Letting Go of Logic

The Renewal of Creativity

By

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Introduction

On logic

Logic is concerned with the coherence of an argument. It is particularly adept at spotting inconsistencies in our reasoning. At its most powerful it can reveal that if one part of our argument is true then another part must be false. Its job is to police deductive reasoning.

It can also help us to draw out the rational consequences of our beliefs. For any set of propositions that we put forward, it has the power to produce further propositions whose truth we must accept if we are to be consistent. This may cause us to reflect upon the confidence we place in our original beliefs.

Let us say that you make the following argument: "The prime minister is either in Britain or abroad. He is not in Britain. Therefore, he is abroad." You are using a disjunctive syllogism to reason from a pair of premises to a single conclusion: expressed symbolically, our argument has the form, "A or B" and "Not A" and therefore "B". Logic lets you know that, in this case, there is nothing wrong with your reasoning. The conclusion that you draw from your premises is rational.

What logic does **not** say is that your conclusion is true. Logic, by its nature, must remain silent on the truth of your premises, and therefore the truth of your conclusion. It is only concerned with the consistency of your reasoning. Your premises may be false, but your argument can still be valid. Or your premises may be true, but if your argument is not logical, then your conclusion is not necessarily true. Issues of internal consistency set the boundary beyond which logic cannot safely venture.

Logic is a powerful instrument. In its mathematical form, it has played a vital part in the growth of scientific knowledge. Yet, it is an unfinished discipline, like any other. It remains open to fresh challenges, and new discoveries. Almost all its core principles have been questioned at some

point during the last 100 years, whether from the perspective of quantum mechanics, paradox, indeterminism, or the open future.

On rationality

Rationality, the application of logic to living, is powerful. It is one of man's most ingenious creations. It can spell out the logical implications of our beliefs. It can disentangle arguments and refute false inferences. To the powers of reason, we largely owe the growth of our knowledge, the expansion of the global economy, and the refinement of our morality.

For Steven Pinker, rationality is "using knowledge to reach our goals"[1]. We are at our most rational when we are using our most solid knowledge to solve our most important problems and attain our most desired objectives. It is a tool kit for helping us to avoid the traps of bias, prejudice, superstition and other cognitive delusions that distort our perception of reality. In the same vein, Ralph Wedgwood argues that "rationality, in the end, is the feature of your mind that guides you – ideally (if you're lucky) – towards the goal of getting things right"[2].

Yet, rationality is far from being the whole story. It can judge thought, but it cannot originate thought. It is masterful at assessment but bereft of creativity. It can deduce the consequences of our ideas but cannot form the ideas from which it makes such deductions.

It can refute what is nonsense, but it is unable to prove what makes sense.

Logic is the rule book of rational thought. It is man's inventive way of adjudicating an argument. It distinguishes between sound and unsound inferences from given premises.

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[1] Steven Pinker, *Rationality: What It Is, Why It Seems Scarce, Why It Matters"*, Penguin, 2021

[2] Ralph Wedgwood, "What is the value of rationality, and why does it matter", https://blog.oup.com/2017/12/what-value-rationality-philosophy/

It is capable of drawing startling conclusions from mundane assumptions. But its concept of truth is limited to what is coherent and consistent. Like the men in Van Gogh's painting, "Prisoners' Round", who are walking in a tight circle within the walls of the jail, there is no way out into the world of the imagination. Wonder, play, improvisation, metaphor, and narrative are not part of its language.

Logic has its limits. Its instinct is to be averse to any risk of error. In man's hands, it tends to favour what is safe and sure, tried and tested, sensible and reasonable, utilitarian and functional. By contrast, the Romantic Revolution, to which Europe has been in thrall for 250 years, was a reaction against the Enlightenment's enthronement of the rational. It privileged freedom above order. Like all things, there is a balance to be struck – not only between the rational and the romantic, but also between the secular and the spiritual, and the literal and the metaphorical. Our most profound categories of thought – truth, morality and beauty – are intrinsically pluralistic.

There is a need for balance in all things. Following Isaiah Berlin's pluralistic morality, every principle, whether ethical or epistemic, would seem to have an equally plausible counter-principle. For example, a life of obligations needs to be balanced by a life of rights, reason by intuition, scientific rigour by speculative play, the material world by the metaphysical, the literal by the figurative, the sensible by the weird, the mechanical by the organic, and the rational by the romantic.

The antithesis of rationality is not necessarily irrationality. What is deemed to be a-rational, or counter-rational, or supra-rational may be fundamental to leading a fulfilling life. For instance, it tends to be true that problems are best addressed counter-intuitively, knowledge is acquired experimentally, art is made playfully, nature unfolds unpredictably, and wealth is created entrepreneurially.

On the bounds of reason

Deductive logic, the kind of careful, and sequential reasoning that we use to track the steps in an argument often applies directly and unambiguously to routine problems such as those found in medicine, law, and finance where the issues are essentially those of making sense of uncertain information. Yet there are other domains where this kind of step-by-step reasoning is less relevant and less productive. Fleming's discovery of penicillin, Beethoven's composition of his string quartets, and Aristotle's theories of virtue owed next nothing to logic. Indeed, Socrates, one of the fathers of logical theory, claimed that some of his most important philosophical insights were the outcome of dreams and visions.

