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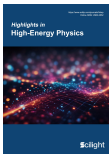



*Editorial*

# The Determined Human: Science Diplomacy in the Age of the Algorithm

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**How To Cite:** Sharma, A. The Determined Human: Science Diplomacy in the Age of the Algorithm. *Highlights in High-Energy Physics* **2026**, *2*(2), 8. https://10.53941/hihep.2026.100008

Received: 12 March 2026
Revised: 20 May 2026
Accepted: 18 June 2026
Published: 30 June 2026

**Abstract:** This essay interrogates the ontological transformation of the scientific enterprise under contemporary technological overload. Its central contention is that we are witnessing a transition from an Enlightenment tradition of human-centric causal inquiry to an age of algorithmic determinism, in which the efficient processing of human variables threatens to render the scientist, and the science diplomat, obsolete. Drawing on Erich Fromm's existentialist critique, Roger Penrose's argument for the non-computability of human consciousness, and Michael Polanyi's account of tacit knowledge, the essay argues that machine logic is hollowing out both the scientific temper and the diplomatic agency of the state. The 'Ghost', a term deliberately inverted from Gilbert Ryle, denotes the irreducibly non-computable dimension of human cognition that no algorithm can capture. The essay finds that science diplomacy's survival depends on reclaiming this dimension: advocating for a diplomacy that prioritises the undetermined over the efficient, and insisting that the future of humanity remain a shared negotiation rather than a solved equation.

**Keywords:** science diplomacy; algorithmic determinism; scientific temper; human agency; non-computability; technology overload

## 1. Introduction: The Alchemy of Data and the Erosion of Mystery

For centuries, the scientific enterprise was the ultimate expression of human liberation. From the observational rigour of Robert Hooke to the celestial mechanics of Isaac Newton, science was a deeply human narrative driven by the 'Why' rather than merely the 'How'. Today we find ourselves in a condition of Technology Overload: the sheer volume of data and the ubiquity of algorithmic intervention have begun to stifle the breath of discovery. We have transitioned, almost without noticing, from a world where science served human flourishing to one where the human is a biological variable to be optimised within a closed, determined system.

The 'determined human' is the quintessential product of this machine logic. When a predictive algorithm can establish with statistical confidence what a person will buy, whom they will love, and how they will respond to a crisis, the concept of mystery is rendered obsolete, and with it the traditional scientist, that figure grappling with the sublimity of the unknown. Erich Fromm anticipated this trajectory with disquieting precision: where the danger of the past was that men became slaves, the danger of the future is that they may become robots [1] (Fromm argues that the technological era threatens humanity with 'robothood': a condition of total alienation in which the individual no longer perceives the discrepancy between mechanical functioning and inner emptiness). A slave knows he is unfree; his spirit may yet rebel. A robot, having internalised the logic of the machine, does not know he has lost his soul. He functions, but does not live.

This mechanisation has catastrophic implications for the role of science in society, and for science diplomacy in particular. Science diplomacy was founded on the premise that science is a global unifier, a neutral ground where the American and the Soviet, the Indian and the Briton, could meet as fellow seekers of truth [2]. It was the soft power of the laboratory, predicated on human trust: the working relationship between

Homi Bhabha and John Cockcroft, or the shared epistemic commitment of Pugwash [3] (Documents Bhabha's science-diplomatic relationships with European counterparts including Cockcroft. For Pugwash, see Joseph Rotblat and Jerome Rabinowitch (eds.), *The Russell–Einstein Manifesto* (1955) and the founding Pugwash Conference proceedings (1957)). But if science becomes a tool of total determination, it loses this human-centric neutrality. It becomes not a bridge but a siege engine, and the scientist-statesman is replaced by a data-janitor who merely tends the machines.

## 2. The Ontological Shift: From Knowing Why to Predicting How

The traditional scientific method, as formulated by Bacon and refined by nineteenth- and twentieth-century empiricism, pursued the uncovering of universal laws. To know a thing was to understand its cause: *rerum cognoscere causas* (Virgil, *Georgics*, II.490). This quest for causality was not merely technical but moral: it assumed a rational universe intelligible to the human mind, and cast the scientist as a detective of the natural order.

In the age of *Technology Overload*, however, we have quietly abdicated this quest. Chris Anderson controversially announced 'the end of theory', if an algorithm can find a correlation within a petabyte of data and predict that A follows B with ninety-nine per cent accuracy, the 'Why' becomes a luxury we feel we can no longer afford [4] (Anderson's thesis provoked immediate scholarly controversy). The world becomes a Black Box. We accept the output without understanding the process.

