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LIST DO REDAKCJI / LETTER TO THE EDITOR

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Basic Cosmic Question or Is There a Meaning to It All? The Biggest of All the Big Questions

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> The most incomprehensible thing about the universe is that it's comprehensible.
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> — Albert Einstein

I once took part in an impassioned television debate about science and religion. At one point, the conversation turned to the philosophy of reductionism, also known as nothing-buttery, which holds that true reality lies with the fundamental physical building blocks of the world, and the great edifice of human achievements and values and culture is, at rock bottom, no more than an illusory embellishment; to maintain otherwise is sentimental twaddle. One of the panellists used a striking illustration to denounce this harsh viewpoint. "Am I to suppose", he said, "that when I tell my wife I love her, it's *nothing but* one meaningless mound of molecules transmitting sound waves to another meaningless mound of molecules?" The philosopher A.J. Ayer, an enthusiastic reductionist and prominent atheist, objected strongly to this comment, claiming that he too loved his wife very much, but that the meaning attached to that endearment was entirely a human construct. It is people who create meaning in their lives, he pointed out: it doesn't descend from on high. "But", countered another panellist, Hugh Montefiore, the bishop of Birmingham, "you're claiming there is no *ultimate* meaning". At that point Ayer became exasperated. "I don't know what «ultimate meaning» means!", he fumed. And there we have it. Meaning is a concept that enriches human lives.

A person can lead a meaningful and rewarding life. But does it make any sense to attribute meaning to nature, or the universe?

I'm with Ayer in thinking that the meaning of meaning is fraught with difficulties, so let me come at this question from a different tack. When I was sixteen, I became friendly with a young lady in the same year at school. Because I was studying science and she arts, we never shared a class. The only time we saw one another was in the school library. I remember her sitting opposite me one day as I ploughed through a physics calculation. "What are you doing?", she asked, frowning at my scribbles. "Working out the range of a ball thrown up an inclined plane", I replied. She thought for a moment, then said, "But how can you do that by writing things on bits of paper?" At the time, I dismissed her question as silly. After all, this was my homework, so it had to make sense! But now I realize that her comment touched on something profound. Scientists and engineers can use abstract mathematics to work out in advance what will happen in the physical world because mathematics, which is a rational construct of the human mind, is also found to align with the deep order of nature.

Successful prediction is only one facet of the role of mathematics in describing nature. Another is understanding. Merely describing the world, however accurately, is not at all the same as making sense of it. (Physicists often refer to "curve fitting" as simply matching up data with the mathematical function that best fits, without that function having any broader linkage with a law or a deeper set of concepts.) Science is full of "Ah!" moments — discoveries when everything falls into place. Let me illustrate this point. In the 1950s, particle accelerators were producing a host of new subatomic splinters. So many, in fact, that physicists ran out of names for them. There were pions and kaons and sigmas and lambdas, and then just a whole bunch of letters and numbers. The rapidly proliferating list of particles looked bewildering and arbitrary. Then, in 1961, Murray Gell-Mann came up with a mathematical scheme based on a branch of mathematics called group theory to bring some order to the data. All those diverse subatomic entities were, he said, made of smaller particles he dubbed quarks — three inside a proton, two inside a kaon, and so on. He produced neat-looking schematic patterns to show how it all hung together. Gell-Mann was able to predict a hitherto undiscovered particle, which rejoiced in the name of the omega minus, based on the fact that there was a gap in one of his pretty group theory patterns. In 1964, Gell-

Mann's missing particle was found. Suddenly the particle zoo "made sense". And quarks are real: you can detect them jiggling about inside protons.

The list of successful predictions in theoretical physics is extensive — the Higgs boson, antimatter, black holes, gravitational waves — they all provide clear examples of things "falling into place", sometimes after decades of experimental searching. It seems to me that if we can extract sense *from* nature, then there must be something like "sense" *in* nature. By this I mean that nature is "about" something, an interconnecting rational scheme that for some reason can be grasped by the human mind.

The mathematical underpinnings of physics became apparent in the seventeenth century, when a small band of visionary "natural philosophers", including Galileo Galilei and Isaac Newton, came to realize that the key to the universe was not to be found in divine agency, nor in the geometry of the cosmic architecture itself. Rather, it resides in laws of nature that transcend the physical world and occupy an abstract plane, invisible to the senses but nevertheless within the grasp of human reason. Number and form, beloved of the ancient philosophers, are manifested not just in specific physical objects and systems, but interwoven into the very laws of nature themselves, forming a mosaic of subtle patterns encrypted in a kind of cosmic code. It was a stunning conceptual pivot, marking a transition from mere description of the world to explanation.

