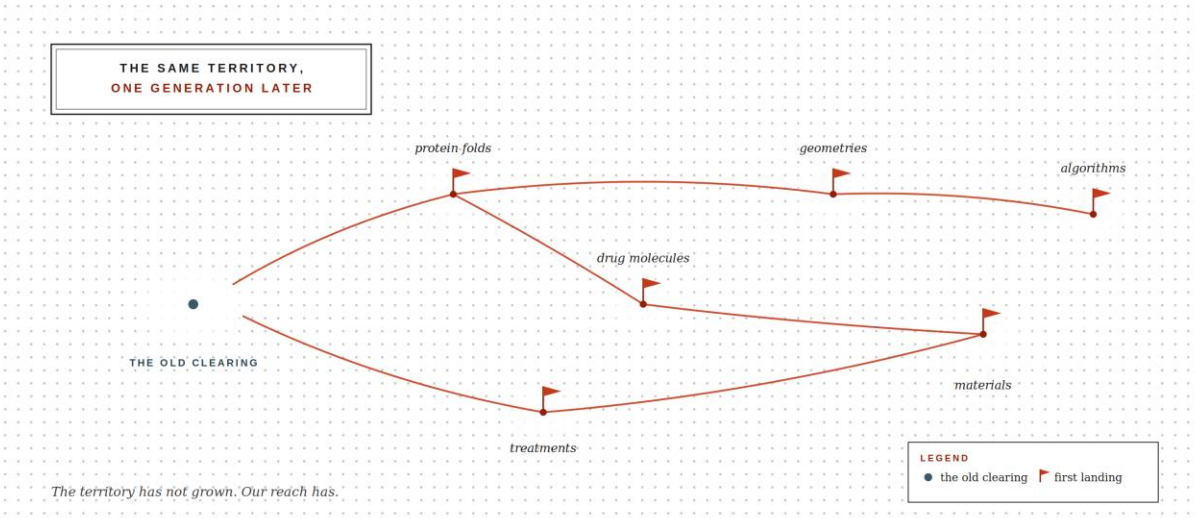

FIG. 06 *The same territory, one generation later. Flags mark first landings.*

The Space Unknown is not new. It has always been there, surrounding every design problem humans have ever solved, full of answers we did not see. What is new is the ability to enter it. Proteins, materials, molecules, geometries, networks, treatments, structures — in domain after domain, the instrument is showing us that the territory is far larger and far richer than our cage allowed us to imagine.

If we use this carefully — pointing it at the problems that matter, judging its outputs against human values, distributing its benefits broadly — the consequence will not be that machines design and humans watch. It will be that humans, for the first time, design at the scale of what is actually possible.

> *The point of the instrument is not to replace the designer's mind. It is to finally give the designer's mind room to breathe.*

ABOUT THE AUTHOR

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Earlier in his career, he designed and built one of the world's largest selective laser sintering machines, producing components that flew on India's Chandrayaan and Mangalyaan missions to the Moon and Mars — work recognized as a top innovation by Lockheed Martin, the University of Texas at Austin, and the Government of India's Department of Science and Technology.

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