For science diplomacy, this is catastrophic. Diplomacy is, at its heart, the management of human motives. If we replace our understanding of motives with a statistical probability of behaviour, we are no longer engaging with other nations as sovereign moral agents. We have traded the Diplomat's Craft for the Engineer's Manual. The moment we stop asking why a state acts as it does, and settle instead for predicting how it will act, we have exited the domain of diplomacy and entered the domain of cybernetics.

## 3. The Crisis of the Scientific Temper in the Age of Determinism

Jawaharlal Nehru's concept of the scientific temper was, for much of the twentieth century, a lighthouse for science diplomacy in the Global South. For Nehru, the scientific temper was not a suite of technologies but an ethical posture: the refusal to accept anything without testing and trial, a reliance on observed fact over pre-conceived theory [5] (Nehru defines the scientific temper as the refusal to accept anything without testing and trial and as fundamentally an exercise in human agency rather than technical instrumentalism). It was, fundamentally, an exercise in human agency and intellectual rebellion.

When every dimension of the human, from genetic predispositions to political leanings, can be efficiently determined by an external processor, the space for 'testing and trial' vanishes. The machine already knows the outcome; the human experiment becomes redundant. This has produced what we might call the cooling of the scientific temper by the air-conditioning of the data centre.

In the diplomatic arena, this cooling has given birth to Techno-Nationalism: states competing not for the best ideas but for the largest datasets. The collaborative spirit of the International Geophysical Year or the early CERN is being eclipsed by a zero-sum struggle for algorithmic dominance. Science diplomacy, once devoted to democratising knowledge for the common good, is being weaponised to secure digital sovereignty. The diplomat's most powerful argument—that science belongs to no single nation—is being systematically dismantled.

The Cuban Missile Crisis provides the definitive historical counterexample. Robert Kennedy's memoir of those thirteen days makes clear that the resolution depended not on calculated escalations but on a psychological breakthrough, a handshake across the abyss that no game-theoretic processor would have recommended [6] (Kennedy's account emphasises that resolution turned on psychological breakthrough and personal trust between the two leaders, precisely the non-algorithmic, non-predictable elements machine-logic diplomacy would eliminate). If we delegate diplomacy to algorithmic governance, we foreclose precisely these moments.

## 4. The Two Cultures Redux: The Chasm Between Humanism and the Heuristic

In 1959, Charles Percy Snow lamented the widening gulf between the sciences and the humanities, arguing that Western intellectual life was splitting into two polar groups [7]. As we survey the twenty-first century, this rift has undergone a radical mutation. The tension is no longer between physicist and poet, both now find themselves on the same side of a more formidable divide. The contemporary chasm lies between the humanist, who believes in the irreducible complexity of human experience, and the heuristic, the systemic logic of the machine that views all complexity as merely insufficient data.

Science diplomacy, once the bridge between Snow's two cultures, finds itself suspended over this abyss. The scientist-statesman—the Vannevar Bush or Homi Bhabha who could carry the rigour of the laboratory

into the fluid world of the chancery—was, in the best sense, an amphibious creature. In the age of Technology Overload, the scientific half of that identity is being swallowed by the technological. We are witnessing the death of the polymath diplomat and the rise of the system administrator.

The logical terminus of this trajectory is the elimination of diplomacy itself. If, as the current tech-orthodoxy holds, every social friction can be resolved through a better algorithm, the need for diplomacy disappears. Machine logic seeks to solve paradoxes; diplomacy consists in learning to live with them. In a 'solved' world, there is no room for the diplomat, just as there is no room for the scientist who wonders why the stars possess a silent eloquence.

## 5. The Mechanisation of the Soul: Have We Adopted Machine Logic?

The quantified self, the obsessive measurement of steps, sleep cycles, caloric intake, and mood scores, represents the internalisation of machine logic at the level of daily life [8] (Lupton argues that self-tracking is not merely technical but constitutes a moral act of self-governance: the data-double produced becomes a site of self-surveillance and social control). By reducing lived experience to a set of metrics, we adopt the belief that anything which cannot be measured does not truly exist. The devastating corollary for science is the loss of the unmeasurable: those flashes of insight, moral convictions, and aesthetic appreciations that have historically driven the greatest scientific revolutions. Einstein did not arrive at the Special Theory of Relativity by optimising a workflow; he arrived there through the thought- experiment of riding a beam of light, an act of sustained, non-algorithmic imagination.

At the level of the state, the quantified self produces the quantified state. Nations now engage in competitive metricism: the success of a scientific collaboration is measured not by the depth of intellectual exchange but by citation counts, impact factors, and patent filings. We have replaced the scientist of independent mind and moral weight with the data clerk, whose primary skill is navigating systems parameters. For diplomacy, this means the replacement of the statesman's judgment with the processor's calculation.