Reason is just one of many tools invented by fallible mankind for getting through life successfully. Other tools, only very lightly related to rationality, include speculation, playfulness, guesswork, obliquity, trial and error, curiosity, meditation, inversion, tranquillity, and humour.

Where does logic fall short?

We cannot reason our way to the truth. Every scientific discovery originates as a guess, a conjecture, a leap of the imagination. Armed with empirical evidence, reason can discriminate between a good and a bad guess, not by proving what is right but by refuting what is wrong. Reason can nail a falsehood with a single fact, but it cannot identify a truth, however many facts are known.

We cannot reason our way to a virtuous choice, or to the right path when facing a genuine moral dilemma. To any ethical question there will usually be multiple viable answers between which reason alone cannot adjudicate. Reason can sometimes recognise what is wrong by applying the categorical imperative but there is no equivalent technique for choosing what is right.

We cannot reason our way to the creation or judgement of a work of art. The meaning of art, particularly music, lies beyond the realm of concepts. Art and beauty have their own language. There is no intermediary realm to be deciphered. Reason plays no part in the aesthetic appreciation of either artefacts or nature.

We cannot reason our way to a desired outcome, whether it be happiness, fulfilment, or eudaimonia. The path is inherently problematic and rarely direct. Seldom do we get what we want in life by aiming for it. Typically, our logical self turns to a plan of some sort to achieve an objective. But success is elusive. Some things cannot simply be pursued or willed.

In short, reason can take us only so far. At a certain point, it ineluctably falls silent. Other ways of thinking need to be called upon. Reason is good at discerning error, identifying evil, and calling out nonsense; but it is poor at deriving actions from aims, theories from observations, laws from facts, values from experience, and judgments from codes of conduct. Because logic cannot escape its own premises, it remains enclosed in its starting assumptions. If everyone in the world obeyed only reason, we would have no science, art, or morality.

Chapter by chapter

To give the gist of each chapter, here is a summary of the argument of each one:

Chapter 1 is about **science**. "The open universe" is Karl Popper's description of the emergent nature of reality. Our knowledge of it grows by conjecture and refutation, not by inductive reasoning from facts to generalisations.

Chapter 2 is about **human nature**. "The crooked timber" is Kant's famous description of the biased nature of man's evolved instincts and intuitions. What has served our survival as a species is an unreliable template for the pursuit of truth and goodness.

Chapter 3 is about the **mind**. "The divided brain" is the name given by Iain McGilchrist to the theory by which he seeks to interpret the role of the mind in making sense of reality. The left hemisphere is the home of logic and sequential argument; the right hemisphere is more holistic and intuitive in its relationship to the world. There is a balance to be struck between these two ways of interpreting reality.

Chapter 4 is about **human agency**. "The active voice" is part of the title of a book by anthropologist Mary Douglas. It serves to warn us against the neuroscientific fashion for conflating the causes of our behaviour (our "objecthood") and the reasons we give for what we do and for the choices we make (our "subjecthood"). Persons are not the passive objects of either nature or society.

Chapter 5 is about **ethics**. "The moral maze" is the name given to a BBC radio programme devoted to philosophical debate about contemporary political issues. Like all grown-up discussion, it reminds us that morality is intrinsically pluralistic, and irreducible to logic.

Chapter 6 is about **art**. "The aesthetic gaze" is Roger Scruton's metaphor for the way in which art, particularly music, represents the world without the need for concepts. Works of art are not means to an end. Nor do they lend themselves to logical interpretation.

Chapter 7 is about the **economy**. "Spontaneous order" is FA Hayek's explanation for the efficacy of a free market. This flies in the face of the preference, advocated by those with a logical turn of mind, for a planned economy.

Chapter 8 is about the **world of work**. "Psychic prison" is the epithet that Gareth Morgan chose to describe the "over-managed" corporate workplace, in which humans are called resources and treated instrumentally. Hierarchy and bureaucracy have their roots in logic, but they are increasingly ineffective.

Chapter 9 is about **problem-solving**. "The inverse method" is the phrase that Warren Buffett has given to his own highly effective method of investing in the stock market. As a way of thinking, it generalises to many other problems in life. It challenges the prevailing model of rational decision-making.

Chapter 10 is about **achievement**. "The oblique approach" refers to economist John Kay's insight that most of our goals are best reached by not aiming for them directly. This seems to fly in the face of the logical argument that we should work back from the outcome we desire to the logical steps we should take to reach it.

Chapter 11 is about **values**. "The first virtue" was the name that Aristotle gave to courage, from which he claimed that all other virtues flow. This was a conviction of ethos and pathos rather than logos.

Chapter 1
The Open Universe

*"T*he world is constantly in flux, always 'becoming' but never 'being'".