Finding that key was by no means inevitable. For a start, there is no absolute reason for nature to have a straightforward mathematical subtext in the first place. And even if it does, there is no reason why humans should be capable of comprehending it. You couldn't tell from daily experience that the disparate physical systems making up the natural world are linked, deep down, by a network of coded mathematical relationships.

How has this come about? How have human beings become privy to nature's subtle and elegant scheme? Somehow the universe has engineered, not just its own awareness, but its own *comprehension*. Mindless, blundering atoms have conspired to spawn beings who are able not merely to watch the show, but to unravel the plot, to engage with the totality of the cosmos and the silent mathematical tune to which it dances.

I have focused on the great questions of existence viewed through the lens of science, which is my own perspective. However, it's fair to say that the majority of

scientists aren't comfortable trespassing into philosophical questions, some of which seem to stray into theology. Challenged on whether the universe might have some sort of meaning or purpose, most would either say no or, like Ayer, dismiss the question itself as meaningless. One distinguished scientist bold enough to address the topic is Steven Weinberg, who wrote, "The more the universe seems comprehensible the more it also seems pointless". [1] Weinberg was roundly condemned for deigning to dignify the concept of a universe with a "point", even if only to deny it.

A universe that "just exists" for no reason, with specific properties that "just are", is correctly described, in formal logic, as "absurd". But if there is no rational coherent scheme beneath the surface phenomena of nature, if things "just are", if the universe is absurd, then the success of the scientific enterprise is totally enigmatic. It cannot be pursued with any expectation that the methods adopted hitherto will continue to work, that we will go on uncovering new mechanisms and processes that make sense, for how can sense be rooted in absurdity?

Some years ago, I committed these deliberations to an article in the *New York Times*. The editor chose the by-line "Having faith in science". It provoked a furious backlash from some of my peers, who counsel against anything that blurs the boundary of science and religion, even on topics where their agendas overlap, and even though the word "faith" has many shades of meaning. One of the more polite responses came from the renowned cosmologist and writer Sean Carroll, who expressed the consensus on the dependability of the laws of nature in characteristically eloquent fashion: "There is a chain of explanations concerning things that happen in the universe, which ultimately reaches the fundamental laws of nature and stops. [...] [A]t the end of the day the laws are what they are. [...] [T]hat's okay. I'm happy to take the universe just as we find it". [2]

Every scientist who opts to work on profound cosmic questions is confronted by this stark choice: either, like Carroll, take the universe for what it is — an inexplicable brute fact — and get on with the practical job of doing science, or accept that the entire scientific enterprise rests on a deeper layer of rational order.

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[1] Statement by Steven Weinberg from the "Faith and Reason" TV Program, https://www.pbs.org/faithandreason/transcript/wein-frame.html (full transcript) [18.03.2022].

[2] Sean Carroll, "Turtles Much of the Way Down", *Discover* 2007, November 26, https://www.discovermagazine.com/the-sciences/turtles-much-of-the-way-down [18.03.2022].

All attempts to explain the physical world, whether through science, religion, mysticism or some other mode of thought, tacitly assume that there is some sort of ground of being in which existence is rooted. The alternative, often called an infinite tower of turtles, is that there is no ultimate reality, only an endless chain of reasoning. I have always preferred the former over the latter, but even if the universe and all its marvellous laws and conscious beings is indeed grounded in an irreducible truth, there is no guarantee that human beings will ever be capable of discovering it, or comprehending it anyway. But as an incurable romantic, I like to believe that the spark of rationality that has enabled us to uncover and understand so much of the workings of nature has within it the power to attain that final goal. Whether that is the case is the biggest of all the big questions discussed in my new book. [3]

Paul Davies

[3] See Paul Davies, **What's Eating the Universe? And Other Cosmic Questions**, The University of Chicago Press, Chicago 2021. This book has been translated into Polish: **Co pożera Wszechświat? I inne zagadki kosmosu**, transl. Tadeusz Chawziuk, Copernicus Center Press, Kraków 2022.