## 6. From Humboldt to the Heuristic: The Loss of the Educational Ideal

To understand what we are losing, one must revisit the Humboldtian ideal of *Bildung*: the conviction that the pursuit of science (*Wissenschaft*) was inextricably linked to the moral and spiritual development of the individual [9]. For Wilhelm von Humboldt, the university was not a factory for determined outcomes but a space for unforced inquiry. The scientist was a human being seeking to understand their place in the cosmos, not a machine for converting data into publications.

Machine logic has strangled this ideal. In the age of Technology Overload, education has become a delivery system. We speak of 'learning outcomes' and 'competencies' with the terminology one might apply to a software package. When we train our students, the future science diplomats of the world, as programmable units to be loaded with the latest skill sets, we strip them of their capacity for independent judgment.

This is particularly dangerous for diplomacy. A diplomat trained in machine logic cannot handle ambiguity. Machine logic hates ambiguity and seeks to resolve it into a binary value. But diplomacy lives in the grey zone where two conflicting truths coexist until a path forward is found. A generation of technocrats brilliant at solving equations will be utterly incapable of negotiating a peace treaty that requires empathy, historical depth, and the ability to read what goes unspoken.

## 7. The Shadow of the Panopticon: Surveillance, Weaponised Interdependence, and the Sublime

The determined human becomes, inevitably, the surveyed human. The logic that treats persons as machines accepts as its corollary that machines should be monitored for performance. In international relations, this logic has given rise to digital authoritarianism: science and technology deployed not to liberate the citizenry but to ensure the efficient determination of its behaviour. The ultimate perversion of science diplomacy is one in which its 'scientific' component reduces to the export of surveillance technologies and its 'diplomatic' component to the negotiation of who controls the data.

Farrell and Newman's concept of weaponised interdependence illuminates the structural dimension of this transformation [10]. The very networks intended to nurture global integration—financial clearinghouses, digital infrastructure—have been converted into instruments of state coercion. The decoupling of Chinese and American technological ecosystems is not a diplomatic disagreement in the traditional sense; it is a system incompatibility. The diplomat of this age is no longer a weaver of relationships but a troubleshooter of systems. Yet the most effective diplomatic interventions in modern history—the Montreal Protocol, the Antarctic Treaty—succeeded precisely because they prioritised long-term human legacy over short-term systemic efficiency.

For Kant, the sublime was that which overwhelmed our rational comprehension yet, in doing so, awakened our awareness of our own moral dignity [11]. Machine logic kills the sublime. It seeks to categorise the galaxies and reduce the majesty of the cosmos to a simulation. A scientist who believes they have solved the universe is a dangerous scientist; a diplomat who believes they have determined the behaviour of their adversary is a catastrophic one. We have already built autonomous weapons systems that operate on machine logic at speeds the human mind cannot follow. We have removed the human brake from the system.

## 8. Science as a Commodity, Not a Quest

There is a particular silence that has fallen over the great research institutions of our time, not the silence of contemplative wonder but the hushed, sterile quiet of the corporate laboratory. The primary engine of this transformation is solutionism: the ideology that every human problem is a technical one awaiting an algorithmic fix [12]. We no longer fund science to understand the world; we fund it to solve specifically and efficiently determined problems. The result is the effective prohibition of serendipity.

The history of science is a history of the unintended. When Fleming noticed the mould on his petri dish, or when Becquerel found the fogged photographic plates in his drawer, they were not solving a problem but following a mystery. In a machine-logic society, mystery is inefficiency. AI systems now predict which research pathways will yield the fastest commercialisation; we have turned the scientific method into a just-in-time supply chain, and in doing so have ceased looking for the things we do not know we do not know.

The Black Box problem is the institutional expression of this crisis. Historically, the strength of science lay in transparency: the scientific temper required that all claims be subjected to testing and trial by the community. This transparency was the bedrock of science diplomacy, mutual trust was grounded in the visibility of each other's workings. Today, the most consequential science, in artificial intelligence and biotechnology, is conducted behind the closed doors of private corporations. The algorithms that determine creditworthiness, threat assessments, and epidemiological models are proprietary. We see the output; we are forbidden from inspecting the logic. When science becomes a commodity, the scientific commons evaporate, and the science diplomat is no longer negotiating between governments but between a government and a silicon giant whose expertise the state itself cannot match.