Heraclitus

"In the beginning there was an ocean of energy that drove a rapid expansion of space known as inflation. There were ripples in the ocean. As inflation ended, the ocean of energy was converted into matter by the Big Bang. And the pattern of the ripples was imprinted into our universe, as regions of slightly different density in the hydrogen and helium gas that formed shortly after the Big Bang. The denser regions of gas collapsed to form the first stars and the first galaxies. And nine billion years later, a new star formed in the Milky Way: the Sun. The star was joined by eight planets including Earth. And, nearly 13.8 billion years after it all began, we emerged, blinking into the light." [1]

Brian Cox

Nature is an open system

We live in a world that continues to create itself even to the extent of becoming aware of its own creativity. It is a self-knowing, self-adaptive universe. In our small corner, the human mind is the instrument of this reflexivity. Karl Popper described the universe as "open".

We seem to be logically committed to a dualistic understanding of reality. Our senses are attuned to experiencing a predictable world of cause and effect – a clockwork universe that science is gradually

[1] Brian Cox, "What Was There Before the Big Bang?", https://www.youtube.com/watch?v=BD0r2Xfgh_E

revealing and codifying. Yet with every discovery we are simultaneously witnessing the operation of a creative mind unfettered by causality. The apparatus that does the discovering would not seem to be obeying the predictability that it is reading into the rest of the universe. The scientific mind studies the brain as a machine but in doing so reveals its own unmechanical properties. Its method refutes its assumption.

We see a world "out there" that exists, for the most part, "in here". In large part, the mind invents the world that it perceives. Our senses may be making more sense of themselves than they are of the world that they claim to be sensing. What is the relationship between perception and reality, the inside and the outside, the cloud-like mind and the clockwork brain, the world of choice and the world of chance? We model the world as deterministic using a means that relies upon indeterministic thought.

A man-made discovery is not the outcome of an automatic process, or the effect of a particular cause. Thinking is an activity that escapes the determinism of cause and effect by operating in the realm of reason and result. Thinking gives reasons, not causes, for its thoughts. When we justify a decision, we offer arguments, not determinants. If we treat ourselves, and not nature, as the explanation for our behaviour, then we are committed to taking responsibility for the reasoning that led to it. We owe it to our sense of agency not to fall back on excuses, such as instincts or emotions. It would not have been a choice if we had assumed ourselves to be as much part of the deterministic universe as a planet in orbit or a wave breaking on a shore.

We inhabit a universe of infinite possibility. It is not chained to its past. Its future is, at least partially, the product of its own volition, drawing upon the freedom of the human mind. Schopenhauer's insightful and wondrous image of the world as will paints a picture of a restless universe with no sense of purpose, direction, or inner meaning. Yet it is also home to the human imagination which cannot help but invest the

world with meaning. We bring our own sense of order to the universe, whether in the form of our mental categories of understanding such as space, time, and causality, or in the form of our self-developed concepts of value, such as truth, beauty and goodness. These are critical components of the emergent properties of an ever-evolving universe. The story may only just be beginning. The quest, as Popper expressed it, is unending.

Living is problem-solving

Knowledge is as old as life on earth. Even the most primitive organisms, such as amoeba, are problem-finders and problem-solvers, albeit unconsciously so. Over time species evolved to a point at which the acquisition of knowledge, certainly by mankind, became a self-conscious, purposeful activity. It operated to a logic of variation and selection, not dissimilar to that of evolution itself. The difference is that human knowledge is driven less by the instinct for survival. It is addressing problems that have no relation to evolutionary fitness but everything to do with the exercise of the imagination and the pure pleasure of discovery. The origin and evolution of knowledge is coterminous with the origin and evolution of life.

Plants and animals possess plentiful innate knowledge. Plants, for example, have an inborn knowledge of the seasons; they know how to attract bees; they know how to put down roots and absorb nutrients; they may even know how to communicate with each other, however weakly.

Their knowledge is very general, and it is anticipatory. Flowers know the difference between night and day. Their petals will close in anticipation of darkness. They know something of the changing seasons. They prepare for winter by shedding their leaves. They don't "understand" the rationale for such "behaviour", but they "know" something of the general regularities within their environment. Human knowledge is an evolved form of the same process. Indeed, science was

once described by Popper as an enlightened form of the "common sense" of primitive organisms, such as bacteria.

The restless energy of the universe, embodied in human desire and finding expression in the frenetic activity of all living things, is the mainspring of discovery. Like any insect, for example, every person is "casting about" for experience. We "put out feelers" in all directions. We "sense our way" into the future, using every means at our disposal. By doing so, we continuously invent and re-invent our interpretations and valuations of the world around us. The only method of acquiring knowledge, whether by plants, animals or humans, is trial and error. Members of all species act on the world, and in doing so, adapt themselves to reality. By seeking, they gradually find.

