Scientific knowledge

Ton Haarmans · Wide Open Windows



My fascination with science began early.

When I was eight, I spent my Saturdays reading a small weekly science column in the Utrechts Nieuwsblad. I cut it out and kept it, just as I did with the science comic that appeared every Friday and Saturday ("De Rusteloze Aarde"). I was drawn to anything that promised access to how the world actually worked. I strongly felt a sense of awe and wonder, which has never left me. I still do not understand how somebody cannot fall silent when looking at the night sky.

I immersed myself in archaeology and astronomy. Later, particle physics and cosmology entered the picture. I followed the space programs of NASA and the Soviet Union with almost ritual devotion. At home, in the garage in Heemstede, I built a small chemical laboratory. Bottles, powders, improvised instruments. The feeling was always the same: somewhere, beneath appearances, there was an order waiting to be understood.

At the same time, my curiosity drifted naturally toward the edges. Parapsychology, UFOs, anomalous phenomena. Not as belief systems, but as question marks. They led me to the fringe zones of science, where established models begin to fray and explanation becomes uncertain. Without realizing it, I was already circling the limits: where evidence thins out, where hypotheses multiply, where fascination quietly turns into epistemology.

Science did not represent cold rationality to me. It represented depth. A promise that the surface of things was not all there was, that beneath everyday experience lay structures, forces, and patterns that could be uncovered. To understand the world was to move closer to something real.

What I did not yet see was that every understanding also establishes a frame. That every explanation functions inside conditions it cannot itself explain. That no matter how refined our instruments become, knowledge always arises within experience, never outside it.

Much later, this would shift the centre of gravity of my questions. Away from what the world is made of, and toward how anything like a world appears at all.

What follows grew out of that shift.

Immediate knowing

The only thing I can truly claim to know is this experience, right now. Not what it means. Not where it comes from. Only that it is.

This does not make knowledge impossible. If it did, ordinary life would be unworkable and science would collapse immediately. Perception, reasoning, and scientific inquiry clearly produce results. They allow us to orient ourselves, to build technologies, to cure diseases, to navigate the world with remarkable precision. Within their domain, they are not only useful but indispensable.

But they do not operate in the same register as experience itself.

Experience does not need to be justified. It is not concluded. It is not inferred. It is simply present. Knowledge, by contrast, always arrives mediated. It rests on memory, on learned structures, on internalized procedures. It requires reference. Even when it feels immediate, it is not.

If I say that five plus three equals eight, the answer appears instantly. Yet it is not known in the same way this moment is known. Somewhere, however briefly, a system is consulted. A rule is applied. A past learning is activated. The knowing is real, but it is indirect.

Most of what we call knowledge lives in this implicit form. It settles into the body. It becomes habit, competence, orientation. Once, arithmetic required effort. Once, cycling required attention. Once, swimming was impossible. Over time, procedures sediment into fluency. The body “knows.” Thought withdraws. The mediation becomes invisible.

This invisibility is what gives knowledge its peculiar authority. It feels like presence. It is not.

What makes knowledge reliable

If imagination can generate anything, what distinguishes a reliable claim from a seductive one? What separates knowledge from fiction, or insight from illusion?

Not certainty, but evidence.

A claim becomes trustworthy when there is sufficient ground to rely on it. “Sufficient” never means absolute. It means: enough to act on, enough to orient by, enough to make a difference in practice.

Sometimes perception itself is enough. I see a cup on the table. I pick it up. I drink from it. Under ordinary circumstances, the perception is its own evidence. Of course, mistakes are possible. Hallucination, illusion, misrecognition. Between seeing and naming, interpretation always intervenes. Memory is consulted. Patterns are matched. Errors occur. A rope is taken for a snake. A shadow for a figure.

But radical doubt is unlivable. If something appears as an apple and nothing suggests deception, eating it is not a philosophical problem.

Sometimes evidence is logical. Certain conclusions follow necessarily from given premises. If infrared radiation lies outside the visible spectrum, and a lamp emits infrared radiation, and such radiation is felt as heat, then sitting close to the lamp will produce warmth. Within its frame, the reasoning closes.

Formal logic already shows us something important: proof is not the same as truth. Proof operates inside systems. Truth requires interpretation. And no formal

system can ever fully ground itself. There will always be statements that cannot be proven within it, even if they are true.

Sometimes evidence is scientific. Here knowledge is not delivered, but produced. Observation. Hypothesis. Experiment. Measurement. Revision. Repetition. Science advances not by certainty, but by organized exposure to error. Its strength lies precisely here.

Evolutionary theory and the Standard Model of particle physics are not “theories” in the casual sense. They are extraordinarily well-supported frameworks, interlocked with vast bodies of evidence and predictive success. They deserve to be called knowledge. And yet both are known to be incomplete. Their reliability does not grant them finality.

This is not a weakness. It is the signature of science.

Knowledge as a process

Scientific knowledge is always provisional. Not because “anything goes,” but because every claim remains open to revision in light of new evidence. Even peer-reviewed, established results can turn out to be wrong. Not as scandal, but as function.

Science is not a storehouse of truths. It is a disciplined way of remaining corrigible.

As long as our questions remain practical, this works remarkably well. We ask what enables prediction, explanation, intervention. We build bridges. We treat illnesses. We send probes into space. There is rarely a problem.

The difficulty begins when we keep asking.

Every answer opens the possibility of another question. Why does this law hold? Why these constants? Why these conditions? Why anything at all? Step by step, explanation ascends or descends toward a limit. A point where evidence no longer reaches. Where proof no longer operates. Where our methods fall silent.

Here knowledge ends.

Not experience. Not presence. But explanation.

The edge of proof

Beyond this boundary, no answer can be established. Whatever is said here will necessarily be hypothesis, metaphor, or belief. Some will find such questions the most important of all. Others will shrug. Both reactions belong to temperament, not to evidence.

Belief, unlike knowledge, has no intrinsic limits. It can extend indefinitely, unconstrained by proof. Entire cosmologies can be erected beyond the edge of evidence. They can be beautiful, profound, consoling. They can also be illusory.

The moment definitive answers to ultimate questions are accepted, knowledge disappears and belief takes its place. What presents itself as final explanation is no longer supported. It is adopted.

In this sense, answers to ultimate questions, when believed, are not the culmination of knowledge, but its disappearance.