## 9. The Republic of Science and the Loss of Tacit Knowledge

Michael Polanyi, in his seminal 1962 essay, described a Republic of Science: a polycentric community of independent self-coordination in which individuals, though working separately, were guided by a shared commitment to universal standards of truth [13] (Polanyi's concept of tacit knowledge—'we can know more than we can tell'—identifies the master–apprentice transmission of unarticulated skill as the true engine of scientific breakthrough, one that cannot be automated without catastrophic loss). Polanyi's insight was that much of scientific progress relies on tacit knowledge—unarticulated, intuitive understanding passed from master to apprentice through human proximity and example. 'We can know more than we can tell'. In the age of Technology Overload, this republic is under siege. When science is commodified, the tacit is replaced by the explicit: apprenticeship is automated, replaced by step-by-step online modules and algorithmic evaluation. The noise that Polanyi identified as essential to scientific self- coordination is systematically suppressed.

For science diplomacy, the loss of tacit knowledge is a disaster. Diplomacy is the ultimate tacit art: it relies on the ability to read a room, sense hesitation in a colleague's voice, and understand cultural undercurrents that no dataset can capture. Scientists trained as data vendors lose their capacity to serve as effective bridges between nations. The cybernetic logic now governing institutions [14] (Note: the essay uses 'cybernetics' in its extended sense of automated feedback governance, distinct from Wiener's precise technical definition, though consistent with the social implications Wiener himself feared) has replaced the steersman who once navigated by moral courage and historical intuition with an autopilot reacting to data-streams in real time. A diplomat who cannot handle the tacit cannot negotiate a peace that requires empathy and the ability to read what goes unspoken between the lines.

History offers two terrible precedents for the treatment of the human as a frictionless variable in a grand engineering project [15,16] (Both document catastrophic outcomes when human substance is treated as a frictionless variable in a grand engineering project). Karl Polanyi documented the social catastrophe of the Industrial Revolution, in which market logic attempted to subordinate human substance to machine requirements. Frank Dikötter's account of the Great Leap Forward reveals the terminal point of pre-digital algorithmic governance: the pursuit of statistical efficiency produced systemic decoupling from reality, and millions died.

The lesson is consistent: when the human element is optimised away, the system does not become more efficient, it becomes more brittle.

## 10. The Ghost in the Diplomacy: Non-Computability and the Reclamation of the Human

Gilbert Ryle coined 'the ghost in the machine' to lampoon Cartesian dualism, to argue against the separateness of mind from body [17] (Ryle coined 'the ghost in the machine' to debunk Cartesian dualism—arguing against the separateness of mind from body. The present essay deliberately inverts Ryle's usage: the 'Ghost' here denotes the irreducibly non-computable dimension of human cognition that resists algorithmic capture, the very thing Ryle's materialist critique sought to dissolve). The present essay deliberately inverts this usage. We have the machine; we have evicted the ghost. We have constructed a science and a diplomacy that are post-human. A science diplomacy that is post-human treats the scientific legacy as a museum piece. We cite Einstein, Raman, and Penrose, but we do not permit ourselves the sublime irrationality that led them: Penrose exploring the boundaries of consciousness, Raman seeing the poetry in the scattering of light.

To understand why this matters scientifically, one must interrogate the limits of determination itself. Roger Penrose, in a philosophically serious if contested argument, contends that there is a fundamental non-computability in human thought [18,19] Penrose's Orchestrated Objective Reduction (Orch-OR) hypothesis, developed with Stuart Hameroff, remains challenged in neuroscience and physics. The essay does not endorse Orch-OR as settled science but invokes it as a philosophically serious challenge to the assumption that human cognition is fully computable). The eureka moment, the seat of scientific intuition, and the moral weight of the individual do not follow the step-by-step logic of a Turing machine; they arise in a domain that resists algorithmic capture. We need not accept the Orchestrated Objective Reduction hypothesis in full to take this challenge seriously. The point for the science diplomat is not that Penrose has resolved the mind-body problem, but that the very existence of the debate refutes the casual assumption that the human is a computable system. If human thought is even partially non- computable, the attempt to determine the human through technology is not only an ethical error but a scientific impossibility. There will always remain a singularity of human intent that cannot be predicted, and it is in that singularity that the decisive diplomatic moments are made.

The most important decisions in the history of science diplomacy, the decision to de-escalate a nuclear standoff, to share a life-saving patent, to protect the global commons, were made in precisely that non-computable space of moral intuition. If machine logic assumes control, we are not merely making diplomacy more efficient; we are hollowing out the mechanism of human survival.