The idea that plants and animals can know something has revolutionised our understanding of knowledge. We are beginning to recognise that most human knowledge, in common with all the knowledge possessed by other creatures, is innate and unconscious. The small portion that is conscious has arisen from purposeful modification, a speculative overturning of some previous belief, just as that belief was itself once an overturning of something that went before. All knowledge goes back to innate knowledge and to its revision. No existing knowledge is immune from further modification.

Innate knowledge is not certain knowledge. All that we can ever attain is conjectural knowledge. No knowledge rests on a firm foundation of any sort. All our beliefs and assumptions are no more than adaptive, fallible, and defective solutions to earlier problems, themselves the result of earlier adaptations. The growth of knowledge is a story of one conjecture after another, each an invented solution to an earlier flawed conjecture. Much of our knowledge must be broadly true (or we would not have survived to tell the tale); but we know nothing for sure. We can, however, be confident that we know more now than we have ever known. Our theories are reliably getting closer to the truth.

Problems, knowledge, and values all evolve together. This is because all problem solving involves evaluation and therefore, values. As one problem is solved, so a new theory is born, and new expectations, priorities, and values come in being. Only with the origin of living beings did problems and values enter the world. Two particularly important values, critical to the development of civilisation, are of relatively recent origin, dependent as they are upon the invention of language: a self-critical attitude towards all claims of knowledge, and a respect for the truth.

Inductive logic is a myth

> "The belief that we can start with pure observation alone, without anything in the nature of a theory is absurd … Observation is always selective. It needs a chosen object, a definite task, an interest, a point of view, a problem."[2]
>
> **Karl Popper**

The general view of knowledge is that it stems from our senses. Our mind is a "bucket" that fills up with sense data. We simply need to open our eyes and the data stream in. But this is an error. For our senses to tell us anything, we must have prior knowledge. In order to see a thing, we must know what things are. For example, we must have a notion of space, movement, duration, and relevance.

Our thinking is profoundly framed by the mental equipment that we inherited from our ancestors, itself the outcome of evolutionary pressures and opportunities. This equipment is both active and selective. It only notices what matters to us, especially what matters biologically. The eye, for example, is not the result of seeing, or of observation. Seeing is the result of the eye.

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[2] Karl R Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge, https://www.goodreads.com/quotes/778918-the-belief-that-science-proceeds-from-observation-to-theory-is*

Theories are not the result of observations any more than sense organs are the result of need. Learning is not an inductive process. We do not start with data and, by bringing a particular method or process to bear upon these data, yield conclusions or discoveries. It certainly feels as though we do. It is natural to believe that our senses perceive the external world objectively and that our minds go to work making sense of these data, summarising them in the form of lawlike patterns. But this is an illusion. What we perceive are not *data* but *capta*. Our theories frame what we observe. We see what we need to see, or want to see, or are motivated to see, or are equipped to see. We see what matters to us. We notice particularly what we don't expect to see.

When we are surprised by an event, the surprise is usually due to an unconscious expectation that something else was going to happen. This is how problems confront us daily. We are forced to acknowledge that some of the assumptions we have been taking for granted – our theory of how things are – must be mistaken. We predicted one thing, and another thing happened. We feel compelled to construct an alternative theory that could account for our experience.

Reason plays the role of saying "no" or "maybe" whenever our non-rational self postulates a possible explanation. But reason is not the source of the thoughts we entertain. These arise from a kind of mental playfulness steeped in indeterminism. They are not entirely random, but they possess a large element of happenstance, or spontaneity. By acting on the world and thereby asking questions of nature, we force a response from nature. The response can be positive or negative. It is our interpretation of nature's response that shapes our knowledge. Every interpretation is itself conjectural and by setting up its own expectations lays itself open to further surprises. "All life is problem-solving", as Popper put it.

We know nothing

We do not know; we guess. Towards the end of his life, Popper remarked, "Do not believe anything I have said."

He urged the adoption of three maxims:

- We know nothing with certainty.
- We should acknowledge our fallibility.
- We are too ready to make claims to knowledge.

Much of what we know is objectively true, despite its inherently hypothetical character. Otherwise, we could hardly have survived as a species. Generally, our theories do not let us down; hence the significance of those occasions when our expectations are confounded.

It is important to distinguish between the truth of an expectation and its certainty. There is much truth in our knowledge but little certainty. Therefore, we must view our hypotheses critically. We must test them. Truth is objective – it is correspondence with the facts; whereas certainty is rarely objective – it is usually no more than a conviction, based on insufficient knowledge. Such feelings are dangerous. They make dogmatists of us. In the worst case, they turn us into hysterical fanatics, obsessed with convincing ourselves of a certainty which we unconsciously know to be nonsense.

These small but significant lapses into dogma are the origins of totalitarianism. A pathological attachment to a belief that may meet an inner need, but which does not meet the threshold of certain knowledge, takes hold. The terrible suffering that ideologues, whether of the left or the right, have wrought upon the world is the result.