## 11. The CERN Model: A Proof of Concept for Humanist Science Diplomacy

India's entry into the modern scientific age was, from its inception, an act of science diplomacy. C. V. Raman, Satyendra Nath Bose, and Homi Bhabha were not merely scientists; they were ambassadors of a post-colonial humanism [20]. Raman, moving through the laboratories of Calcutta and the gardens of Bangalore, was not looking for efficient determination. He was looking for the poetry of the photon, asserting that science was a way for a young nation to claim its moral sovereignty in a world that sought to reduce it to a data point in a colonial ledger. This is the scientific temper as a form of resistance: a series of intellectual islands refusing to be submerged by the rising tide of technocracy.

It is precisely here that the CERN model presents itself not merely as an institutional precedent but as a proof of concept for the kind of science diplomacy this essay advocates (For the CERN governance model, see refs. [21,22]. Current CMS and ATLAS membership figures are available at cms.cern.ch and atlas.cern.ch respectively). CERN was conceived at the intersection of physics and political vision: a post-war act of deliberate trust in which twelve nations, many still nursing the wounds of mutual destruction, chose to build together an instrument of pure enquiry. What is remarkable about CERN is not only its scientific yield, from the W and Z bosons to the Higgs, but the architecture of its governance. It operates on open access to data, collective authorship of discovery, and the radical premise that no single state may lay sovereign claim to a result produced by thousands of hands across dozens of nationalities. The CMS and ATLAS collaborations, each comprising thousands of physicists from over a hundred institutions, are not managed by an algorithm optimising individual contributions; they are sustained by a culture of shared tacit knowledge, Polanyian apprenticeship, and the trust that accrues only through decades of working at the edge of the computable. This is the antithesis of the Black Box: science made radically transparent.

The question that confronts the global community is whether this model, polycentric, open, and resolutely human in its collaborative ethos, can be extrapolated to the existential challenges of our century. The climate system presents a problem of comparable complexity to the Standard Model: non-linear, with poorly constrained

phase transitions and consequences irreversible on any timescale relevant to statecraft. Pandemic preparedness presents a similar topology, a vast parameter space in which the decisive variable is not computing power but the speed and depth of inter-state trust. To address these challenges through the CERN model would mean constructing platforms of genuinely open, multinational data-sharing governed by the Humboldtian conviction that the shared pursuit of understanding is itself a form of peace.

My own experience at CERN confirms that this is not a utopian conceit. When a physicist from Geneva sits beside a colleague from Tehran or Beijing to debug a reconstruction algorithm at three in the morning, the national dataset to which each belongs becomes, briefly, irrelevant. What remains is the problem, the shared hunch, and the non- computable satisfaction of finding together that the universe is stranger and more coherent than the models predicted. It is that irreducible moment, undetermined, unoptimised, and gloriously inefficient—that science diplomacy must learn to protect and replicate.

## 12. Conclusion: The Prophecy of the Ghost

If we follow machine logic to its terminal point, science ceases to be a quest and becomes a simulation. We will no longer need to build telescopes or accelerators; the efficiently determined world will be one in which the algorithm has already run all possible experiments in virtual space. The scientist will be a curator of a completed museum. Society will no longer be a community of seekers but a user-base of consumers. Legacy requires a future that is undetermined; in a fully determined world, there is no legacy.

I do not believe we shall reach that point, not because the technology will fail (it is far too efficient for that) but because the Ghost will not be evicted. The laws of nature themselves appear to leave a space for the non-computable. There is a singularity in the human spirit that remains stubbornly opaque to the algorithm.

Science diplomacy, in its highest form, must be the protector of this singularity: a diplomacy of the Ghost. It must negotiate not only for data privacy or AI safety, but for the right to be mysterious. It must insist that the world remain a place where a scientist can still be surprised, where a diplomat can still change their mind for no reason other than a sudden, intuitive flash of empathy, and where a human being can still do science as an act of inquiry rather than an act of production.

The scientific temper, Nehru's democratic and humanist vision, must be reclaimed as a form of resistance. The scientific in science diplomacy does not mean technological. It means inquisitive. It means sceptical. It means human. We must assert that there are parts of the human experience that no machine will ever map, and that the preservation of those parts is not a sentimental indulgence but a condition of survival.

It is only through the persistent, glitchy resistance of the humanistic scientist, the deliberate, stubborn insistence on the Ghost, that we may preserve the legacy of a world that is understood rather than merely processed.

## Conflicts of Interest

The author declares no conflict of interest. Given the role as Editorial Board Member, Archana Sharma had no involvement in the peer review of this paper and had no access to information regarding its peer-review process. Full responsibility for the editorial process of this paper was delegated to another editor of the journal.

## Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper.

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