There is a distinction to be made between experts and authorities. Bertrand Russell used this distinction to formulate his own version of the 10 commandments[3], 8 of which are the following:

1. Do not feel absolutely certain of anything.

[3] Bertrand Russell, "A Liberal Decalogue", *The Autobiography of Bertrand Russell, 1944-1969*, pp. 71-2

2. Do not think it worthwhile to proceed by concealing evidence, for the evidence is sure to come to light.

3. Never try to discourage thinking for you are sure to succeed.

4. When you meet with opposition, even if it should be from your husband or your children, endeavour to overcome it by argument and not by authority, for a victory dependent upon authority is unreal and illusory.

5. Have no respect for the authority of others, for there are always contrary authorities to be found.

6. Do not use power to suppress opinions you think pernicious, for if you do the opinions will suppress you.

7. Do not fear to be eccentric in opinion, for every opinion now accepted was once eccentric.

8. Find more pleasure in intelligent dissent than in passive agreement, for, if you value intelligence as you should, the former implies a deeper agreement than the latter.

This way of thinking, still only marginal in most human communities, was central to the emergence of Greek philosophy during the first millennium BC. The invention of critical discussion – taking an interest in opposing points of view – lay at the heart of classical civilisation. Beginning with the Presocratic philosophers, a culture of dialogue came into play in which the freedom to challenge conventional thought was encouraged and honoured.

Before that, a culture of solidarity reigned. The truth was handed down from generation to generation. It was not for ordinary mortals to question the authorities, whether religious or political. Dissent was a crime against society. One was brought up and taught to fall in line with an official doctrine of some sort. It was just such a setting in which the

early Greek philosophers invented a culture of interrogation and dialogue. They institutionalised curiosity, inquiry and debate. It came to be called philosophy.

Freedom of thought was born and, in its wake, theories of the good, the true and the beautiful were developed, debated and refined. No longer chained to doctrine, free to imagine alternative ways of looking at the world, and encouraged to form ideas of one's own, the seeds of scientific civilisation were sown. But the old ways of thinking still hold many societies hostage. People allow themselves to be the prisoners of dogma and the victims of ideology, fearful of even the slightest form of dissent. Today, we would call this a "cancellation culture". Many lack the courage to live without assurances, without certainty, without authority, or without a leader. In a sense, they remain trapped in infancy. Concepts of blasphemy, where some ideas are invested with God-given sanctity, still imprison many minds.

The Greeks broke with this authoritarian tradition. They encouraged each other to think aloud, to question common sense, to challenge the status quo, and to improve upon accepted wisdom. With this new habit of thought, astrology gradually gave way to astronomy, religious doctrine gradually succumbed to scientific inquiry, alchemy declined as chemistry grew, and superstition surrendered to reason.

Truth is not manifest

Francis Bacon, the father of inductive logic, was one of the first philosophers to articulate a theory of scientific discovery. He believed that knowledge of the external world is built upon pure observation and the application of reason. He argued that it is possible for anyone "to read the book of nature". All that is necessary is an open mind, by which he meant a mind free of perceptual bias or other sources of unreason. Truth is not coded. It is not hiding from humanity. Nature is an open book. It says all there is to know – and it says it transparently. Provided we clear our minds of folklore, myths and fables,

preconceptions, and alternative narratives, the truth will speak directly to us. Popper referred to this as the doctrine that truth is manifest.

This optimistic faith in reason was central to the Enlightenment and contributed to an efflorescence of scientific progress, but it posed a knotty problem. If truth is indeed manifest – if it is so easily and directly accessible to all, irrespective of intelligence or good will – how can one possibly explain – *or forgive* – those who formulate and advocate falsehoods? How are we to interpret a world in which so many people are deluded? And what should be our response to those who are mischievous enough to knowingly ignore, or pervert what is in front of their eyes?

To many believers in the manifest doctrine, the answer to these questions can be expressed in a syllogism:

- Truth is manifest.
- It is directly accessible to an open mind.
- I have an open mind.
- Therefore, I know what is true (and right and good).
- And those with whom I disagree are misguided, wrong (and potentially toxic).
- Thus, their influence must be cancelled.

Popper himself warned of the danger of this line of thought. Its premise is that "only the most depraved wickedness can refuse to see the manifest truth"[4] and a correlate of this is that "only those who have reason to fear truth conspire to suppress it". These words were prophetic. They were written in 1963, but, 70 years later, they provide an astute interpretation of today's "cancel culture" and the fanaticism that lurks behind it.

[4] Karl R Popper, *Conjectures and Refutations, https://www.goodreads.com/quotes/1361369-this-false-epistemology-however-has-also-led-to-disastrous-consequences*

It goes some way to explaining the polarisation of belief systems that we witness throughout Europe and America today. We demonise those who think differently from us. We weaponize discussion and debate, calling it "hate speech". We read bad intent into a simple difference of opinion or an alternative reading of events. If truth is self-evident then, so the thinking goes, those with whom we disagree must be disingenuous, claiming to see what is clearly not there, and fabricating a narrative that bears no relation to reality. Such people are not simply mistaken but potentially malignant.

If both sides in a dispute adhere to the manifest doctrine, then each side will portray their opponents in the worst possible light and interpret their every move as not only as mistaken but also wicked. A culture of censorship, hate speech and cancellation will be the natural and disturbing outcome. Critical theory and intersectionality will be the intellectual bedrock of those whose belief in the manifest doctrine gives their own version of the truth a certainty that it does not possess.

We are living with the consequences of a widespread faith in an irrational doctrine. For the fact is that truth is **not** manifest. It is inherently provisional. As soon as we abandon any sense of our own fallibility, all sorts of mischief-making become tempting. We find ourselves relaxing critical standards in regard to our own beliefs and neglecting whatever might challenge our own favoured theory. It needs to be acknowledged that the intellect is particularly vulnerable to this style of reasoning. It prides itself on finding evidence for its own views, even if it means torturing the data until it confesses, to borrow a phrase from Richard Coase. It is sometimes said that there is no idea so daft that data cannot be found to confirm it. If truth is hidden rather than manifest – and if we are fallible creatures – then rationality comes into its own when searching for error, especially amongst our strongest beliefs, rather than when gathering yet more evidence in their support.

A related, equally disturbing trend is the growth of factionalism. Factions, seemingly impervious to their own fallibility and hostile to

constructive dialogue with each other, are a disturbing and growing characteristic of the modern age. Madison, in the Federalist papers, had argued that a well-designed Union would be one that could "break and control the violence of faction". What is missing today is the humility to engage with those of a different viewpoint or ideology, to experience the humanity of "the other", to build some form of empathy, to find some common ground, and to explore differences of belief with an open mind. Walt Whitman put it beautifully:

> "I like the scientific spirit – the holding off, the being sure but not too sure, the willingness to surrender ideas when the evidence is against them: this is ultimately fine – it always keeps the way beyond open – always gives life, thought, affection, the whole man, a chance to try over again after a mistake – after a wrong guess."[5]

Factionalism is the abandonment of a critical rationalism that honours the elusive, non-manifest quality of truth.

When our personal identity is subsumed in that of a group, whether defined in terms of class, ethnicity, nationality, sexuality, or ideology, the manifest doctrine becomes a powerful ally. It provides the weapons of vilification and facilitates the demonisation of those affiliated to different identities. Reason would suggest that there are only two forms of identity to which we genuinely belong – our shared humanity and our unique personhood. Anything other than these two is likely to become the vehicle for prejudice and factionalism.

It is sometimes said of political rivalry that the left typically regards the right as profoundly immoral whereas the right regards the left as simply mistaken. These views, particularly the first, tend preclude the rational practice of listening to, and learning from, those of a different world view. They illustrate the distinction sometimes drawn between a

[5] Walt Whitman, *Walt Whitman's Camden Conversations, https://www.goodreads.com/quotes/22709-i-like-the-scientific-spirit-the-holding-off-the-being-sure*

fixed mindset and a growth mindset. A truly rational world would be one in which there is a plethora of viewpoints, a joy in critical dialogue, and a love of the non-manifest truth.

Logic is the art of refutation, not proof

> "There are two key steps that a mathematician uses. He uses intuition to guess the right problem and the right solution, and then logic to prove it."[6]
>
> **Cedric Villaini**, a mathematician and winner of a Fields medal.

In science, we only know where we are going when we get there. Only at the destination can we rationalise the journey we have taken. The final piece of the puzzle consists in facts, because we only know what would count as a telling fact when we are already in possession of the idea whose truth or falsity we are trying to determine.

All creative activity divides into two distinct stages. First, there is the invention of something wholly original. In science, this is a hypothesis of some sort. How it came about resists analysis. Indeed, too much attention paid to methodologies of discovery – or to heuristics of various kinds – has a habit of sterilising the very creativity they are designed to enhance. There would seem to be a potent need for a degree of playfulness, disorderliness, improvisation, and latitude for error if the process is to be genuinely fruitful. The enemy of insight is the displacement activity that would prefer to dwell on the gathering of facts and their statistical analysis.

Second, there is a need to appraise the quality of the discovery. In science, this entails an empirical test, such as a controlled experiment or a clinical trial. Does the theory hold water, or not? What reasons can we find to reinforce or weaken our belief in the idea? For example, do the

[6] https://www.theguardian.com/science/2015/mar/01/cedric-villani-mathematics-progress-adventure-emotion

facts of the case lend support to the hypothesis, or do they point to an error? This is where logic kicks in. This is the domain of critical rationalism.

Danger lurks when we ignore or blur the distinction between invention and appraisal.

Whenever we seek to over-rationalise the process of invention or under-rationalise the process of appraisal, we harm the overall productivity of the process. Discovery is the casting of a net to see what it catches, rather than the opening of a cupboard to see what it contains. We sometimes give too much credit to nature, as though truth is manifest, and its perception simply requires an unbiased mind. We should give greater credit to the human mind, the extraordinary apparatus that superinduces the patterns in what it perceives and casts them in the form of self-created concepts. The best thing for the enhancement of creativity would be to acknowledge the power of play in the invention of ideas and to enable intuition to play its full part. If we downplay the role of intuition in the discovery of truth, we diminish the natural and most precious gifts of the human mind.

Peter Medawar, a Nobel prize-winning biologist, has described how scientific papers are often written "back to front", minimising any suggestion that guesswork played any part at the front end of the process[7]. No scientist is comfortable describing his cherished discovery as a conjecture, let alone a guess. The phrase, "trial and error", seems to diminish the heroic qualities of a scientific discovery, as though every great breakthrough were a shot in the dark, and the entire edifice of science were no more than a lottery favouring the lucky. Yet, as Medawar argued in defence of the heroism of science, the mind that makes discoveries is also a mind steeped in earlier conjectures and refutations.

[7] Peter Medawar, *The Art of the Soluble*, Penguin, 1967

Kepler's method exemplifies scientific reasoning

Kepler's discovery of his third law – which relates the size of the planets' orbits and the times of their revolutions – elegantly illustrates the logic of scientific discovery.

The ancient Greeks had noticed that the longer the "year" of a planet's orbit around the sun, the larger the orbit. This discovery, amongst many others, led to the belief that the universe is an ordered system, and that this order takes the form of structurally invariant patterns between measurable variables in the natural world. It was this assumption that inspired Kepler to seek to quantify the precise relationship that the Greeks had first noticed. He had already established that the orbit of each planet forms an ellipse with the Sun in the centre (his first law) and that the radius vector of each planet sweeps out equal areas in equal times (his second law). He was sure that there must be an equally lawlike relationship between a planet's average orbit radius (R) and its "year" measured in earth-days (T). He tried hundreds of formulae. Eventually he found one that seemed to fit. R cubed divided by T squared gave the same value for all 6 planets known at the time.

Discovering the third law, as with the discovery of any scientific law of science, meant finding a numerical relationship between two or three variables (in this case, R and T) that would generalise across many cases (in this case, 6 planets). There are an infinite number of "wrong" guesses, a very small number "right" guesses in relation to all six of Kepler's planets, and even fewer for all the planets known today. As it happens, Kepler's third law also worked for Uranus (the seventh planet) and Neptune (the eighth planet), thereby strongly reinforcing the belief that this law captured the truth.

From this archetypal scientific discovery, we can define the scientific method, in so far as it is a "method" at all, in terms of three main principles:

1. The first principle is that science progresses by a method of **conjecture and refutation**, to borrow the terms used by Popper. Peter Medawar calls this principle the "hypothetico-deductive scheme of scientific reasoning" and condensed it into four central ideas:

    a. Generalising from data is intrinsically uncertain; thus, the status of every hypothesis is necessarily provisional.
    b. The formulation of a hypothesis is necessary to initiate the process of inquiry, give it direction, and narrow its focus to what is practicably discoverable.
    c. Proof and disproof are asymmetrical: no amount of evidence can conclusively **prove** a theory to be true; but a single fact is sufficient to **disprove** the same theory.
    d. Science takes upon itself the obligation to test its theories as rigorously and disinterestedly as it can.

Over 100 years ago, David Brewster described Kepler's method in very much the same terms:

"His imagination … indulged itself in the creation and invention of various hypotheses. The most plausible or, perhaps, the most fascinating of these was then submitted to a rigorous scrutiny; and the moment it was found to be incompatible with the results of observation and experiment, it was willingly abandoned, and another hypothesis submitted to the same severe ordeal."[8]

Kepler used Tycho de Brahe's carefully amassed astronomical data not to **get to** his ideas but to **test** them. There is no logical path from Tycho's data to Kepler three great laws. Science is a speculative project. It tells highly inventive stories of how the world might be and uses observation to sift the stories that stack up from those that are wrong-

[8] David Brewster, *Life of Johannes Kepler*, Prabhat Prakashan, 2018

headed. Scientific knowledge is the sum of refutable hypotheses that have survived every attempt to refute them.

2. The second principle is that the first duty of a scientific theory is to describe the **properties** of a system; and only when such a description has been given, to offer an **explanation** of why these properties are as they are.

   Arthur Eddington, an astronomer, suggested that Kepler was one of the pioneers of this principle:

   > "We are apt to forget that in the discovery of the laws of the solar system, as well as the laws of the atom, an essential step was the emancipation from mechanical models. Kepler did not proceed by thinking out possible devices by which the planets might be moved across the sky – the wheels upon wheels of Ptolemy, or the whirling vortices of later speculation … Kepler was guided by a sense of mathematical form, an aesthetic instinct for the fitness of things … After Kepler came Newton, and gradually mechanism came into predominance again. It is only in the latest years that we have gone back to something like Kepler's outlook, so that the music of the spheres is no longer drowned by the roar of machinery."[9]

In other words, causality may be a superfluous variable. A good description, in the form of a lawlike relationship, has no need of any further explanation as though the world were a machine.

3. The third principle is that the role of observation, experimentation and data is to **test** theories and not to **originate** them. As Einstein

[9] Beer, A. and D. Beer eds., *Kepler: Four Hundred Years*, Pergamon Press, 1975, https://www.robweir.com/blog/presentations-and-publications/arthur-stanley-eddington

put it: "A theory could be proved by experiment; but no path leads from experiment to the birth of a theory."[10]

Peter Medawar, who believed, with Popper, that "induction is a myth", pointed out that Karl Pearson, one of the founding fathers of inductive statistics, had fallen victim to his own erroneous method. Pearson, in what may be taken as the motto of modern statistical inference, had written that:

> "The classification of facts … and the recognition of their sequence and relative significance is the function of science. … Let us be quite sure that whenever we come across a conclusion in a scientific work which does not flow from the classification of facts, or which is not directly stated by the author to be an assumption, then we are dealing with bad science."

Medawar's retort was ruthless:

> "Poor Pearson! His punishment was to have practised what he preached and his general theory of heredity, of genuinely inductive origin, was in principle quite erroneous."[11]

Objective observation is impossible. What we perceive is biased by our state of mind. We cannot simply "observe" the world. What we notice is framed by what we find interesting, noteworthy, surprising, or in any other way relevant to our interests.

To summarise, the argument against induction, first put forward in 1840 by William Whewell, a polymath scientist, is that no general statement, not even the simplest iterative generalisation, can be derived from raw data without some imaginative effort on the part of the mind. Perception itself "superinduces" ideas and patterns upon the bare facts. A scientific hypothesis is just one of many conjectures that might be

[10] https://todayinsci.com/E/Einstein_Albert/EinsteinAlbert-TheoryQuote500px.htm
[11] Peter Medawar, The Art of the Soluble, Penguin, 1967

suggested to explain a given phenomenon. Nature cannot **propose** hypotheses; but Nature is pre-eminently capable of **disposing** of those that are false. This philosophy is directly at odds with modern statistical methodology which is much closer to Bacon's and Mill's systems of inductive logic than to Popper's and Medawar's hypothetico-deductive logic. The addiction of most social science to the myth of induction goes a long way to explaining the dearth of its theoretical discoveries.

AI is clever but not intelligent

"Artificial Intelligence" is an unfortunate and egregious misnomer. AI is not intelligent. It cannot think. It lacks imagination. It has no ability to reflect upon its own activities, or the assumptions underpinning them. It does not know what it is doing. In short, it operates entirely on the logic of inductive reasoning, turning inputs and instructions into outputs and actions.

The logic of an algorithm is inherently inductive. ChatGPT is a perfect example. Prompted by a human question, it can turn data into text and image without a moment's "thought". In doing so it perfectly illustrates both the strengths and limitations of inductive logic.

Using prodigiously well-designed instructions, it can quickly summarise existing knowledge in startlingly useful ways – but it cannot initiate an idea or make a discovery. It works with a dictionary of known words but is quite incapable of inventing a new word to convey a new meaning. It has at hand the entire literature of the world but cannot itself write a novel of genuine originality. It is fed the "best thoughts of the best minds" but is incapable of adding to them. By its very nature, AI perfectly demonstrates the sterility of induction as a logic of discovery.

ChatGPT has been described as "sophisticated plagiarism" and "immaculate bullshit"[12]. Dutifully following its coded instructions, it

[12] The Penn Gazette, May/June 2023

cannot ask a good question, if only because it deals solely with ready-made answers. It finds nothing funny or bizarre or surprising. It possesses no curiosity or wonder or imagination. It lacks any sense of irony or humour or paradox.

Mechanically, it may be wonderfully gifted, but humanly, it is utterly inept. Chat GPT reminds one of the school swot or the office nerd. It is the kind of intelligence that does well in IQ tests: it gives the right answers to the stereotypical questions asked in exams. This may be a feat of memory, diligence and self-discipline but it falls short of the full meaning of intelligence as commonly understood. We demean our own minds by thinking of computers as intelligent. There is a critical distinction to be drawn between the intelligence of ChatGPT and the brilliant team who created it, just as there is between IBM's Deep Blue and Hán Xin, the Chinese inventor of chess in 200BC.

In a sense, "Artificial Intelligence" is a harmless, albeit misplaced, metaphor. It only becomes perilous if we then reverse the metaphor and assume that the human mind is a computer. If we are to call computers clever then we could just as well call cars brave, books perceptive, crutches virtuous, paint creative and violins emotional.

There can be no short cut to the discovery of knowledge and the growth of science without the faculties of intentionality and self-consciousness. Intentionality is a property of the mind that can separate its thoughts from the things thought about. Mental states, such as perceptions, beliefs, and desires, are **about** something: they represent or stand for objects, events, and situations. As a result, the mind, unlike any machine, is able to distinguish between its contents and the objects to which they refer. Self-consciousness is the heightened sense of awareness of one's own being that enables us to think about our thoughts, and reflect upon their veracity, meaning, and implication. Truth, as with virtue and style, are concepts that belong to the human mind that invented them. It is a fool's errand to try and mechanise them.